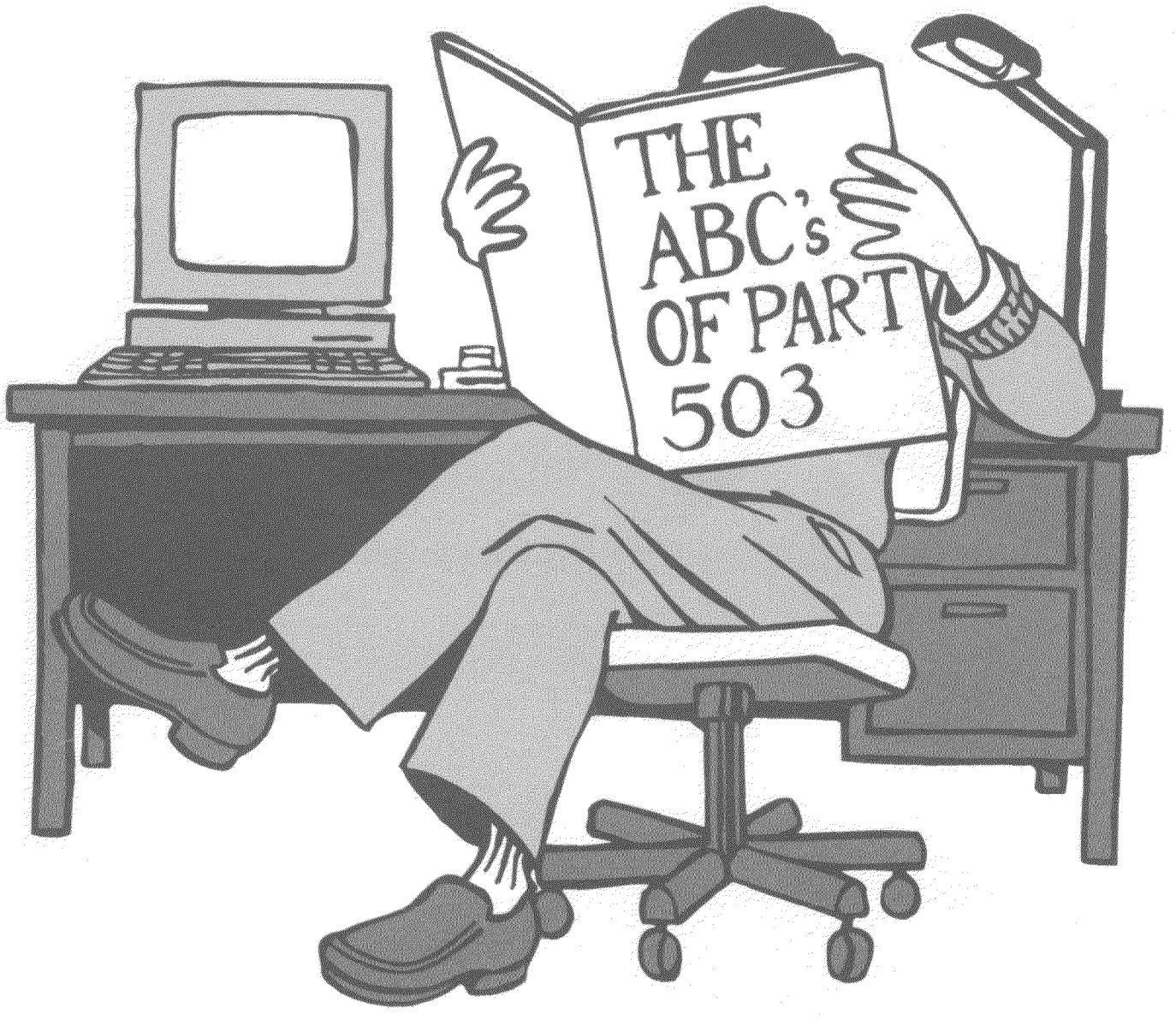
United States
Environmental Protection
Agency

Office of Wastewater
Management
(4204)

EPA/832/R-93/003
September 1994

EPA

A Plain English Guide to the EPA Part 503 Biosolids Rule



Excellence in compliance through optimal technical solutions

MUNICIPAL TECHNOLOGY BRANCH

EPA/832/R-93/003
September 1994

A Plain English Guide to the EPA Part 503 Biosolids Rule

U.S. Environmental Protection Agency
Office of Wastewater Management
Washington, DC

Notice

Foreword

The U.S. Environmental Protection Agency's (EPA's) Part 503 rule provides comprehensive requirements for the management of biosolids generated during the process of treating municipal wastewater. The final rule benefited greatly from the substantial input received from the regulated and environmental communities, and especially the group of scientific experts who worked closely with EPA in revising the proposed rule. Hence, the final rule is the result of a very effective combination of public comment, scientific risk assessment, and informed risk management.

The Part 503 rule creates incentives for beneficial use of biosolids. EPA believes that biosolids are an important resource that can and should be safely used (e.g., to condition soils and provide nutrients for agricultural, horticultural, and forest crops and vegetation, and for reclaiming and revegetating areas disturbed by mining, construction, and waste disposal activities).

This guide to the final rule for the use or disposal of sewage sludge biosolids was developed to help make the Part 503 rule more understandable. While the guide is not a substitute for the actual rule, we believe that it can be a very helpful tool for the rule's interpretation and implementation. Throughout the document sewage sludge is referred to as biosolids to emphasize the beneficial nature of this valuable recyclable resource.

While this guide is consistent with the content of the Part 503 rule, it is structured in a manner intended to make information more understandable. After presenting an overview of the rule, the document provides separate, complete descriptions of the requirements associated with land application, surface disposal, incineration, pathogen and vector attraction reduction, and sampling and analysis. The guide also raises questions and provides answers that should help you interpret the rule. It also refers to additional sources of information.

We hope that you find this type of interpretative guidance useful, and we welcome your comments on how to make such information more useful as well as your suggestions about other needed materials. A tear-out comment sheet is provided for this purpose in the back of the document.

Michael B. Cook, Director
Office of Wastewater Management

Acknowledgments

This document represents the efforts of several individuals. Gratitude is extended to each person involved in preparing and reviewing this guide.

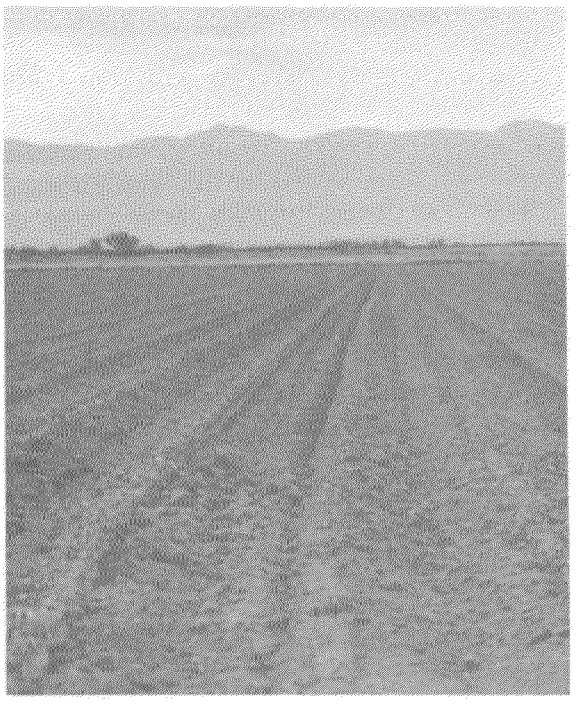
The authors are John Walker, Municipal Technology Branch, U.S. EPA Office of Wastewater Management; and Lynn Knight and Linda Stein of Eastern Research Group, Inc. Special thanks goes to Robert M. Southworth, Ross Brennan, Ruth Miller, Wendy Bell, and Cris Gaines of U.S. EPA for their technical review of this guide.

Contents

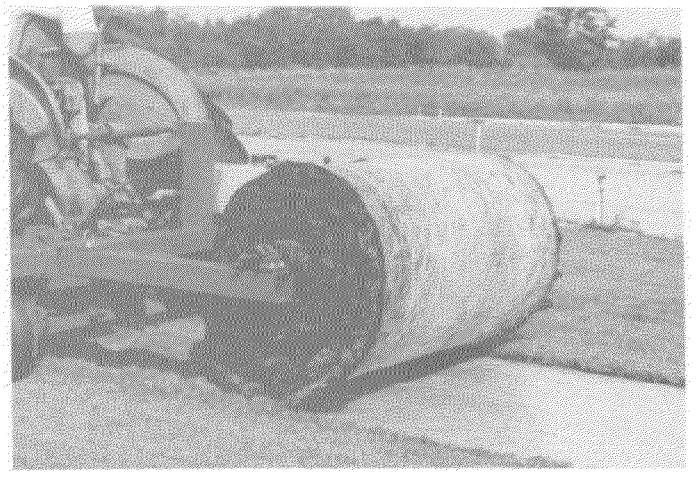
(Comments are requested on this Part 503 rule guidance. See tear-out sheet at end of document.)

Biosolids Are Used Beneficially in Many Ways

Pasture in Albany, Georgia.



Row crops in Arizona.



Lightweight sod in Columbus, Ohio.

Flowers worldwide.

Ornamental garden in Denver, Colorado.

Chapter 1

Use or Disposal of Sewage Sludge Biosolids

Background on the Part 503 Rule

As required by the Clean Water Act Amendments of 1987, the U.S. Environmental Protection Agency (EPA) developed a new regulation to protect public health and the environment from any reasonably anticipated adverse effects of certain pollutants that might be present in sewage sludge biosolids. This regulation, ***The Standards for the Use or Disposal of Sewage Sludge*** (Title 40 of the Code of Federal Regulations [CFR], Part 503), was published in the ***Federal Register (58 FR 9248 to 9404)*** on February 19, 1993, and became effective on March 22, 1993. This document will refer to the regulation as "the Part 503 rule" and also as "Part 503."

This guidance document is not a substitute for the actual rule, but it is intended as a helpful tool for interpretation and implementation of the rule.

In this document you will notice the nearly exclusive reference to sewage sludge as biosolids. ***Biosolids*** are a primarily organic solid product produced by wastewater treatment processes that can be beneficially recycled. The fact that the biosolids can be recycled does not preclude their being disposed. Whenever the document first quotes portions of the Part

503 rule that include the words "sewage sludge," the word "biosolids" is substituted in brackets (e.g., "[biosolids] incinerator" for sewage sludge incinerator). Subsequently, the word biosolids is used without brackets (e.g., sewage sludge incinerators are called "biosolids incinerators").

The Part 503 rule establishes requirements for the final use or disposal of sewage sludge [biosolids] when biosolids are:

applied to land to condition the soil or fertilize crops or other vegetation grown in the soil;

placed on a surface disposal site for final disposal; or

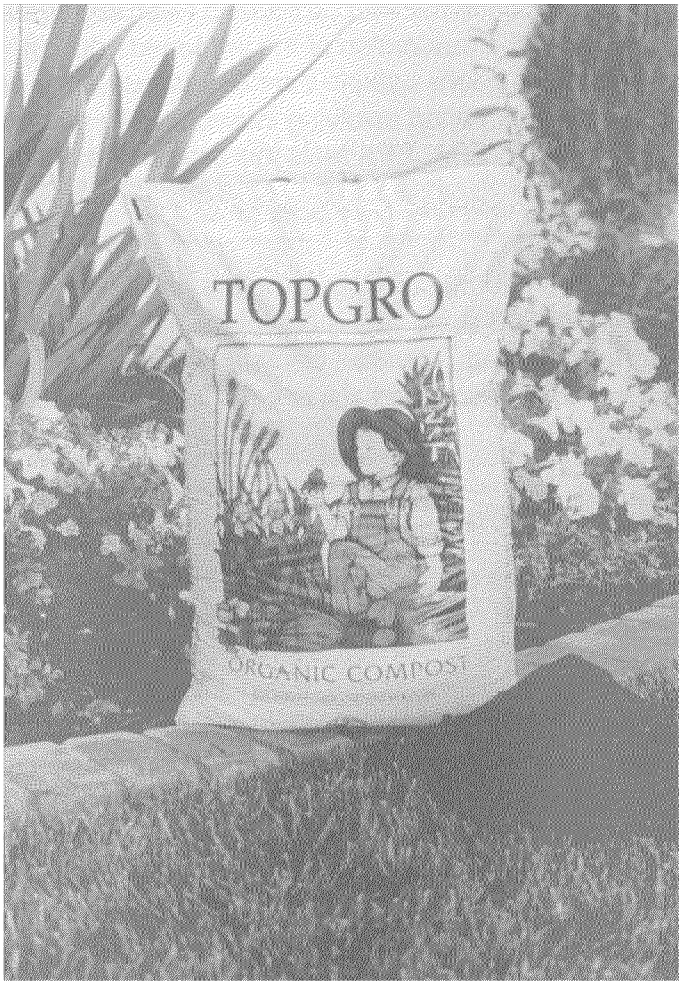
fired in a biosolids incinerator.

The rule also indicates that if biosolids are placed in a municipal solid waste landfill, the biosolids must meet the provisions of 40 CFR Part 258.

The Part 503 rule was amended on February 25, 1994 (59 FR 9095). The amendment made two changes. It deleted pollutant limits for molybdenum in biosolids applied to land but retained the molybdenum ceiling limits; and in certain situations, it permitted carbon monoxide (CO) monitoring in place of total hydrocarbon (THC) monitoring for biosolids incinerators. Please be aware that there may be further modifications to the currently amended molybdenum and CO provisions as well as changes in other requirements of the rule, mainly involving technical correction and litigation response.

The Part 503 rule is designed to protect public health and the environment from any reasonably anticipated adverse effects of certain pollutants and contaminants that may be present in [biosolids]. The provisions of the Part 503 rule are consistent with EPA's policy of promoting beneficial uses of [biosolids] (see 49 FR 24358, June 12, 1984). Land application takes advantage of the soil conditioning and fertilizing properties of biosolids. A separate EPA booklet (EPA/832-R-93-009), as well as other literature, describes the benefits of using biosolids (see References at the end of this document).

STATE RULES ALSO APPLY TO BIOSOLIDS USE OR DISPOSAL: It is important to note that persons using or disposing of biosolids are subject to State and possibly local regulations as well. Furthermore, these State and other regulations may be more stringent generally than the Federal Part 503 rule, may define biosolids differently, or may regulate certain types of biosolids more stringently than the Part 503 rule. For information on specific State biosolids regulations, consult the appropriate State biosolids permitting authorities listed in Appendix B.



TopGrow organic compost is produced from biosolids and other waste materials by the City of Los Angeles.

Risk Assessment Basis of the Part 503 Rule

Many of the requirements of the Part 503 rule are based on the results of an extensive multimedia risk assessment. This risk assessment was more comprehensive than for any previous Federal biosolids rulemaking effort, the earliest of which began in the mid-1970s. Research results and operating experience over the past 25 years have greatly expanded EPA's understanding of the risks and benefits of using or disposing of biosolids.

Development of the Part 503 rule began in 1984. During this extensive effort, EPA addressed 25 pollutants using 14 exposure pathways in the risk assessment. In this assessment, EPA also developed a new methodology that provided for the protection of the environment and public health. The new method for conducting the multimedia risk assessment was reviewed and approved by EPA's Science Advisory Board.

EPA proposed the Part 503 rule in February 1989. During the four years between the publication of the proposed and final rule, the data, models, and assumptions used in the risk assessment process were reviewed and revised in an effort involving internationally recognized experts working closely with EPA. EPA feels this process has resulted in the establishment of state-of-the-art risk-based standards for controlling the use or disposal of biosolids.

Detailed information describing the risk assessment and technical basis of the Part 503 standards is contained in the Preamble to the Part 503 rule and in several Technical Support Documents, available from the National Technical Information Service (NTIS) (see References at the end of this document).

Purpose of This Document

The purpose of this document is to explain the intent and requirements of the Part 503 rule and to assist owner/operators in determining the extent to which their biosolids management operation is covered. To help clarify the intent of the Part 503 rule, this guidance document sometimes uses terms that do not appear in the rule itself and organizes information differently from the rule. For example, Chapter Two first describes land application of biosolids with the fewest regulatory requirements, then provides a discussion of land application of biosolids for which more regulatory requirements apply.

CAUTION! This document does not serve as a substitute for the actual Part 503 rule and its amendments published in the *Federal Register* and the *Code of Federal Regulations*. Rather, this document is intended to be used as guidance to assist users or disposers of sewage sludge in complying with the rule. In addition, official interpretations of various portions of Part 503 may change after the publication of this guidance document. For clarification on any discussion contained in this guidance document, the actual rule and the appropriate EPA Regional [biosolids] permitting authorities listed in Appendix B should be consulted.

What Are Sewage Sludge Biosolids?

Part 503 defines ***sewage sludge*** as a solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes scum or solids removed in primary, secondary, or advanced wastewater treatment processes and any material derived from sewage sludge (e.g., a blended sewage sludge/fertilizer product) but does not include grit and screenings or ash generated by the firing of sewage

Department of Transportation personnel plant flowers in composted biosolids beds at La Guardia Airport, New York.

sludge in an incinerator. Part 503 considers domestic septage as sewage sludge and sets separate requirements for domestic septage applied to agricultural land, forests, or reclamation sites. ***Domestic septage*** is defined as a liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar system that receives only domestic sewage. The Part 503 definition of domestic septage excludes grease-trap pumpings and commercial or industrial waste. As previously stated, this guidance document refers to sewage sludge as biosolids to emphasize the beneficial nature of this recyclable biological resource.

Overview of the Rule

The Part 503 rule includes five subparts: general provisions, and requirements for land application, surface disposal, pathogen and vector attraction reduction, and incineration. For each of the regulated use or disposal practices, a Part 503 standard includes general requirements, pollutant limits, management practices, operational standards, and requirements for the frequency of monitoring, recordkeeping, and reporting, as shown in Figure 1-1. For the most part, the requirements of the Part 503 rule are self-implementing and must be followed even without the issuance of a permit.

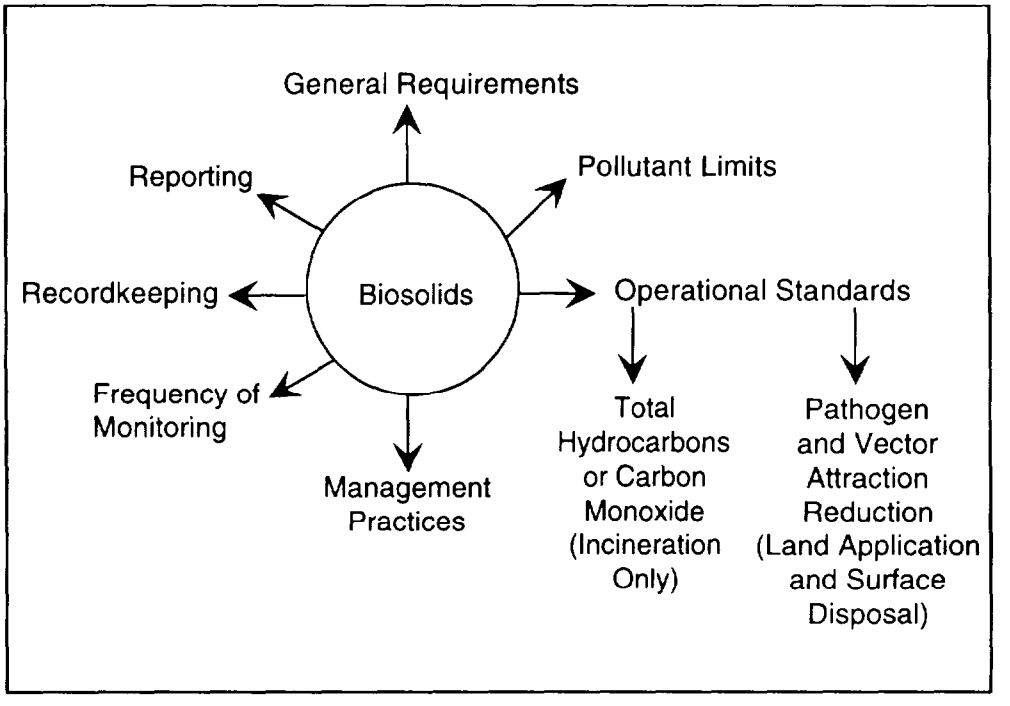


Figure 1-1. What a Part 503 standard includes.

Subpart A—General Provisions

Subpart A of the rule covers general provisions, such as the purpose and applicability of the rule, the compliance period, and exclusions from the rule. These general provisions apply to each of the three biosolids use or disposal practices.

Subpart B—Requirements for Land Application

Options for Land Application of [Biosolids] Under Subpart B:
Subpart B of the rule specifies requirements for biosolids applied to land. The term ***apply*** means to put biosolids on the land to take advantage of the nutrient content or soil conditioning properties of the biosolids.

The requirements for land application also pertain to material ***derived*** from biosolids; that is, biosolids that have undergone a change in quality through treatment (e.g., composting) or by mixing with other materials (e.g., wood chips, municipal solid waste, yard waste).

The biosolids land application requirements, which are explained in detail in Chapter Two of this guidance document, are summarized below. (See also ***Process Design Manual: Land Application of Sewage Sludge and Domestic Septage.*** U.S. EPA, Center for Environmental Research Information, Cincinnati, OH. Expected to be available in early 1995.) There are several options for land applying biosolids under Subpart B of the Part

503 rule, all of which are equally protective of human health and the environment. This guidance discusses these options in order of increasing regulatory complexity.

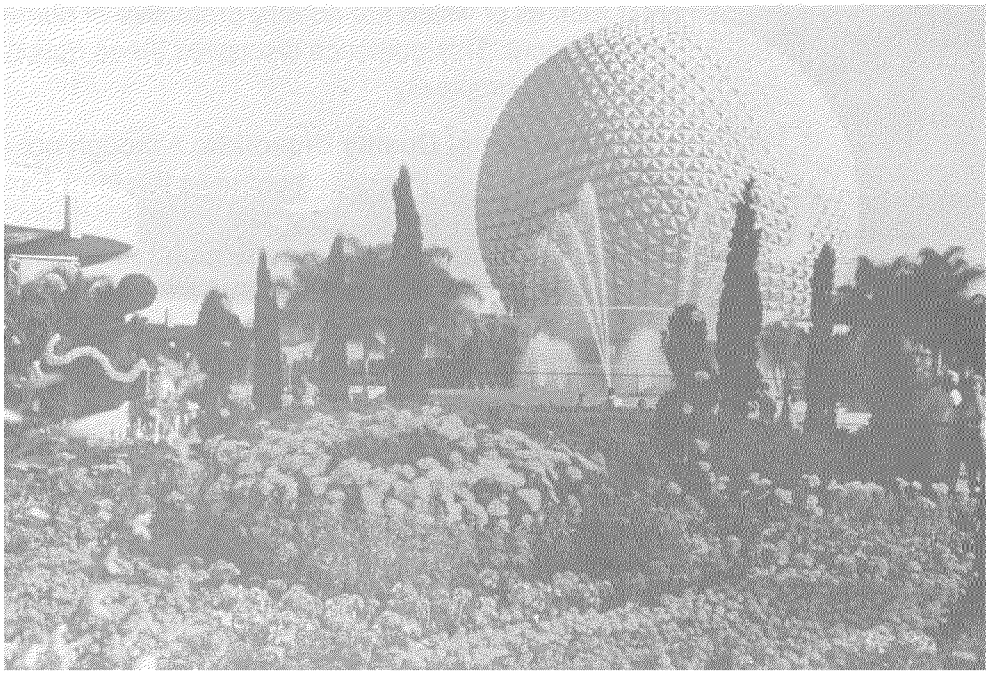
Exceptional Quality Biosolids: Although not explicitly defined in the Part 503 rule, this document uses the term ***Exceptional Quality (EQ)*** to characterize biosolids that meet low-pollutant and Class A pathogen reduction (virtual absence of pathogens) limits and that have a reduced level of degradable compounds that attract vectors. Once the requirements discussed in detail in Chapter Two are met, EQ biosolids are considered a product that is virtually unregulated for use, whether used in bulk, or sold or given away in bags or other containers.

Pollutant Concentration Biosolids: Although not explicitly defined in the Part 503 rule, this document uses the term ***Pollutant Concentration (PC)*** to refer to biosolids that meet the same low-pollutant concentration limits as EQ biosolids, but only meet Class B pathogen reduction and/or are subjected to site management practices rather than treatment options to reduce vector attraction properties. Unlike EQ biosolids, PC biosolids may only be applied in bulk and are subject to general requirements and management practices; however, tracking of pollutant loadings to the land is not required.

A majority of the biosolids currently generated in the United States are believed to be EQ or PC biosolids containing low levels of pollutants. EPA expects that many municipalities will strive to produce EQ or PC biosolids because of the reduced regulatory requirements and the anticipated improved public perception about using EQ and PC biosolids beneficially. Cumulative levels of pollutants added to land by EQ or PC biosolids do not have to be tracked because the risk assessment has shown that the life of a site would be at least 100 to 300 years under the conservative parameters assumed.

Cumulative Pollutant Loading Rate (CPLR) [Biosolids]: CPLR biosolids typically exceed at least one of the pollutant concentration limits for EQ and PC biosolids but meet the ceiling concentration limits (see Chapter Two). Such biosolids must be applied to land in bulk form. The cumulative levels of biosolids pollutants applied to each site must be tracked and cannot exceed the CPLR.

Annual Pollutant Loading Rate (APLR) [Biosolids]: APLR biosolids are biosolids that are sold or given away in a bag or other container for application to the land that exceed the pollutant limits for EQ biosolids but meet the ceiling concentration limits (see Chapter Two). These biosolids must meet APLR requirements and must be accompanied by specific biosolids application rate information on a label or handout that includes instructions on the material's proper use.



Biosolids compost enhances gardens at Walt Disney World Epcot Center in Orlando, Florida.

Compost derived from biosolids is used to condition mountain soils near Denver, Colorado.

Each of the options for land applying biosolids are affected by the Part 503 February 25, 1994, amendment, which states that EPA is reconsidering appropriate land application and pollutant limits for molybdenum.

During the period of reconsideration, only ceiling limits for molybdenum must be met. Molybdenum pollutant limits for EQ, PC, CPLR, or APLR biosolids have been deleted.

Options for Using or Disposing of Domestic Septage Under Subpart B: If domestic septage is applied to land with a high potential for contact by the public (e.g., public parks, ball fields, cemeteries, plant nurseries, and golf courses), the Part 503 land application requirements apply. However, when domestic septage is applied to nonpublic contact sites (e.g., agricultural land, forests, and reclamation sites), less burdensome requirements may apply. A separate EPA guidance document, entitled ***Domestic Septage Regulatory Guidance: A Guide to the EPA 503 Rule,*** provides detailed guidance on how to comply with these requirements.

Subpart C—Requirements for Sewage Sludge Placed on a Surface Disposal Site

Subpart C of the rule covers requirements for biosolids—including domestic septage—placed on a surface disposal site.

Placement refers to the act of putting biosolids on a parcel of land at high rates for final disposal rather than using the organic content in the biosolids to condition the soil or using the nutrients in the biosolids to fertilize crops. Placing biosolids in a monofill, in a surface impoundment, on a waste pile, or on a dedicated site is considered surface disposal.

Treatment and ***storage*** of biosolids are not considered surface disposal. ***Treatment*** is the preparation of biosolids for final use or disposal through such activities as thickening, stabilization, and dewatering. ***Storage*** is the placement of biosolids on the land for 2 years or less. Placement on land for longer than 2 years is considered surface disposal unless the site owner/operator retains written records demonstrating clearly to the permitting authority that the area of land onto which biosolids are placed is not a surface disposal site but rather, based on management or operational practices, constitutes a treatment or temporary storage site.

Surface disposal requirements and the difference between disposal, treatment, and storage of biosolids are explained in Chapter Three of this document. (See also ***Process Design Manual: Land Application of Sewage Sludge and Domestic Septage.***)

Certain materials ***derived*** from biosolids, the quality of which has been changed by treating the biosolids or by mixing them with other materials (e.g., wood chips), are subject to the surface disposal requirements in Part 503 with one exception. If biosolids are mixed with nonhazardous solid wastes, the mixture and the land onto which the mixture is placed are subject to the solid waste regulations (40 CFR Part 258) instead of Part 503.

Subpart D—Requirements for Pathogen and Vector Attraction Reduction

Subpart D of the Part 503 rule covers requirements for the control of disease-causing organisms, called ***pathogens***, in biosolids and the reduction of the attractiveness of biosolids to ***vectors***, such as flies, mosquitoes, and other potential disease-carrying organisms. These requirements are described in Chapter Five of this document. Pathogen and vector attraction reduction requirements also are briefly described for biosolids applied to land or placed on a surface disposal site in Chapters Two and Three of this document. More detailed guidance on meeting pathogen and vector attraction reduction requirements is provided in another EPA publication (see References, EPA/625-R-92-013).

Subpart E—Requirements for Sewage Sludge Fired in a Sewage Sludge Incinerator

Subpart E of the rule covers the requirements for biosolids fired in a [biosolids] incinerator. The firing of biosolids with auxiliary fuels also is covered by the Part 503 incineration requirements. ***Auxiliary fuel*** materials include gas, oil, coal, and other materials that serve as a fuel source.

The co-firing of biosolids in an incinerator with other wastes is generally not regulated under Part 503. It should be noted, however, that wastes either in auxiliary fuel or mixed and co-fired with biosolids are considered to be auxiliary fuel when the weight is less than or equal to 30 percent (by dry weight) of the total biosolids and auxiliary fuel mixture. The requirements in Subpart E for biosolids incineration are discussed in Chapter Four.

The February 25, 1994, amendment to the Part 503 rule states that under certain conditions EPA will allow continuous monitoring of carbon monoxide emissions from biosolids incinerators as an alternate to continuous monitoring of total hydrocarbons in emissions. The details of the amendment are also discussed in Chapter Four.

To Whom the Rule Applies

Part 503 applies to any person who applies biosolids to the land or fires biosolids in a biosolids incinerator, and to the owner/operator of a surface

disposal site, or to any person who is a preparer of biosolids for use, incineration, or disposal. Part 503 defines a ***person*** as an individual, association, partnership, corporation, municipality, State or Federal agency, or an agent or employee thereof. A ***preparer*** is a person who generates or derives a material from biosolids (i.e., changes the quality of biosolids).

Exclusions from the Rule

Part 503 specifies certain exclusions from the rule. These exclusions are listed in Figure 1-2. Also listed in Figure 1-2 are the Federal regulations that apply to biosolids-related activities not covered by the Part 503 rule.

Permits

Self-Implementing Nature of the Rule

In most cases, the Part 503 rule is ***self-implementing***—that is, preparers, land appliers, owner/operators of surface disposal sites, or biosolids incinerators, and other users or disposers of biosolids must comply with the Part 503 rule (including the compliance dates listed in Table 1-2), even if they have not been issued a permit covering biosolids use or disposal requirements. Similarly, EPA (or an approved State) can take enforcement actions directly against persons who violate the Part 503 requirements.

Who Must Apply for a Permit

A person must apply for a permit covering biosolids use or disposal standards if they own or operate a treatment works treating domestic sewage. A person is an owner or operator of a ***treatment works treating domestic sewage*** (TWTDS) if the facility generates, changes the quality of, or provides final disposition of solids, practices for which are ultimately subject to the Part 503 rule.

Table 1-1 provides a more detailed summary of who does and does not have to apply for a Federal permit. Appendix A lists the type of information that should be provided in a permit application. Interim application forms are available from EPA's Office of Wastewater Management.

In most cases, Part 503 requirements will be incorporated over time into National Pollutant Discharge Elimination System (NPDES) permits issued to publicly owned treatment works (POTWs) and TWTDSs. As decided by the permitting priorities of EPA Regions and approved States, "biosolids-only" permits covering applicable Part 503 requirements are likely to be issued to non-NPDES facilities as well. A permit applicant who has not received a response from EPA should continue to comply with the applicable provisions of the Part 503 rule.

FIGURE 1-2
Exclusions from Part 503

Part 503 Does Not Include Requirements For:	Applicable Federal Regulation
Treatment of Biosolids Processes used to treat sewage sludge prior to final use or disposal (e.g., thickening, dewatering, storage, heat drying).	None (except for operational parameters used to meet the Part 503 pathogen and vector attraction reduction requirements)
Selection of Use or Disposal Practice The selection of a biosolids use or disposal practice.	None (the determination of the biosolids use or the disposal practice is a local decision)
Incineration of Biosolids with Other Wastes Biosolids co-fired in an incinerator with other wastes (other than as an auxiliary fuel).	40 CFR Parts 60, 61
Storage of Biosolids Placement of biosolids on land for 2 years or less (or longer when demonstrated not to be a surface disposal site but rather, based on practices, constitutes treatment or temporary storage).	None
Industrial Sludge Sludge generated at an industrial facility during the treatment of industrial wastewater with or without combined domestic sewage.	40 CFR Part 257 if land applied 40 CFR Part 258 if placed in a municipal solid waste landfill
Hazardous Sewage Sludge Sewage sludge determined to be hazardous in accordance with 40 CFR Part 261, *Identification and Listing of Hazardous Waste*.	40 CFR Parts 261-268
Sewage Sludge Containing PCBs ≥50 mg/kg Sewage sludge with a concentration of polychlorinated biphenyls (PCBs) equal to or greater than 50 milligrams per kilogram of total solids (dry-weight basis).	40 CFR Part 761
Incinerator Ash Ash generated during the firing of biosolids in a biosolid incinerator.	40 CFR Part 257 if land applied 40 CFR Part 258 if placed in a municipal solid waste landfill or 40 CFR Parts 261-268 if hazardous
Grit and Screenings Grit (e.g., sand, gravel, cinders) or screenings (e.g., relatively large materials such as rags) generated during preliminary treatment of domestic sewage in a treatment works.	40 CFR Part 257 if land applied 40 CFR Part 258 if placed in a municipal solid waste landfill
Drinking Water Sludge Sludge generated during the treatment of either surface water or ground water used for drinking water.	40 CFR Part 257 if land applied 40 CFR Part 258 if placed in a municipal solid waste landfill
Certain Non-domestic Septage Septage that contains industrial or commercial septage, including grease-trap pumpings.	40 CFR Part 257 if land applied 40 CFR Part 258 if placed in a municipal solid waste landfill

TABLE 1-1
Who Must Apply for a Permit?

Treatment Works Treating Domestic Sewage (TWTDS) *Required* to Apply for a Permit
All generators of biosolids that are regulated by Part 503 (including all POTWs)
Industrial facilities that *separately* treat domestic sewage and generate biosolids that are regulated by Part 503
All surface disposal site owner/operators
All biosolids incinerator owner/operators
Any person (e.g., individual, corporation, or government entity) who changes the quality of biosolids regulated by Part 503 (e.g., biosolids blenders or processors)[a]
Any other person or facility designated by the permitting authority as a TWTDS

TWTDS and Other Persons *Not Automatically Required* To Apply for a Permit[b]
Biosolids land appliers, haulers, persons who store, or transporters who do not generate or do not change the quality of the biosolids
Land owners of property on which biosolids are applied
Domestic septage pumpers/haulers/treaters/appliers
Biosolids packagers/baggers (who do not change the quality of the biosolids)

[a] If all the biosolids received by a biosolids blender or composter are exceptional quality (EQ) biosolids (see Chapter Two for full explanation of EQ biosolids), then no permit will be required for the person who receives or processes the EQ biosolids

[b] EPA may request permit applications from these facilities when necessary to protect public health and the environment from reasonably anticipated effects of pollutants that may be present in biosolids.

Site-Specific Permit Limits

Biosolids incinerator owner/operators are required to have site-specific pollutant limits in their permits, and certain surface disposal sites with unique site conditions may also apply for site-specific pollutant limits. Site-specific permit limits are not allowed for land application sites; to the extent the owner of a land application site desires permit limits exceeding pollutant ceiling concentrations, the site may be more appropriately addressed as a surface disposal site (and subject to the Part 503 requirements for surface disposal).

Who Issues the Permit?

At the time this guidance document was published, the permitting authority for Part 503 was EPA. Thus, applications for a Federal biosolids permit must be submitted to the appropriate EPA Regional Office, not the State. This will remain the case until the biosolids management programs of individual States are approved by EPA. Until a State has an EPA-approved program, EPA will remain the permitting authority.

Note that State laws regarding the use or disposal of biosolids, including permit requirements, must be complied with, even if the State program has not received Federal approval.

Unless Otherwise Specified by the Permitting Authority

There are a number of places in the Part 503 rule that indicate ***unless otherwise specified by the permitting authority***. For example, two instances where a permitting authority could be asked to establish different requirements are: (i) to apply biosolids to reclamation sites in excess of the agronomic rate, or (ii) to apply biosolids closer than 10 meters to waters of the United States. The permitting authority could establish such different requirements for biosolids use or disposal through a permit or other enforceable means on a case-by-case basis (e.g., a letter of approval under the authority of Section 308 of the Clean Water Act [CWA] or a settlement agreement).

Compliance with, and Enforcement of, the Rule

Compliance deadlines under the Part 503 rule vary according to the type of requirement (e.g., compliance dates for frequency of monitoring and for recordkeeping and reporting requirements differ from compliance dates for other requirements) and whether new pollution control facilities will have to be constructed to meet the requirement. Compliance dates for all Part 503 requirements are provided in Table 1-2.

To ensure compliance with Part 503, regulatory authorities have the right to inspect operations involved in the use or disposal of biosolids; review and evaluate required reports and records; sample biosolids at regulated facilities; and respond to complaints from persons affected by an alleged improper use or disposal of biosolids. If records are not kept or other Part 503 requirements are not met, EPA can initiate enforcement actions.

Violations of the Part 503 requirements are subject to the same sanctions as wastewater effluent discharge violations—EPA can sue in civil court and seek remediation and penalties, and it can prosecute willful or negligent violations as criminal acts. If a problem occurred (e.g., ground-water

TABLE 1-2
Compliance Dates for Part 503 Requirements

Part 503 Requirement	Compliance Date
Land Application and Surface Disposal	
Initial monitoring and recordkeeping	July 20, 1993
All other requirements *when current pollution control facilities are adequate to meet requirements, including initial reporting when required*	February 19, 1994
All other requirements *when construction of new pollution control facilities is needed to meet requirements*	February 19, 1995
Incineration	
Initial monitoring, recordkeeping, and reporting (except for total hydrocarbons [THC] or carbon monoxide [CO])	July 20, 1993
All other requirements, including frequency of monitoring, recordkeeping, and reporting for THC (or CO), *when current pollution control facilities are adequate to meet requirements*	February 19, 1994
All other requirements, including frequency of monitoring, recordkeeping, and reporting for THC (or CO), *when construction of new pollution control facilities is needed to meet requirements*	February 19, 1995

contamination), the government could seek to have the offending party correct the situation. EPA can pursue civil fines of up to $25,000 per day, per violation (a single violation that occurs over a 1-year period could result in a fine of over $9 million). Filing a false report carries a fine of up to $10,000 and up to 2 years in prison. Negligent violations carry a criminal fine of $2,500 to $25,000 per day of violation and up to 1 year in prison. Willful violations carry a criminal fine of $5,000 to $50,000 per day of violation and up to 3 years in prison.

Finally, where EPA is unable to take an enforcement action, Section 505 of the CWA authorizes any citizen (e.g., a landowner, neighbor, lending institution) to bring a civil action against the violator for corrective action and/or the same penalties that EPA could have sought (i.e., $25,000 per violation per day).

Who Must Report

The Part 503 rule includes reporting requirements only for the following types of facilities:

Publicly owned treatment works (POTWs) with a design flow rate equal to or greater than 1 mgd;

POTWs that serve a population of 10,000 or greater, and

Class 1 [biosolids] management facilities that are POTWs required to have an approved pretreatment program (5 mgd or greater as per 40 CFR Part 403.3[a]) and POTWs located in states that have elected to assume local program responsibilities for pretreatment (140 CFR 403.10[e]), and treatment works processing domestic sewage (TWTDS) that EPA and/or the State have classified as Class 1 because of the potential to negatively affect public health and the environment.

Relationship of the Federal Requirements to State Requirements

Part 503 does not replace any existing State regulations; rather, it sets minimum national standards for the use or disposal of biosolids. In some cases, the State requirements may be more restrictive or administered in a manner different from the Federal regulation.

States can change their regulations to meet the minimum Federal standards. EPA will be working with States to encourage them to gain approval for administering the Part 503 rule. States can apply to EPA for approval of a biosolids program at any time, but they are under no obligation to do so.

Knowing exactly which State or Federal rules to follow can sometimes be complicated. Users or disposers of biosolids should keep the following situations in mind when considering the applicability of requirements:

- In all cases, users or disposers of biosolids must comply with all applicable requirements of the new Federal rule (Part 503), as explained in this document.
- If a State has its own rules governing the use or disposal of biosolids and has not yet adopted the Federal rule, the owner/operator will have to follow the most restrictive portions of both the Federal and State rules.

Users or disposers of biosolids are strongly encouraged to check with the appropriate sewage sludge [biosolids] coordinator (listed in Appendix B) regarding the specific State requirements.

Assistance with Technical, Permitting, and Compliance Issues

EPA will provide technical information and assistance on the Part 503 regulation. Also, on occasion EPA can provide project-specific assistance on biosolids use or disposal. The following EPA personnel and offices can provide assistance in the subject areas indicated.

Permitting

Wendy Miller (202) 260-3716
Wendy Bell (202) 260-9534
Regional & State Sewage Sludge [Biosolids] Coordinators (see Appendix B)

Compliance Monitoring and Enforcement

Joe Theis (Enforcement) (202) 260-8185
George Gray (Compliance) (202) 260-8313
Regional & State Sewage Sludge [Biosolids] Coordinators (see Appendix B)

Sampling & Analysis

Cristina Gaines (202) 260-6284

Incineration

Cristina Gaines (202) 260-6284
Wendy Bell (202) 260-9534

Beneficial Use and Biosolids Management Technology Issues

John Walker (202) 260-7283
Bob Bastian (202) 260-7378

Pretreatment/Removal Credits

Louis Eby (202) 260-2991

Technical Guidance for Incineration

Cristina Gaines (202) 260-6284

Dewatering

Jim Smith (513) 569-7355

Pathogen & Vector Control

Jim Smith (513) 569-7355
Bob Bastian (202) 260-7378
Bob Southworth (202) 260-7157

Odor Control, Composting, Bioaerosols

John Walker (202) 260-7283

Part 503 Regulation Development

Bob Southworth (202) 260-7157
Alan Hais (202) 260-1306

Risk Assessment

Jim Ryan (513) 569-7653
Bob Southworth (202) 260-7157
John Walker (202) 260-7283

Biosolids Publications

Sharie Centilla (202) 260-6052
Bernita Starks (202) 260-7287

For Further Information: See "References" listed after Chapter Six.

Common Questions and Answers

Q: If an industrial facility has separate treatment works for its domestic sewage and its process wastewater, are the biosolids generated from both treatment processes covered under Part 503?

A: No. Only the biosolids from the domestic sewage treatment process would be covered by Part 503 if used or disposed through land application, surface disposal, or solid incineration. The sludge from the industrial wastewater treatment process would not be covered. In fact, even if domestic sewage is mixed and treated in an industrial treatment works, the sludge from that system is not covered by Part 503.

Q: If a publicly owned treatment works (POTW) has only industrial wastewater influent, is the sludge generated at this treatment works considered sewage sludge [biosolids] and covered under the Part 503 rule?

A: No. By definition, the sludge is not sewage sludge [biosolids] because it is not a residual from the treatment of domestic sewage, but industrial wastewater. See Section 503.6(d).

Q: If the influent from a POTW or any treatment works other than an industrial facility is 99 percent industrial wastewater and only 1 percent domestic wastewater, are the biosolids generated at the treatment works sewage sludge covered under Part 503?

A: Yes. Because any domestic content in the wastewater being treated in a facility other than an industrial facility brings the biosolids generated within the scope of Part 503 if used or disposed through land application, surface disposal, or biosolids incineration.

Q: What does "new pollution control facilities" mean as referred to in Section 503.2?

A: A ***new pollution control facility*** is any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which must have begun after the promulgation of Part 503. A new pollution control facility includes any building, structure, or installation that replaces or substantially upgrades the process or production equipment necessary to meet a standard under this Part. An example of an acceptable new pollution control facility is the installation of an incinerator afterburner.

New pollution control facilities do not include:

(1) replacement of any building, structure, or installation due to normal operational wear and tear;

(2) installation of monitoring equipment or devices, including the purchase of computer hardware or software for monitoring purposes; or

(3) purchase of a special truck for land application of biosolids.

The permitting authority should be consulted for specific determinations.

Q: If a treatment works is able to comply immediately with the standards for one use or disposal practice covered under Part 503 but would like to construct devices necessary for compliance with another use or disposal practice, does that treatment works have 2 years to achieve compliance? For example, if a treatment works needs 2 years to build pollution control processes, is that facility allowed to use or dispose biosolids that violate the requirements of Part 503 for 2 years?

A: The treatment works may have up to 2 years to achieve compliance (i.e., until February 19, 1995—2 years after promulgation of the Part 503 rule) only for that use for which is requires construction. In all other instances, the treatment works must comply with Part 503 by the February 19, 1994, deadline. Thus, in the above example, if the treatment works is converting from surface disposal to incineration, the biosolids disposed until the incinerator comes on line must comply with surface disposal requirements under Subpart C of the Part 503 rule.

Q: Suppose the only practice followed by a treatment works has been incineration and the treatment works cannot meet the 503 incinerator requirements without construction of new pollution control devices (e.g., a wet electrostatic scrubber), would the treatment works have until February 19, 1995 (2 years) to come into compliance?

A: Yes.

Q: Suppose the only practice followed at a treatment works is land application and the biosolids (a) cannot meet the pollutant ceiling limits or (b) have been aerobically digested and cannot meet either the pathogen reduction or the vector attraction reduction requirements. Would that treatment works have until February 19, 1995 (2 years) to come into compliance?

A: (a) Possibly yes if the owner/operator of a treatment works could demonstrate that he or she had no other readily available alternative, such as shifting to a surface disposal operation or diluting the biosolids with other material prior to land use. (b) Probably no, because the treatment works could likely have readily provided pathogen and vector attraction reduction by using an additive process, such as lime stabilization, or alternatively by soil incorporation for vector attraction reduction.

Q: If the POTW gives/sells biosolids to a farmer, will the farmer be required to be permitted? How is the "poor farmer" going to know he has to keep records for 5 years?

A: The owner/operator of a treatment works treating domestic sewage (TWTDS) must apply for a permit if the biosolids being generated/disposed are regulated by Part 503. The Preamble to Part 122 addresses what is considered a TWTDS. Excluded from this definition are land appliers who do not change the quality of the biosolids prior to land application. Therefore, if a POTW provides a farmer with biosolids and the farmer merely land applies the biosolids, the farmer will not have to apply for a permit. There may be some requirements, however, that apply directly to the farmer under Part 503 (e.g., recordkeeping). The POTW is required to provide notice and necessary information to the farmer to ensure that the Part 503 requirements are met. This provision was included in Part 503 specifically to ensure that all parties involved in the land application of biosolids are aware of the requirements.

Q: How can the State continue to include in an NPDES permit State biosolids requirements that are less stringent than Part 503?

A: If the State has separate authority to include such limits, it can continue to do so. However, such limits will not be Federally enforceable because they are not issued under an approved State program, which would require the State to implement requirements at least as stringent as Part 503. Meanwhile, the permittee would have to follow the most restrictive portions of the State as well as the self-implementing Federal rules.

Q: If States already require cumulative metal loading tracking, will past loading count toward ultimate cumulative metal loadings on the site? If no, what position will EPA take if a State (or Region) chooses to acknowledge past loadings? Will EPA be more willing to support a State on this issue if the State is seeking program approval?

A: Part 503 built in certain assumptions about the background concentrations of metals in developing the limits for cumulative loadings. Because of these assumptions, previous land application of biosolids according to the CPLR concept are not considered prior to July 20, 1993. At that time, the recordkeeping requirements became effective, requiring the regulated community to track cumulative loadings under the Federal program. This requirement, however, will not affect existing State programs that already require tracking. These State requirements would generally be considered more stringent and would need to be complied with under State law. Again, if a State chooses to include pre-Part 503 loadings, EPA will take the position that this is a more stringent State requirement. It will not matter if the State is seeking program approval. However, EPA will

be working with all the States to provide an understanding of the Part 503 requirements and to encourage adoption of Part 503 as it exists. The permitting authority may choose to look at past loadings on a case-by-case basis if it determines that a more stringent requirement is necessary to protect public health and the environment from any adverse effect of a pollutant in biosolids.

Q: Can a State prohibit the use or disposal of biosolids generated outside that State? If a State cannot ban the importation of biosolids, how can the receiving State control the quality of biosolids generated in another State? Can it, for example, require analysis of additional pollutant prior to shipment?

A: Although a number of States have attempted to ban the importation of biosolids, the courts have generally struck down such State laws as being contrary to the Commerce Clause of the U.S. Constitution. Furthermore, courts have invalidated laws that discriminate against out-of-State wastes merely because of where those wastes were generated. However, the preparer of biosolids has to notify the permitting authority in the receiving state where the biosolids will be used or disposed. Moreover, the receiving State has the authority to control the use or disposal of biosolids within its borders, regardless of where they are generated. For example, the State could require permits for land application. In this case, anyone who land applies within the State, regardless of where the biosolids come from, would have to obtain a permit. Another option, is to require a joint permit for both the generator and the land applier. However, the State would need to ensure that its legal authority is adequate to go beyond its geographical boundaries.

Q: Does accepting authority for the Part 503 program automatically give the State jurisdiction over out-of-State biosolids that are imported for use or disposal?

A: Program approval does not give the State additional jurisdiction for dealing with out-of-State biosolids. Rather, it merely allows the State to implement the Federal program. The State will have to show that its laws ensure compliance with the Federal program at a minimum. One of the requirements for program approval is that the State demonstrate that it has adequate authority to regulate all biosolids that are used or disposed within its borders—regardless of where that biosolids material is generated. The State would not necessarily be required to regulate all generators of biosolids that are located outside its border, although many States might have this capability.

***Q*: According to Part 503, the choice of a use or disposal option is a local decision. Does the receiving municipality have some say in the decision to permit land application?**

A: If allowed under State law, municipalities also may regulate the use or disposal of biosolids within their borders. The receiving municipality could require a permit or pass an ordinance, such as a zoning or land use requirement, to regulate where biosolids are applied or placed.

***Q*: If biosolids are sent to a different State that has a permitting program, does the generator have to comply with the other State's requirements?**

A: Yes.

Chapter 2

Land Application of Biosolids

What Is Land Application?

Land application is the application of biosolids to land to either condition the soil or to fertilize crops or other vegetation grown in the soil. Nearly half of the biosolids production in the United States is currently being used beneficially to improve soils. This guidance document categorizes the types of land that benefit from the application of biosolids (see Figure 2-1) as follows:

- agricultural land, forests, and reclamation sites—collectively called ***nonpublic contact sites*** (areas not frequently visited by the public); and
- public parks, plant nurseries, roadsides, golf courses, lawns, and home gardens—collectively called ***public contact sites*** (areas where people are likely to come into contact with biosolids applied to land). The Part 503 rule, however, does not regard lawns and home gardens as public contact sites, and fewer types of biosolids may be land applied to these sites (i.e., CPLR biosolids are not permitted on lawns and home gardens given the considerable difficulty of tracking cumulative levels of metals in biosolids applied to such sites).

Biosolids can be either applied to land in ***bulk*** or sold or given away in ***bags or other containers*** for land application (see Figure 2-2). The term ***biosolids in bulk*** refers to biosolids that are marketed or given to manufacturers of products that contain biosolids. The term ***biosolids in bags*** generally refers to biosolids in amounts that are bagged and generally marketed for use on smaller units of land such as lawns and home gardens.

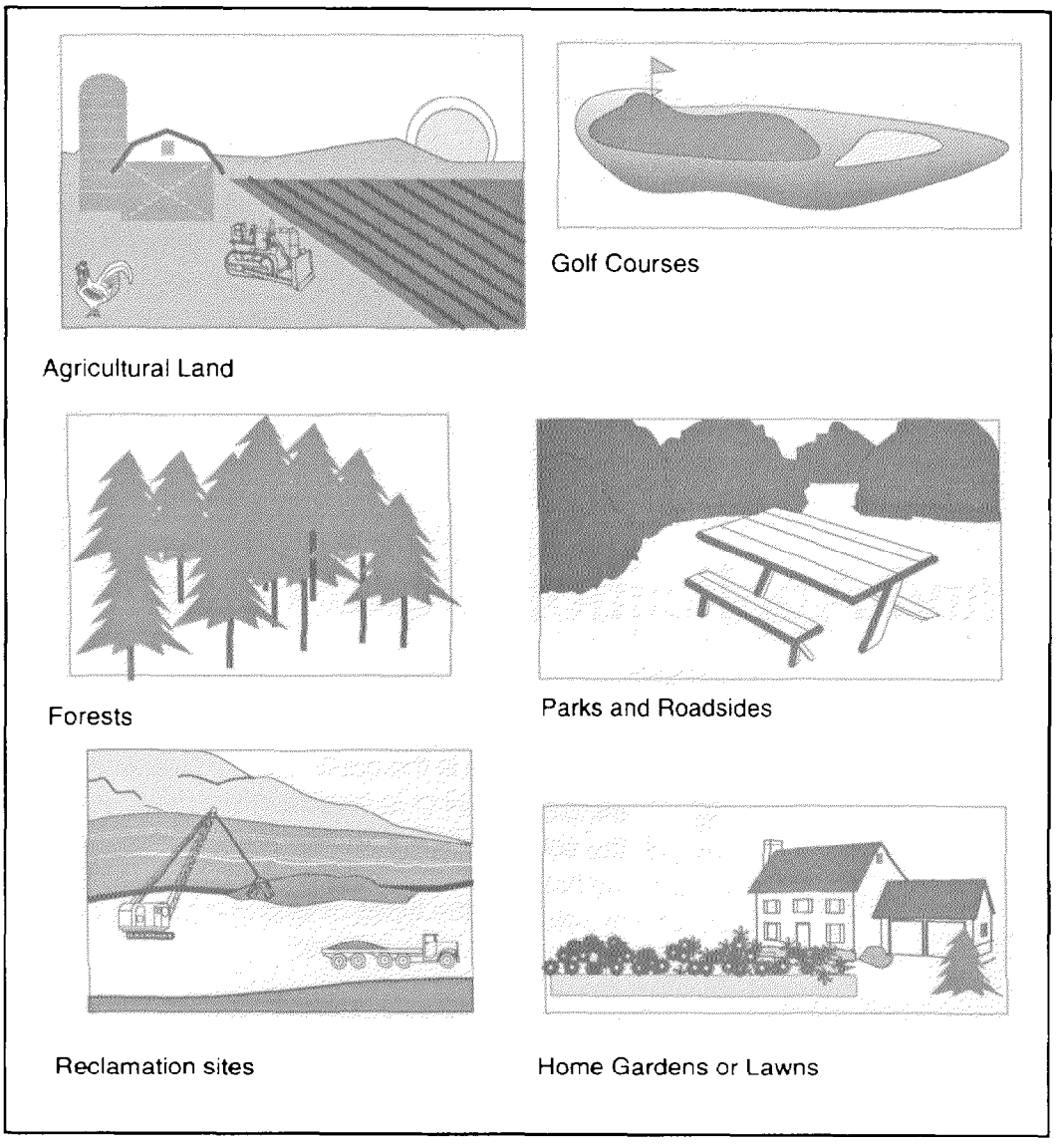


Figure 2-1. Biosolids can be beneficially land applied on agricultural land, forest land, reclamation sites, golf courses, public parks, roadsides, plant nurseries, and lawns and home gardens.

The term ***other containers*** is defined in the Part 503 rule as open or closed receptacles (e.g., buckets, boxes, or cartons) or vehicles with a load capacity of one metric ton or less. (Most pickup trucks as well as trailers pulled by an automobile would meet the regulatory definition of other containers.)

Biosolids are generally land applied using one of several techniques. The biosolids may be sprayed or spread on the soil surface and left on the surface (e.g., on pastures, range and forest land, or lawn). They also may be tilled (incorporated) into the soil after being surface applied or injected

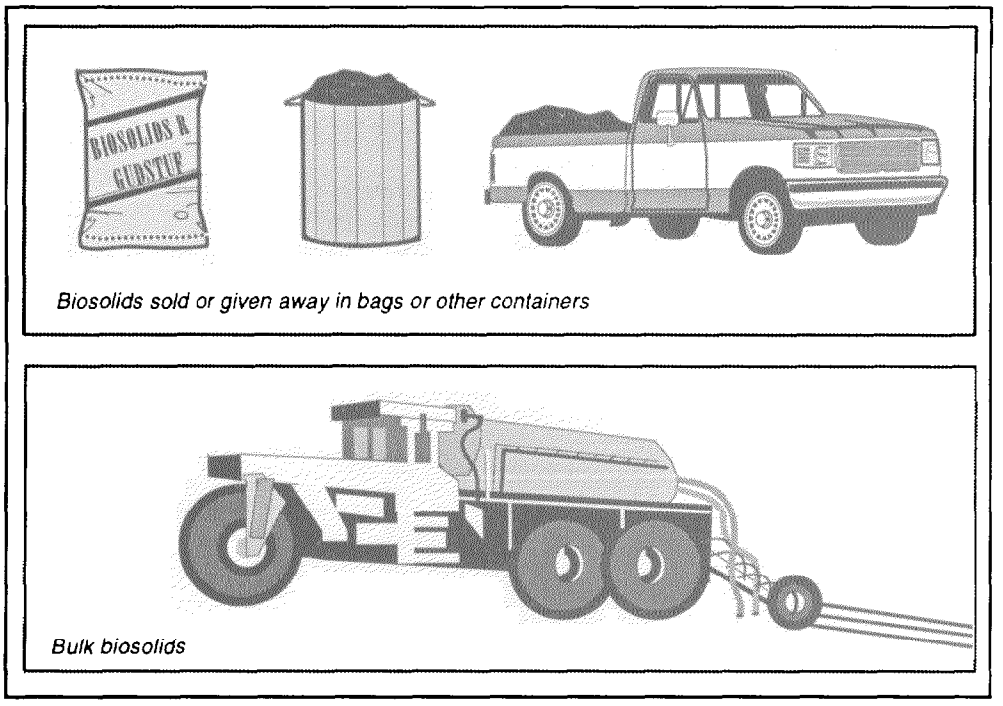


Figure 2-2. For application to the land, biosolids can be sold or given away in bags, in other containers, or they can be land applied in bulk form.

directly below the surface for producing row crops or other vegetation and for establishing lawns.

Biosolids in a liquid state can be applied using tractors, tank wagons, irrigation systems, or special application vehicles. Dewatered biosolids are typically applied to land using equipment similar to that used for applying limestone, animal manures, or commercial fertilizers. Both liquid and dewatered biosolids are applied to land with or without subsequent incorporation into the soil.

Because biosolids are typically treated before being land applied, their use poses a low degree of risk. This chapter discusses approaches for meeting the requirements of the Part 503 rule for the land application of biosolids.

The practice of growing crops or grazing animals on a biosolids surface disposal site, another form of beneficial use, is discussed in Chapter 3. This guidance document refers to this practice as ***dedicated beneficial use***. A permitting authority can allow crops to be grown on a surface disposal site and marketed or grazed if the owner/operator of the site shows that site-specific management practices are being used that will ensure protection of public health and the environment from any reasonably anticipated adverse effects of certain pollutants that can be present in biosolids.

Spreading finished biosolids product on Walt Disney World tree farm in Orlando, Florida.

To Whom the Land Application Requirements Apply

Different provisions of the Part 503 rule apply to the ***preparer*** and the ***applier*** of biosolids. The ***preparer*** of biosolids is defined as a person who either ***generates*** biosolids during the treatment of domestic sewage in a treatment works or who ***derives*** a material from biosolids (i.e., changes the quality of the biosolids prepared by a generator). Examples of materials derived from biosolids include biosolids treated by composting, pelletizing, or drying (to kill pathogens and reduce attractiveness to vectors), and mixtures of biosolids with other materials (e.g., biosolids blended with soil or fertilizer, which will usually lower pollutant concentrations). The ***applier*** is defined as the person who applies the biosolids to land. The responsibilities of preparers and appliers of biosolids under the Part 503 rule are summarized in Figure 2-8.

Landowners and leaseholders also have certain responsibilities. These are discussed at the end of this chapter.

Land Application Requirements

Biosolids applied to the land must meet risk-based pollutant limits specified in Part 503. Operational standards to control disease-causing organisms called pathogens and to reduce the attraction of vectors (e.g., flies, mosquitoes, and other potential disease-carrying organisms) to the

biosolids must also be met. In addition, there are general requirements, management practices, and frequency of monitoring, recordkeeping, and reporting requirements that must be met. Each of these land application requirements is discussed below.

Pollutant Limits, Pathogen and Vector Attraction Reduction Requirements

All biosolids applied to the land must meet ***the ceiling concentrations for pollutants,*** listed in the first column of Table 2-1. The ceiling concentrations are the maximum concentration limits for 10 heavy metal

TABLE 2-1
Pollutant Limits

Pollutant	Ceiling Concentration Limits for All Biosolids Applied to Land (milligrams per kilogram)[a]	Pollutant Concentration Limits for EQ and PC Biosolids (milligrams per kilogram)[a]	Cumulative Pollutant Loading Rate Limits for CPLR Biosolids (kilograms per hectare)	Annual Pollutant Loading Rate Limits for APLR Biosolids (kilograms per hectare per 365-day period)
Arsenic	75	41	41	2.0
Cadmium	85	39	39	1.9
Chromium	3,000	1,200	3,000	150
Copper	4,300	1,500	1,500	75
Lead	840	300	300	15
Mercury	57	17	17	0.85
Molybdenum[b]	75	—	—	—
Nickel	420	420	420	21
Selenium	100	36	100	5.0
Zinc	7,500	2,800	2,800	140
Applies to:	All biosolids that are land applied	Bulk biosolids and bagged biosolids[c]	Bulk biosolids	Bagged biosolids[c]
From Part 503	Table 1, Section 503.13	Table 3, Section 503.13	Table 2, Section 503.13	Table 4, Section 503.13

[a] Dry-weight basis

[b] As a result of the February 25, 1994, Amendment to the rule, the limits for molybdenum were deleted from the Part 503 rule pending EPA reconsideration.

[c] Bagged biosolids are sold or given away in a bag or other container.

pollutants in biosolids; specifically, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. If a limit for any one of the pollutants is exceeded, the biosolids cannot be applied to the land until such time that the ceiling concentration limits are no longer exceeded. The ceiling concentrations for pollutants are included in Part 503 to prevent the land application of biosolids with the highest levels of pollutants and to encourage pretreatment efforts that will result in lower levels of pollutants.

2 Biosolids applied to the land must also meet either pollutant concentration limits, cumulative pollutant loading rate limits, or annual pollutant loading rate limits for these same heavy metals.

3 Either ***Class A or Class B pathogen requirements*** (summarized in Table 2-5) ***and site restrictions*** (Figure 2-4) must be met before the biosolids can be land applied; the two classes differ depending on the level of pathogen reduction that has been obtained.

4 Finally, 1 of 10 options specified in Part 503 and summarized in Table 2-6 to achieve ***vector attraction reduction*** must be met when biosolids are applied to the land.

Options for Meeting Land Application Requirements

This guidance document groups the Part 503 requirements into four options for meeting pollutant limits and pathogen and vector attraction reduction operational standards when biosolids are applied to the land. The options include:

- the Exceptional Quality (EQ) Option
- the Pollutant Concentration (PC) Option
- the Cumulative Pollutant Loading Rate (CPLR) Option
- the Annual Pollutant Loading Rate (APLR) Option

It is very important to realize that each option is equally protective of public health and the environment; that is, EQ, PC, CPLR, and APLR biosolids used in accordance with the Part 503 rule are equally safe. This safety is ensured by the combination of pollutant limits and management practices imposed by each option.

Whichever option is chosen, at a minimum, the ceiling concentrations for pollutants (listed in Table 2-1) and the frequency of monitoring, reporting, and recordkeeping requirements (see Tables 2-7 and 2-8) must be met. The four options are summarized in Table 2-2, illustrated in Figure 2-3, and discussed in detail below.

Depending on the land application option under consideration, site restrictions (Figure 2-4), general requirements (Figure 2-8), and management practices (Figure 2-9) also apply. These additional restrictions,

TABLE 2-2
Options for Meeting Pollutant Limits and Pathogen and Vector Attraction Reduction Requirements for Land Application

Option*	Pollutant Limits	Pathogen Requirements	Vector Attraction Reduction Requirements
"Exceptional Quality" (EQ) Biosolids	Bulk or bagged biosolids meet pollutant concentration limits in Table 2-1	Any 1 of the Class A requirements in Table 2-5	Any 1 of the requirements in options 1 through 8 in Table 2-6
"Pollutant Concentration" (PC) Biosolids	Bulk biosolids meet pollutant concentration limits in Table 2-1	Any 1 of the Class B requirements in Table 2-5 and Figure 2-4	Any 1 of the 10 requirements in Table 2-6
		Any 1 of the Class A requirements in Table 2-5	Requirements 9 or 10 in Table 2-6
"Cumulative Pollutant Loading Rate" (CPLR) Biosolids	Bulk biosolids applied subject to cumulative pollutant loading rate (CPLR) limits in Table 2-1	Any 1 of the Class A or Class B requirements in Table 2-5 and Figure 2-4	Any 1 of the 10 requirements in Table 2-6
"Annual Pollutant Loading Rate" (APLR) Biosolids	Bagged biosolids applied subject to annual pollutant loading rate (APLR) limits in Table 2-1	Any 1 of the Class A requirements in Table 2-5	Any 1 of the first 8 requirements in Table 2-6

* Each of these options also requires that the biosolids meet the ceiling concentrations for pollutants listed in Table 2-1, and that the frequency of monitoring requirements in Table 2-7 and recordkeeping and reporting requirements in Table 2-8 be met. In addition, the general requirements in Figure 2-8 and the management practices in Figure 2-9 have to be met when biosolids are land applied (except for EQ biosolids).

requirements, and practices are summarized in Tables 2-3 and 2-4 and discussed in greater detail at the end of this chapter.

Rather than presenting the four options in the order described in the Part 503 rule, this document presents them in order of increasing regulatory requirements. Table 2-3 graphically displays the level of required regulatory control for each option. The types of land onto which these different biosolids may be applied are listed in Table 2-4.

Option 1: Exceptional Quality (EQ) Biosolids

For biosolids to qualify under the EQ option, the following requirements must be met:

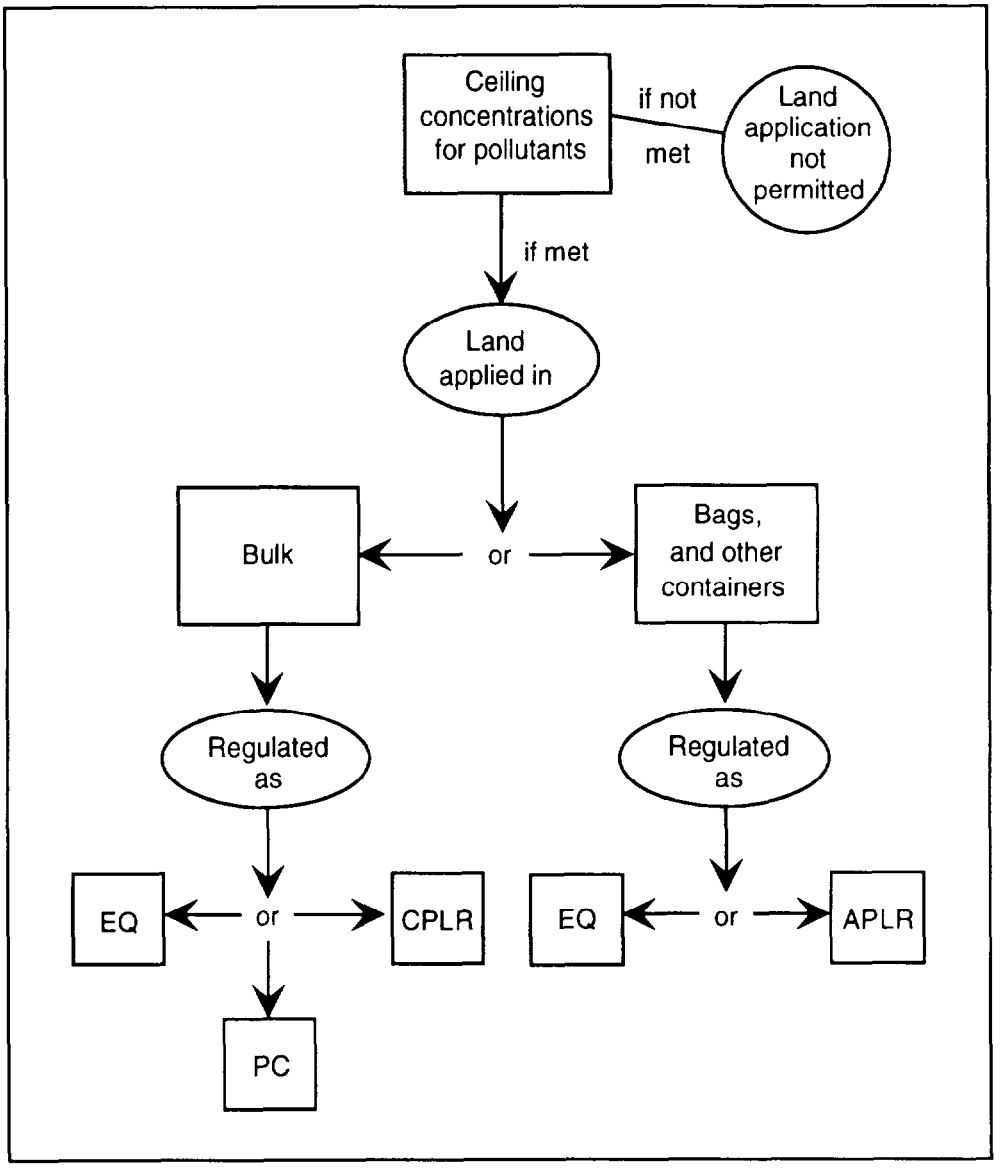


Figure 2-3. Options for meeting certain Part 503 land application requirements

- The ceiling concentrations for pollutants in Table 2-1 may not be exceeded.
- The pollutant concentration limits in Table 2-1 may not be exceeded.
- One of the Class A pathogen requirements in Table 2-5 must be met.
- One of the first eight vector attraction reduction options in Table 2-6 must be achieved.

Methods that typically achieve the pathogen and vector attraction reduction requirements and allow biosolids to meet EQ requirements include alkaline stabilization, composting, and heat drying. The Part 503 frequency of

Use of biosolids on parkland in Manhattan, New York. *Biosolids compost is piled on barren site to be spread for soil conditioning.*

Use of biosolids on parkland in Manhattan, New York (continued). *One month after spreading of biosolids, the turf is vigorously established.*

Use of biosolids on parkland in Manhattan, New York (continued). Different view showing public enjoying the park.

monitoring, recordkeeping, and reporting requirements (see Tables 2-7 and 2-8) also must be met for EQ biosolids.

Once biosolids meet EQ requirements, they are not subject to the land application general requirements and management practices in Part 503, with one possible exception—if the Regional Administrator or the State Director determines, on a case-by-case basis, that such requirements are necessary to protect public health and the environment (this exception applies only to bulk biosolids). Once biosolids have been established as meeting EQ requirements, whether in bulk form or in bags or other containers, they can generally be applied as freely as any other fertilizer or soil amendment to any type of land. While not required by the Part 503 rule, EQ biosolids should be applied at a rate that does not exceed the agronomic rate that supplies the nitrogen needs of the plants being grown, just as for any other commercial fertilizer or soil amending material that contains nitrogen.

Option 2: Pollutant Concentration (PC) Biosolids

To qualify under the PC option, biosolids must meet several requirements, including:

> The ceiling concentration for pollutants in Table 2-1 may not be exceeded.

TABLE 2-3
Summary of Regulatory Requirements for Different Types of Biosolids

Type of Biosolids and Class of Pathogens	Meet Ceiling Concentration for Pollutants	Meet Pollutant Concentration Limits	Site Restrictions	General Requirements and Management Practices	Track Added Pollutants
EQ Bag or Bulk Class A	Yes	Yes	No		
PC Bulk Only Class A[a]	Yes	Yes	No	Yes	No
PC Bulk Only Class B	Yes	Yes	Yes		No
CPLR Bulk Only Class A	Yes	No	No	Yes	
CPLR Bulk Only Class B	Yes	No	Yes		
APLR Bag Only Class A	Yes	No	No	Yes[b]	Yes[c]

[a] Biosolids meeting Class A pathogen reduction requirements but following options 9 or 10 vector attraction reduction requirements are also considered PC biosolids.

[b] The only general and management practice requirement that must be met is a labeling requirement.

[c] The amount of biosolids that can be applied to a site during the year must be consistent with the annual whole sludge application rate (AWSAR) for the biosolids that does not cause any of the ALPRs to be exceeded.

Note: See Chapter Two text for explanation of biosolids types.

The pollutant concentration limits in Table 2-1 may not be exceeded (same requirement as for EQ biosolids, discussed above).

One of three Class B pathogen requirements must be met (see Table 2-5), as well as Class B site restrictions (see Figures 2-4 and 2-5).

One of 10 vector attraction reduction options must be achieved (see Table 2-6).

Frequency of monitoring (see Table 2-7), as well as recordkeeping and reporting requirements (see Table 2-8) must be met.

TABLE 2-4
Types of Land onto Which Different Types of Biosolids May Be Applied

Biosolids Option	Pathogen Class	VAR[a] Options	Type of Land	Other Restrictions
EQ	A	1-8	All[b]	None
PC	A	9 or 10	All except lawn and home gardens[c]	Management practices
	B	1-10	All except lawn and home gardens[c]	Management practices and site restrictions
CPLR	A	1-10	All except lawn and home garden[d]	Management practices
	B	1-10	All except lawn and home garden[c,d]	Management practices and site restrictions
APLR	A	1-8	All, but most likely lawns and home gardens	Labeling management practice

[a] VAR means vector attraction reduction.

[b] Agricultural land, forest, reclamation sites, and lawns and home gardens.

[c] It is not possible to impose site restrictions on lawns and home gardens.

[d] It is not possible to track cumulative additions of pollutants on lawns and home gardens.

Applicable site restrictions, general requirements, and management practices must be met (summarized in Tables 2-3 and 2-4 and listed in Figures 2-4, 2-8, and 2-9).

Class A biosolids meeting vector attraction reduction requirements 9 and 10 in Table 2-6 are another type of biosolids material that would fit in the PC category.

Thus, PC biosolids must meet more requirements than EQ biosolids, but are subject to fewer requirements than CPLR biosolids. Currently, the majority of biosolids in the United States could be characterized as PC biosolids, as defined in this guidance document.

Option 3: Cumulative Pollutant Loading Rate (CPLR) Biosolids

The third option for meeting land application requirements allows bulk biosolids that do not meet the pollutant concentration limits in Table 2-1 to

TABLE 2-5
Summary of Class A and Class B Pathogen Reduction Requirements

CLASS A

In addition to meeting the requirements in one of the six alternatives listed below, fecal coliform or *Salmonella* sp. bacteria levels must meet specific density requirements at the time of biosolids use or disposal or when prepared for sale or give away (see Chapter Five of this guidance)

Alternative 1: Thermally Treated Biosolids

Use one of four time-temperature regimens

Alternative 2: Biosolids Treated in a High pH-High Temperature Process

Specifies pH, temperature, and air-drying requirements

Alternative 3: For Biosolids Treated in Other Processes

Demonstrate that the process can reduce enteric viruses and viable helminth ova. Maintain operating conditions used in the demonstration

Alternative 4: Biosolids Treated in Unknown Processes

Demonstration of the process is unnecessary. Instead, test for pathogens - *Salmonella* sp. or fecal coliform bacteria, enteric viruses, and viable helminth ova - at the time the biosolids are used or disposed of or are prepared for sale or give-away

Alternative 5: Use of PFRP

Biosolids are treated in one of the Processes to Further Reduce Pathogens (PFRP) (see Table 5-4)

Alternative 6: Use of a Process Equivalent to PFRP

Biosolids are treated in a process equivalent to one of the PFRPs, as determined by the permitting authority

CLASS B

The requirements in one of the three alternatives below must be met

Alternative 1: Monitoring of Indicator Organisms

Test for fecal coliform density as an indicator for all pathogens at the time of biosolids use or disposal

Alternative 2: Use of PSRP

Biosolids are treated in one of the Processes to Significantly Reduce Pathogens (PSRP) (see Table 5-7)

Alternative 3: Use of Processes Equivalent to PSRP

Biosolids are treated in a process equivalent to one of the PSRPs, as determined by the permitting authority

Note: Details of each alternative for meeting the requirements for Class A and Class B designations are provided in Chapter Five.

TABLE 2-6
Summary of Vector Attraction Reduction Options

Requirements in one of the following options must be met:

Option 1:	Reduce the mass of volatile solids by a minimum of 38 percent
Option 2:	Demonstrate vector attraction reduction with additional anaerobic digestion in a bench-scale unit
Option 3:	Demonstrate vector attraction reduction with additional aerobic digestion in a bench-scale unit
Option 4:	Meet a specific oxygen uptake rate for aerobically treated biosolids
Option 5:	Use aerobic processes at greater than 40°C (average temperatures 45°C) for 14 days or longer (e.g., during biosolids composting)
Option 6:	Add alkaline materials to raise the pH under specified conditions
Option 7:	Reduce moisture content of biosolids that do not contain unstabilized solids from other than primary treatment to at least 75 percent solids
Option 8:	Reduce moisture content of biosolids with unstabilized solids to at least 90 percent
Option 9:	Inject biosolids beneath the soil surface within a specified time, depending on the level of pathogen treatment
Option 10:	Incorporate biosolids applied to or placed on the land surface within specified time periods after application to or placement on the land surface.

Note: Details of each vector attraction reduction option are provided in Chapter Five.

FIGURE 2-4
Restrictions for the Harvesting of Crops and Turf, Grazing of Animals, and Public Access on Sites Where Class B Biosolids Are Applied

Restrictions for the harvesting of crops* and turf:

1. Food crops, feed crops, and fiber crops, whose edible parts do not touch the surface of the soil, shall not be harvested until *30 days* after biosolids application.
2. Food crops with harvested parts that touch the biosolids/soil mixture and are totally above ground shall not be harvested until *14 months* after application of biosolids.
3. Food crops with harvested parts below the land surface where biosolids remain on the land surface for 4 months or longer prior to incorporation into the soil shall not be harvested until *20 months* after biosolids application.
4. Food crops with harvested parts below the land surface where biosolids remain on the land surface for less than 4 months prior to incorporation shall not be harvested until *38 months* after biosolids application.
5. Turf grown on land where biosolids are applied shall not be harvested until *1 year* after application of the biosolids when the harvested turf is placed on either land with a high potential for public exposure or a lawn, unless otherwise specified by the permitting authority.

Restriction for the grazing of animals:

1. Animals shall not be grazed on land until *30 days* after application of biosolids to the land.

Restrictions for public contact:

1. Access to land with a high potential for public exposure, such as a park or ballfield, is restricted for *1 year* after biosolids application. Examples of restricted access include posting with no trespassing signs, and fencing.
2. Access to land with a low potential for public exposure (e.g., private farmland) is restricted for *30 days* after biosolids application. An example of restricted access is remoteness.

* Examples of crops impacted by Class B pathogen requirements are listed in Figure 2-5.

be land applied as safely as EQ and PC biosolids. To qualify as CPLR biosolids, the following requirements must be met:

The ceiling concentrations for pollutants in Table 2-1 may not be exceeded.

Cumulative Pollutant Loading Rates (CPLRs) listed in Table 2-1 may be not be exceeded.

FIGURE 2-5
Examples of Crops Impacted by Site Restrictions for Class B Biosolids

Harvested Parts That:		
Usually Do Not Touch the Soil/Biosolids Mixture	**Usually Touch the Soil/Biosolids Mixture**	**Are Below the Soil/Biosolids Mixture**
Peaches	Melons	Potatoes
Apples	Strawberries	Yams
Oranges	Eggplant	Sweet Potatoes
Grapefruit	Squash	Rutabaga
Corn	Tomatoes	Peanuts
Wheat	Cucumbers	Onions
Oats	Celery	Leeks
Barley	Cabbage	Radishes
Cotton	Lettuce	Turnips
Soybeans		Beets

Either the Class A or Class B pathogen requirements in Table 2-5 must be met.

One of the 10 vector attraction reduction options in Table 2-6 must be met.

Frequency of monitoring (see Table 2-7), as well as recordkeeping and reporting requirements (see Table 2-8) must be met.

Applicable site restrictions, general requirements, and management practices must be met (summarized in Tables 2-3 and 2-4 and listed in Figures 2-4, 2-8, and 2-9).

The CPLR is the maximum amount of regulated pollutants in biosolids that can be applied to a site considering all biosolids applications made after July 20, 1993. When the CPLR for any one of the 10 heavy metals listed in Table 2-1 is reached at a site, no additional bulk biosolids, subject to the CPLR limits, may be applied to the site.

Option 4: Annual Pollutant Loading Rate (APLR) Biosolids

The fourth option only applies to biosolids that are sold or given away in a bag or other container for application to land. Under this option, the following requirements must be met:

The ceiling concentrations for pollutants in Table 2-1 may not be exceeded.

The Annual Pollutant Loading Rates (APLRs) listed in Table 2-1 may not be exceeded.

The Class A pathogen requirements in Table 2-5 must be met.

One of the first eight vector attraction reduction options in Table 2-6 must be met.

The frequency of monitoring as well as recordkeeping and reporting requirements in Tables 2-7 and 2-8 must be met.

Applicable site restrictions, general requirements, and management practices must be met (summarized in Tables 2-3 and 2-4 and listed in Figures 2-4, 2-8, and 2-9).

An APLR is the maximum amount of regulated pollutants in biosolids that can be applied to a site in any 1 year. APLRs rather than CPLRs are used for biosolids sold or given away in a bag or other container because tracking the amount of pollutants applied in biosolids is not feasible in this situation.

A labeling requirement for bagged or containerized APLR biosolids is discussed in Figure 2-9. To meet the labeling requirement, the preparer of biosolids must calculate the amount of biosolids that can be applied to a site during the year so that none of the APLRs are exceeded. This amount of biosolids is referred to as the annual whole sludge application rate (AWSAR). The AWSAR can be determined once the pollutant concentrations in the biosolids are known. The procedure for determining the AWSAR is explained in Figure 2-6. The AWSAR must be calculated for each of the 10 metals listed in Table 2-1, and the lowest AWSAR for the 10 metals is the allowable AWSAR for the biosolids. The AWSAR on the required label or information sheet has to be equal to or less than the AWSAR calculated using the procedure in Figure 2-6.

While not required by the Part 503 rule, it would also be good practice to provide information about the nitrogen content of the biosolids as well as the AWSAR on the label or information sheet that accompanies the biosolids. Figure 2-7 shows calculations that can be useful for determining how much nitrogen is being applied to land relative to the AWSAR and the nitrogen requirements of the plants being grown.

General Requirements and Management Practices

The Part 503 general requirements and management practices must be met for all but EQ biosolids. The specific general requirements and kinds of management practices that apply to each type of biosolids are given in Figures 2-8 and 2-9, respectively. Several of the management practices are singled out for a bit more discussion below.

Biosolids are applied on a semi-arid rangeland demonstration study site in Rio Puerco, New Mexico.

FIGURE 2-6
Procedure To Determine the Annual Whole Sludge (Biosolids) Application Rate for Biosolids Sold or Given Away in a Bag or Other Container

1. Analyze a sample of the biosolids to determine the concentration of each of the 10 regulated metals in the biosolids.
2. Using the pollutant concentrations from Step 1 and the APLRs from Table 2-1, calculate an AWSAR for each pollutant using equation (1) below:

$$AWSAR = \frac{APLR}{C \cdot 0.001} \text{ where:}$$

$AWSAR$ = Annual whole sludge (biosolids) application rate (dry metric tons of biosolids/hectare/year)

$APLR$ = Annual pollutant loading rate (in Table 2-1) (kg of pollutant/ha/yr)

C = Pollutant concentration (mg of pollutant/kg of biosolids, dry weight)

0.001 = A conversion factor

3. The AWSAR for the biosolids is the lowest AWSAR calculated for each pollutant in Step 2.

Example:

1. Biosolids to be applied to land are analyzed for each of the 10 metals regulated in Part 503. Analysis of the biosolids indicates the pollutant concentration in the second column of the table below.
2. Using these test results and the APLR for each pollutant from Table 2-1, the AWSAR for all the pollutants are calculated as shown in the fourth column of the table below.
3. The AWSAR for the biosolids is the *lowest* AWSAR calculated for all 10 metals. In our example, the lowest AWSAR is for copper at 20 metric tons of biosolids/hectare/year. Therefore, the controlling AWSAR to be used for the biosolids is 20 metric tons per hectare/year. The 20 metric tons of biosolids/hectare is the same as 410 pounds of biosolids/1,000 square feet (20 metric tons × 2,205 lb per metric ton/107,600 square feet per hectare). The AWSAR on the label or information sheet would have to be equal to or less than 410 pounds per 1,000 square feet.

Metal	Biosolids Concentrations (milligrams/kilogram)	APLR* (kilograms/ hectare/year)	AWSAR = APLR / Conc. in Biosolids (0.001) = metric tons/hectare
Arsenic	10	2.0	2 / (10 x 0.001) = 200
Cadmium	10	1.9	1.9 / (10 x 0.001) = 190
Chromium	1,000	150	150 / (1,000 x 0.001) = 150
Copper	3,750	75	75 / (3,750 x 0.001) = 20
Lead	150	15	15 / (150 x 0.001) = 100
Mercury	2	0.85	0.85 / (2 x 0.001) = 425
Nickel	100	21	21 / (100 x 0.001) = 210
Selenium	15	5.0	5 / (15 x 0.001) = 333
Zinc	2,000	140	140 / (2,000 x 0.001) = 70

* Annual Pollutant Loading Rate from Table 2-1 of this guide and Table 4 of the Part 503 rule.

FIGURE 2-7
Procedure for the Applier To Determine the Amount of Nitrogen Provided by the AWSAR Relative to the Agronomic Rate

In Figure 2-6, the AWSAR for the biosolids in the example calculation was determined to be 410 pounds of biosolids per 1,000 square feet of land. If biosolids were to be placed on a lawn that has a nitrogen requirement of about 200 pounds* of available nitrogen per acre per year, the following steps would determine the amount of nitrogen provided by the AWSAR relative to the agronomic rate if the AWSAR was used:

1. The nitrogen content of the biosolids indicated on the label is 1 percent total nitrogen and 0.4 percent available nitrogen the first year.
2. The AWSAR is 410 pounds of biosolids per 1,000 square feet, which is 17,860 pounds of biosolids per acre:

$$\frac{410\text{ lb}}{1{,}000\text{ sq ft}} \times \frac{43{,}560\text{ sq ft}}{\text{acre}} \times 0.001 = \frac{17{,}860\text{ lb}}{\text{acre}}$$

3. The available nitrogen from the biosolids is 71 pounds per acre:

$$\frac{17{,}860\text{ lb biosolids}}{\text{acre}} \times .004 = \frac{71\text{ lb}}{\text{acre}}$$

4. Since the biosolids application will only provide 71 pounds of the total 200 pounds of nitrogen required, in this case the AWSAR for the biosolids will not cause the agronomic rate for nitrogen to be exceeded and an additional 129 pounds per acre of nitrogen would be needed from some other source to supply the total nitrogen requirement of the lawn.

*Assumptions about crop nitrogen requirement, biosolids nitrogen content, and percent of that nitrogen that is available are for illustrative purposes only.

TABLE 2-7
Frequency of Monitoring for Pollutants, Pathogen Densities, and Vector Attraction Reduction

Amounts of Biosolids* (metric tons per 365-day period)	Amount of Biosolids (English tons)		Frequency
	Avg. per day	per 365 days	
Greater than zero but less than 290	>0 to <0.85	>0 to <320	Once per year
Equal to or greater than 290 but less than 1,500	0.85 to <4.5	320 to <1,650	Once per quarter (4 times per year)
Equal to or greater than 1,500 but less than 15,000	4.5 to <45	1,650 to <16,500	Once per 60 days (6 times per year)
Equal to or greater than 15,000	≥45	≥16,500	Once per month (12 times per year)

* Either the amount of bulk biosolids applied to the land or the amount of biosolids received by a person who prepares biosolids for sale or give-away in a bag or other container for application to the land (dry-weight basis).

FIGURE 2-8
Part 503 Land Application General Requirements

For EQ Biosolids

None (unless set by EPA or State permitting authority on a case-by-case basis for bulk biosolids to protect public health and the environment).

For PC and CPLR Biosolids

The ***preparer**** must notify and provide information necessary to comply with the Part 503 land application requirements to the person who applies bulk biosolids to the land.

The ***preparer*** who provides biosolids to another person who further prepares the biosolids for application to the land must provide this person with notification and information necessary to comply with the Part 503 land application requirements.

The ***preparer*** must provide written notification of the total nitrogen concentration (as N on a dry-weight basis) in bulk biosolids to the applier of the biosolids to agricultural land, forests, public contact sites, or reclamation sites.

The ***applier*** of biosolids must obtain information necessary to comply with the Part 503 land application requirements, apply biosolids to the land in accordance with the Part 503 land application requirements, and provide notice and necessary information to the owner or leaseholder of the land on which biosolids are applied.

Out of State Use

The ***preparer*** must provide written notification (prior to the initial application of the bulk biosolids by the applier) to the permitting authority in the State where biosolids are proposed to be land applied when bulk biosolids are generated in one State and transferred to another State for application to the land. The notification must include:

- the location (either street address or latitude and longitude) of each land application site;
- the approximate time period the bulk biosolids will be applied to the site;
- the name, address, telephone number, and National Pollutant Discharge Elimination System (NPDES) permit number for both the preparer and the applier of the bulk biosolids; and
- additional information or permits in both States, if required by the permitting authority.

Additional Requirements for CPLR Biosolids

The ***applier*** must notify the permitting authority in the State where bulk biosolids are to be applied prior to the initial application of the biosolids. This is a one-time notice requirement for each land application site each time there is a new applier. The notice must include:

- the location (either street address or latitude and longitude) of the land application site; and
- the name, address, telephone number, and NPDES permit number (if appropriate) of the person who will apply the bulk biosolids.

The ***applier*** must obtain records (if available) from the previous applier, landowner, or permitting authority that indicate the amount of each CPLR pollutant in biosolids that have been applied to the site since July 20, 1993. In addition:

- when these records are available, the ***applier*** must use this information to determine the additional amount of each pollutant that can be applied to the site in accordance with the CPLRs in Table 2-1;
- the ***applier*** must keep the previous records and also record the additional **amount of each pollutant he or she is applying to the site**; and
- when records of past known CPLR applications since July 20, 1993, are not available, biosolids meeting CPLRs cannot be applied to that site. However, EQ or PC biosolids could be applied.

If biosolids meeting CPLRs have not been applied to the site in excess of the limit since July 20, 1993, the CPLR limit for each pollutant in Table 2-1 will determine the maximum amount of each pollutant that can be applied in biosolids if:

- all applicable management practices are followed; and
- the applier keeps a record of the amount of each pollutant in biosolids applied to any given site.

The ***applier*** must not apply additional biosolids under the cumulative pollutant loading concept to a site where any of the CPLRs have been reached.

* The preparer is either the person who generates the biosolids or the person who derives a material from biosolids.

FIGURE 2-9
Part 503 Land Application Management Practice Requirements

For EQ Biosolids

None (unless established by EPA or the State permitting authority on a case-by-case basis for bulk biosolids to protect public health and the environment).

For PC and CPLR Biosolids

These types of biosolids cannot be applied to flooded, frozen, or snow-covered agricultural land, forests, public contact sites, or reclamation sites in such a way that the biosolids enter a wetland or other waters of the United States (as defined in 40 CFR Part 122.2, which generally includes tidal waters, interstate and intrastate waters, tributaries, the territorial sea, and wetlands adjacent to these waters), except as provided in a permit issued pursuant to Section 402 (NPDES permit) or Section 404 (Dredge and Fill Permit) of the Clean Water Act, as amended.

These types of biosolids cannot be applied to agricultural land, forests, or reclamation sites that are 10 meters or less from U.S. waters, unless otherwise specified by the permitting authority.

If applied to agricultural lands, forests, or public contact sites, these types of biosolids must be applied at a rate that is equal to or less than the agronomic rate for nitrogen for the crop to be grown. Biosolids applied to reclamation sites may exceed the agronomic rate for nitrogen as specified by the permitting authority.

These types of biosolids must not harm or contribute to the harm of a threatened or endangered species or result in the destruction or adverse modification of the species' critical habitat when applied to the land. Threatened or endangered species and their critical habitats are listed in Section 4 of the Endangered Species Act. Critical habitat is defined as any place where a threatened or endangered species lives and grows during any stage of its life cycle. Any direct or indirect action (or the result of any direct or indirect action) in a critical habitat that diminishes the likelihood of survival and recovery of a listed species is considered destruction or adverse modification of a critical habitat.

For APLR Biosolids

A label must be affixed to the bag or other container, or an information sheet must be provided to the person who receives APLR biosolids in other containers. At a minimum, the label or information sheet must contain the following information:

- the name and address of the person who prepared the biosolids for sale or giveaway in a bag or other container;
- a statement that prohibits application of the biosolids to the land except in accordance with the instructions on the label or information sheet;
- an AWSAR (see Figure 2-6) for the biosolids that do not cause the APLRs to be exceeded; and
- the nitrogen content.

There is no labeling requirement for EQ biosolids sold or given away in a bag or other container.

Endangered Species

The Part 503 rule prohibits the application of bulk biosolids to land if it is likely to adversely affect endangered or threatened species or their designated critical habitat. Any direct or indirect action that reduces the likelihood of survival and recovery of an endangered or threatened species is considered an "adverse effect." Critical habitat is any place where an endangered or threatened species lives and grows during its life cycle. The U.S. Department of Interior, Fish and Wildlife Service (FWS) publishes a list of endangered and threatened species at 50 CFR 17.11 and 17.12.

Practices that involve applying biosolids to lands (subjected to normal tillage, cropping, and grazing practices, or mining, forestry, and other activities that by their nature are associated with turning the soil and affecting vegetation) are not likely to result in any increase in negative impacts on endangered species and in fact may be beneficial given the nutritive and soil-building properties of biosolids. It is the responsibility of the land applier, however, to determine if the application of biosolids might cause an adverse effect on an endangered species or its critical habitat. Moreover, the Part 503 rule requires the land applier to certify (Figure 2-10) that the applicable management practices have been met, including the requirement concerning endangered species, and that records are kept indicating how the applicable management practices have been met.

One recommended step for making the threatened and endangered species determination is to contact the FWS Endangered Species Protection Program in Washington, DC (703-358-2171), or one of the FWS Field Offices, listed in Appendix C, for more information about the general area being considered for land application. State fish and game departments also can be contacted for specific state requirements.

Flooded, Frozen, or Snow-Covered Land

Application of biosolids to flooded, frozen, or snow-covered land is not prohibited by the Part 503 rule. Appliers must ensure, however, that biosolids applied to such land does not enter surface waters or wetlands unless specifically authorized by a permit issued under Sections 402 or 404 of the Clean Water Act (CWA). Some common runoff controls include slope restrictions, buffer zones/filter strips, tillage to create a roughened soil surface, crop residue or vegetation, berms, dikes, silt fences, diversions, siltation basins, and terraces.

Distance to U.S. Waters

Bulk biosolids may not be applied within 10 meters (33 feet) of any waters of the United States (e.g., intermittent following streams, creeks, rivers, wetlands, or lakes) unless otherwise specified by the permitting authority. Permitting authorities can allow exceptions to this requirement if the application of biosolids is expected to enhance the local environment. For

example, biosolids application may help revegetate a stream bank and otherwise minimize erosion. Approval of such biosolids application could be given via letters of authorization under Section 308 of the CWA, a settlement agreement, or a permit.

Agronomic Rate

The ***agronomic rate*** for biosolids application is a rate that is designed to provide the amount of nitrogen needed by a crop or vegetation to attain a desired yield while minimizing the amount of nitrogen that will pass below the root zone of the crop or vegetation to the ground water. Crop-available nitrogen in biosolids that is applied in excess of the agronomic rate could result in nitrate contamination of the ground water. The Part 503 rule requires that the rate of land application for bulk biosolids be equal to or less than the agronomic rate, except in the case of a reclamation site where a different rate of application is allowed by the permitting authority. Approval could be given via letters of authorization under Section 308 of the CWA, a settlement agreement, or a permit.

Although the preparer is required to supply the land applier with information on the nitrogen content of the biosolids, the land applier is responsible for determining that the biosolids are applied at a rate that does not exceed the agronomic rate for that site. Procedures for the design of the agronomic rate differ depending on such factors as the total and available nitrogen content of the biosolids, nitrogen losses, nitrogen from sources other than biosolids (including estimates or measurements of available nitrogen already present in the soil), and the requirements for the expected yield of crop or vegetation. Assistance in designing the agronomic rate should be obtained from a knowledgeable person, such as the local extension agent or the soil testing department at the Land Grant University in each state. (A sample calculation of the nitrogen supplied by biosolids based on the AWSAR is provided in Figure 2-7.)

Frequency of Monitoring Requirements

Pollutants, pathogen densities, and vector attraction reduction must be monitored when biosolids are applied to the land. This monitoring ensures that pollutant limits and pathogen and vector attraction reduction requirements are being met. Chapter Six describes the sampling and analytical procedures to be followed. The required frequency of monitoring is 1, 4, 6, or 12 times per year, depending on the number of metric tons (mt) (dry-weight basis) of biosolids used or disposed in that year. This frequency is presented in Table 2-7. Frequency of monitoring requirements must be met regardless of which option is chosen for meeting pollutant limits and pathogen and vector attraction reduction requirements, with the exception of Class B pathogen Alternative 2.

TABLE 2-8
Recordkeeping and Reporting Requirements

Type of Biosolids	Records That Must Be Kept	Person Responsible for Recordkeeping		Records That Must Be Reported[a]
		Preparer	Applier	
EQ Biosolids	Pollutant concentrations	✓		✓
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓		✓
PC Biosolids	Pollutant concentrations	✓		✓
	Management practice certification and description		✓	
	Site restriction certification and description (where Class B pathogen requirements are met)		✓	
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓	✓[b]	✓[c]
CPLR Biosolids	Pollutant concentrations	✓		✓
	Management practice certification and description		✓	
	Site restriction certification and description (if Class B pathogen requirements are met)		✓	
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓	✓[b]	✓[c]
	Other information: — Certification and description of information gathered (information from the previous applier, landowner, or permitting authority regarding the existing cumulative pollutant load at the site from previous biosolids applications) — Site location — Number of hectares — Amount of biosolids applied — Cumulative amount of pollutant applied (including previous amounts) — Date of application		✓	✓[d]
APLR Biosolids	Pollutant concentrations	✓		✓
	Management practice certification and description	✓		✓
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓		✓
	The AWSAR for the biosolids	✓		✓

[a] Reporting responsibilities are only for POTWs with a design flow rate equal to or greater than 1 mgd, POTWs that serve a population of 10,000 or greater, and Class I sludge management facilities.

[b] The preparer certifies and describes vector attraction reduction methods other than injection and incorporation of biosolids into the soil. The applier certifies and describes injection or incorporation of biosolids into the soil.

[c] Records that certify and describe injection or incorporation of biosolids into the soil do not have to be reported.

[d] Some of this information has to be reported only when 90 percent or more of any of the CPLRs is reached at a site.

Recordkeeping and Reporting Requirements

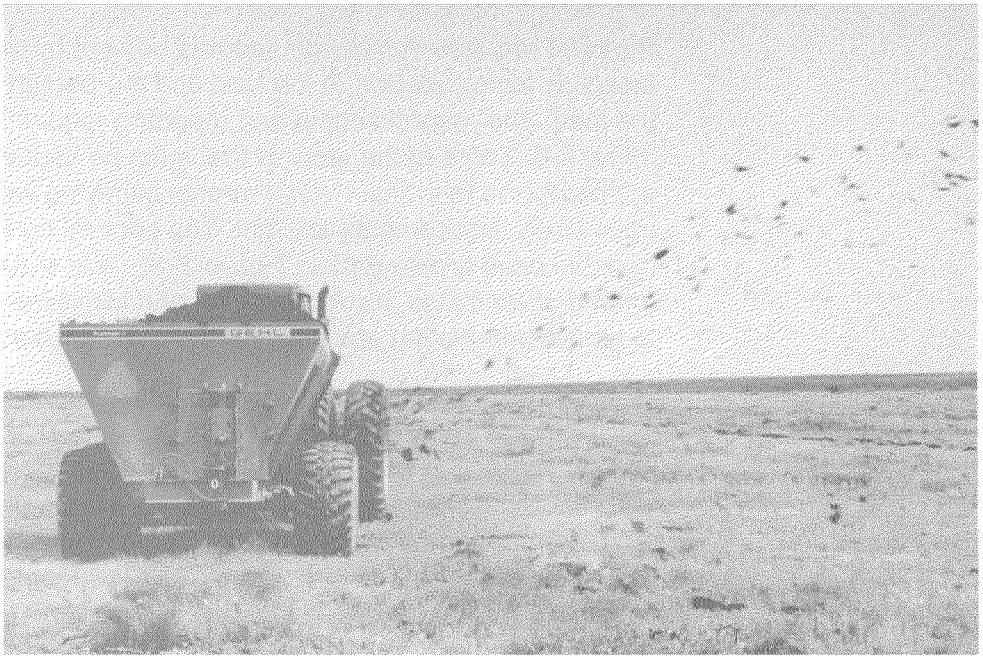
Part 503 requires that certain records be kept by the person who ***prepares*** biosolids for application to the land and the person who ***applies*** biosolids to the land. The recordkeeping and reporting requirements are summarized in Table 2-8. Some of the records that must be kept when biosolids are applied to the land include statements certifying whether certain land application requirements are met. The general certification statement that must be used is provided as Figure 2-10. This statement certifies that, among other things, the land applier and his or her employees are qualified to gather information and perform tasks as required by the Part 503 rule.

The certifier should periodically check the performance of his or her employees to verify that the Part 503 requirements are being met. Then, when a Federal or State inspector checks the employee's logs, office records, and performance in the field, the inspector should find that the required management practices are being followed and that any applicable pathogen and vector attraction reduction requirements, including associated crop harvesting, animal grazing, and site access restrictions, are being met. The inspector also should find that all other necessary records and requirements listed in Table 2-8 are in order. Even if the preparer/applier is not required to report this information, he or she must keep these records for 5 years, or indefinitely for cumulative amounts of pollutants added to any site by CPLR biosolids. These required records may be requested for review at any time by the permitting or enforcement authority.

FIGURE 2-10
Certification Statement Required for Recordkeeping

"I certify under penalty of law, that the *[insert each of the following requirements that are met: Class A or Class B pathogen requirements, vector attraction reduction requirements, management practices, site restrictions, requirements to obtain information]* in *[insert the appropriate section number/s in Part 503 for each requirement met]* have/have not been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the requirements have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

Signature _____ Date _____



Anaerobically digested biosolids from Los Angeles are injected into the soil in California.

Some facilities are not subject to any Part 503 reporting requirements. However, all Class I treatment works, treatment works serving a population of 10,000 or more, and treatment works with a 1 mgd or greater design flow (as described in the first chapter of this guidance) have reporting responsibilities. Each year, facilities with reporting requirements must submit some of the information contained in their records (according to Table 2-8). The information must be submitted every February 19th to the permitting authority (either EPA or a State with an EPA-approved biosolids management program).

Domestic Septage

Part 503 imposes separate requirements for domestic septage applied to agricultural land, forest, or a reclamation site (i.e., nonpublic-contact sites). The "simplified rule" for application of domestic septage to such sites is explained in ***Domestic Septage Regulatory Guidance: A Guide to the EPA 503 Rule.*** If domestic septage is applied to public contact sites or home lawns and gardens, the same requirements must be met as for bulk biosolids applied to the land (i.e., general requirements, pollutant limits, pathogen and vector attraction reduction requirements, management practices, frequency of monitoring requirements, and recordkeeping and reporting requirements).

Landowner and Leaseholder Responsibilities

If the landowner or leaseholder is also the land applier of the biosolids, that person must follow the applicable provisions of the Part 503 rule for land appliers as described in this chapter. If the land-applying operation is of sufficient size or concern to the permitting authority, the landowner or leaseholder applier might also be required to obtain a permit for the land application activities.

If the landowner or leaseholder is not the land applier (e.g., the applier is a contractor or biosolids generator/preparer), the landowner or leaseholder might wish to obtain certain information and maintain certain records even though not required by the Part 503 rule. For example, he or she might wish to keep records on information that Part 503 requires the land applier to give to the landowner or leaseholder for any site where cropping or grazing restrictions apply.

Additional information that the landowner or leaseholder should obtain from the biosolids preparer and/or land applier is the nutritive value (i.e., the amount of each available nutrient such as nitrogen, potassium, phosphorus, and lime being applied), so that he or she will not over-apply any supplemental fertilizers. Also, if biosolids are being applied to the land in accordance with the CPLR concept, it would be prudent for the landowner

or leaseholder to make sure that he or she is given and retains information on the cumulative totals of pollutants that have been added to each parcel of land so that more CPLR biosolids can be applied each year until the cumulative limits for CPLR biosolids have been reached.

The landowner or leaseholder might wish to obtain assurances via an agreement that any biosolids being land applied are of an appropriate quality and have been sufficiently prepared and that the application procedures used meet the requirements of the Part 503 rule. One possible agreement between the landowner or leaseholder and land applier might be:

> **Contractor agrees to indemnify, defend, and hold harmless [Landowner/Leaseholder] from and against any and all claims, suits, actions, demands, losses, costs, liabilities, and expenses (including remediation costs and reasonable attorney's fees) to the extent such losses result from: (1) Contractor's or Generator/Preparer's violation of applicable laws or regulations in effect at the time of biosolids application; or (2) the negligence or willful misconduct of Contractor in delivery and application of biosolids to the undersigned Landowner/ Leaseholders' property. In the event this indemnification is enforced against the Contractor for a violation of law by a Generator/Preparer, Landowner/Leaseholder agrees to assign and subrogate to Contractor its claim against Generator/ Preparer. This indemnification shall survive termination of this Agreement until the expiration of any applicable statutes of limitations. Landowner/Leaseholder shall promptly notify Contractor in the event of a third-party claim and Contractor shall have the right to provide and oversee the defense of such claim and enter into any settlement of such claim at its discretion (holding the Landowner/Leaseholder harmless). Landowner/Leaseholder agrees to fully cooperate with Contractor in the defense against any third-party claim.**

Liability Issues and Enforcement Oversight

Remember that the Part 503 rule is self-implementing and that its provisions must be followed whether or not a permit is issued. Remember also that State rules, which may be different from and more stringent than the Part 503 rule, may also apply.

EPA's Part 503 rule concerning the use or disposal of biosolids includes enforcement measures regarding the proper testing and application of biosolids. Landowners (including their lenders) and leaseholders who use biosolids beneficially as a fertilizer substitute or soil conditioner in

accordance with EPA's Part 503 rule are protected from liability under the Superfund legislation (Comprehensive Environmental Response, Compensation and Liability Act—CERCLA) (see 58 *Federal Register* 9262, February 19, 1993) as well as any enforcement action from EPA under the Part 503 rule. Where the Federal requirements are not followed, appliers of biosolids are vulnerable to EPA enforcement actions or citizen-initiated suits and can be required to remediate any problems for which they are found liable.

There is concern that if for some reason the application of biosolids to farmland might result in damage to crops, livestock, or the land itself, a farmer or the farmer's lender may be exposed to significant financial loss. There is also concern about possible future loss that might occur if unanticipated hazards from previous biosolids use are discovered. While there are no guarantees, past experience with agronomic use of biosolids is very reassuring. Where biosolids have been applied in accordance with Federal and State regulations, problems have been rare and virtually the same as those that have occurred from normal farming practices. Available research indicates that the agronomic use of high-quality biosolids is sustainable.

EPA oversight of land application practices includes a program for administering permits and for monitoring, reporting, and inspecting. As with wastewater discharge standards and requirements, preparers and land appliers are required to keep detailed records and Class I biosolids management facilities must self-report on their activities during the preceding calendar year by February 19th. As described in Table 2-8, the reports must include information on biosolids quality. In the case of CPLR biosolids, a field-by-field analysis of the site activity must also be reported, including information on management practices and on the cumulative application of metals. Hence, EPA will know the quality of the biosolids and where they are going, in accordance with EPA Part 503 requirements.

EPA will not rely solely on the word of the regulated community. The Agency will conduct routine sampling and inspections of these facilities. If discrepancies are identified, enforcement actions will be taken. Enforcement actions can include fines of up to $25,000 per day per violation, injunctive relief, or criminal imprisonment.

EPA shares the concern regarding the potential for harm from the misapplication of biosolids (i.e., not in accordance with general or management practices) or the failure to meet quality or treatment requirements. Notwithstanding, EPA believes that the Part 503 rule is protective and that most land application activities will be in compliance with its requirements.

Common Questions and Answers

Q: EPA has an enforcement strategy that focuses on EQ biosolids first and then addresses biosolids meeting more burdensome requirements. Why?

A: Biosolids that meet the EQ criteria are exempt from further consideration (i.e., management practices or tracking requirements) under the rule. This means that EQ biosolids may be used to supply plant nutrients and to condition soils, such as commercial fertilizers and other soil amending products, after meeting the EQ criteria. If biosolids that are claimed as EQ do not meet these requirements, then it is not possible to know if the untracked non-EQ biosolids are being used in accordance with other applicable provisions of the Part 503 rule and there could be a potential for adverse environmental and public health impacts. Therefore, it is crucial, from a public health and environment standpoint, to ensure that biosolids truly meet these EQ requirements. That is why EPA chose to focus first on EQ biosolids.

Q: The Part 503 rule states that its requirements apply to any person who prepares [biosolids], applies [biosolids] to land, fires [biosolids] in an incinerator, or owns or operates a surface disposal site. The Part 503 rule defines a person as an individual, association, partnership, corporation, municipality, or a State or Federal agency or an agent or employee thereof. EQ biosolids are not subject to general requirements or management practices. If the biosolids are distributed as EQ and later found not to be EQ, will all the individuals who apply the biosolids to land be considered to have violated the Part 503 rule? Who is ultimately responsible?

A: The generator and/or preparer, and possibly in some unique cases the land applier, would be liable. Whom EPA targets for enforcement action would depend on the specifics of the situation. It is highly unlikely that EPA would target any individual user or land applier of such alleged EQ biosolids material. In many cases, the user or land applier might not even know that he or she was using a biosolids product.

Q: What happens to sites that reach the CPLR? Can you ever reuse or repermit that site?

A: Once a site reaches the CPLR, that site can no longer have biosolids subject to the CPLR concept applied to it. You could, however, continue to apply biosolids that meet the EQ or PC requirements.

Q: If EQ or PC biosolids are land applied, do you need to keep records of cumulative application rates? If non-EQ or non-PC biosolids are subsequently applied to the same land, do you have to consider the pollutants land applied in the EQ or PC biosolids?

A: Part 503 does not require land appliers to keep track of the cumulative amounts of pollutants in EQ or PC biosolids that are applied to a particular parcel of land. The applier of any biosolids that are subject to CPLRs are not required by Part 503 to consider the pollutant loadings already applied to the same parcel of land from EQ or PC biosolids.

Q: When biosolids from a Class I facility are land applied, exactly what information must be reported regarding biosolids pollutant levels and pathogen and vector attraction reduction?

A: On February 19 of each year, the preparer and land applier, as applicable, would be required to submit on the previous year the following information to the permitting authority:

- the concentration in biosolids of each pollutant listed in Table 2-1 of this guidance;
- the appropriate certification statement indicating the Class A and B pathogen reduction and vector attraction reduction options used; and
- a description of how the preparer/applier is meeting the requirements of the pathogen and vector attraction reduction options chosen. In general, the preparer/applier would not need to report the actual data collected on pathogens or related to vector attraction reduction; however, the preparer/applier would need to describe how the required limiting numbers have been met or exceeded and how required operating parameters have been maintained. In addition, the preparer/applier must retain the actual data collected for a minimum of 5 years and have it available for inspection by authorized permitting or regulatory authorities when requested. Pollutant loading rate information must be kept indefinitely for CPLR biosolids on a site-by-site basis.

Q: If biosolids are applied to land in accordance with the requirements of the Part 503 rule, would the landowner, leaseholder, mortgage lender, land applier, or generator/preparer be liable under CERCLA for the cost of any cleanup of soil or water contamination or loss of crops?

A: No. Application of sewage sludge for a beneficial purpose in compliance with the Part 503 rule would not give rise to CERCLA liability.

Q: Does EPA believe there is an environmental or public health problem related to the beneficial use of biosolids in accordance with the Part 503 rule?

A: It is EPA's long-standing position that the beneficial application of biosolids to provide crop nutrients or to condition the soil is not only safe but good public policy, so long as preparers and land appliers comply with all applicable requirements of the Part 503 rule. Among other things, those requirements address the quality of biosolids allowed for land application, the rates of application of biosolids under various circumstances, and monitoring. Beneficial use of biosolids reclaims a wastewater residual, converting it into a resource that is recycled to land. EPA's position on biosolids use is based on extensive research involving hundreds of successful land application projects over the past 25 years.

Chapter 3

Surface Disposal of Biosolids

What Is Surface Disposal?

The Part 503 rule defines an activity as surface disposal if [biosolids] are placed on an area of land for final disposal. Some surface disposal sites may be used for beneficial purposes as well as for final disposal. Owners and operators of surface disposal sites and anyone who prepares biosolids for final disposal of only biosolids on a surface disposal site must meet the requirements in Subpart C of the Part 503 rule. These requirements are described in this chapter.

Surface disposal sites include monofills, surface impoundments, lagoons, waste piles, dedicated disposal sites, and dedicated beneficial use sites (see Figure 3-1.)

Monofills are landfills where only biosolids are disposed. Monofills include trenches and area fills. In trenches, biosolids are placed in an excavated area that can be a wide, shallow trench or a narrow, deep trench. In area fills, biosolids are placed on the original ground surface in mounds, layers, or diked containments. With area fills, excavation is not required (as it is with trenches) because biosolids are not placed below the ground surface. Area fills often are used when shallow bedrock or ground water is present.

Surface impoundments and lagoons are disposal sites where biosolids with a high water content are placed in an open, excavated area. If lagoons are used for treatment, they are not considered surface disposal sites.

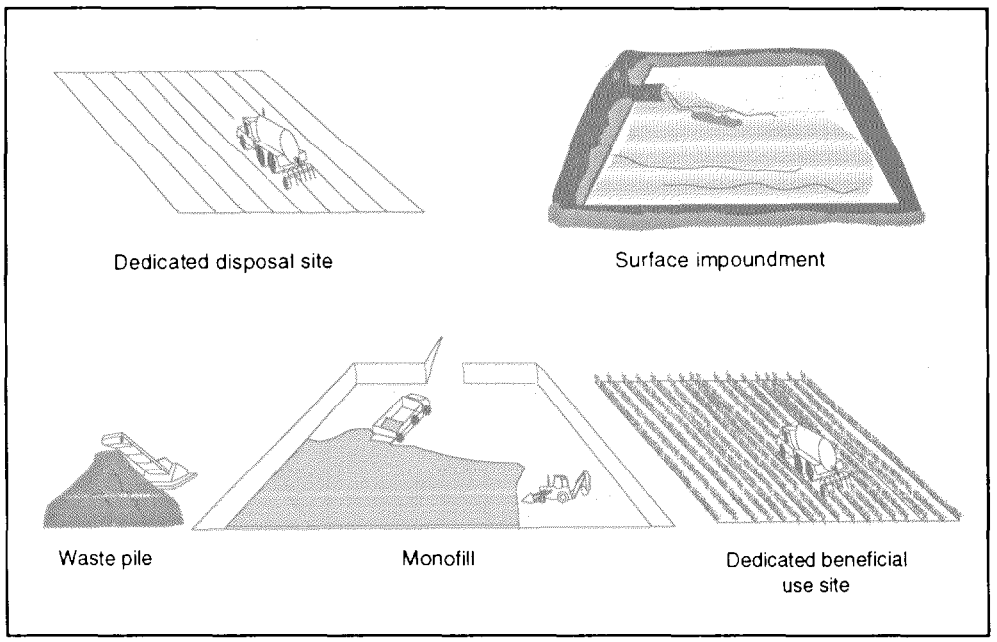


Figure 3-1. Dedicated disposal sites, surface impoundments, waste piles, biosolids monofills, and dedicated beneficial use sites are all governed by Part 503's surface disposal standards in Subpart C.

Waste piles are mounds of dewatered biosolids placed on the soil surface for final disposal.

Dedicated disposal sites receive repeated applications of biosolids for the sole purpose of final disposal. Such sites often are located at publicly owned treatment works (POTW) sites.

Dedicated beneficial use sites are surface disposal sites where biosolids are placed on the land at higher rates or with higher pollutant concentrations than are allowed when biosolids are land applied for farming or reclamation. Such sites might receive repeated applications of biosolids. In contrast to dedicated disposal sites, dedicated beneficial use sites are used to grow crops for beneficial purposes. For such sites, the permitting authority will issue a permit that specifies appropriate management practices that ensure the protection of public health and the environment from any reasonably anticipated adverse effects of certain pollutants that may be present in biosolids if crops are grown or animals are grazed.

Differentiation Among Surface Disposal, Storage, Land Application, and Treatment

An activity is considered ***storage*** if biosolids are placed and remain on land for 2 years or less. If biosolids remain on land for longer than 2 years, this land is considered an active [biosolids] unit and the surface disposal

requirements in Part 503 have to be met. An ***active biosolids unit*** is the area, trench, waste pile, or lagoon where biosolids are currently being placed. Please note, however, that biosolids can remain on the land for longer than 2 years, but the person who prepares the biosolids must demonstrate that the site is not an active biosolids unit. The demonstration must include the following information:

- the name and address of the person who prepares the biosolids;
- the name and address of the person who either owns the land or leases the land;
- the location, by either street address or latitude and longitude, of the land;
- an explanation of why biosolids need to remain on the land for longer than 2 years prior to final use or disposal, or why a site is used for longer than 2 years to store batches of biosolids for less than 2 years (e.g., storage of individual batches of biosolids for several months during a given 2-year period before final use or disposal); and
- the approximate time when biosolids will be transferred from storage to their final use or disposal destination.

This demonstration information must be retained by the person who prepares the biosolids for the period that the biosolids remain on the land.

Any practice in which biosolids that meet pollutant concentrations, CPLRs, or APLRs, as well as ceiling limits are applied to land at agronomic rates to condition soil or to fertilize crops or vegetation is considered land application, not surface disposal. Regulatory requirements for land application are discussed in Chapter Two.

The surface disposal provisions of the Part 503 rule do not apply when biosolids are treated on the land, such as in a treatment lagoon or stabilization pond, and treatment could be for an indefinite period. Placement of biosolids on the land in a municipal solid waste landfill also is not considered surface disposal under Part 503, but would be covered under 40 CFR Part 258 instead.

Regulatory Requirements for Surface Disposal of Biosolids

A Part 503 standard for surface disposal of biosolids includes:

- general requirements
- pollutant limits
- management practices
- operational standards for pathogen and vector attraction reduction
- frequency of monitoring requirements

recordkeeping requirements

reporting requirements

These seven elements are discussed below.

General Requirements for Surface Disposal Sites

Placement. No person shall place [biosolids] on an active [biosolids] unit unless the requirements in Subpart C of Part 503 (described in this chapter) are met.

Closure is required if a unit is located in certain types of areas. If an active biosolids unit is located within 60 meters of a geologic fault with displacement in Holocene time (i.e., relatively recently), located in an unstable area, or located in a wetland, the unit must have closed by March 22, 1994. There are two exceptions to this requirement: (1) if the permitting authority has indicated that the location of a specific unit within 60 meters of a fault with displacement in Holocene time is acceptable, or (2) if a permit was issued under Section 402 of the Clean Water Act that allows the unit to be located in a wetland.

When a unit is closing, the permitting authority must be notified. If an active biosolids unit is about to be closed, the owner/operator of the unit must provide the permitting authority with a written plan at least 180 days prior to the closing. The Plan must describe closure and post-closure activities and systems; for example, (1) the operation and maintenance of the leachate collection system for 3 years after closure (if the unit has such a system); (2) the system used to monitor the air for methane gas for 3 years after closure (if biosolids units are covered); and (3) measures to restrict public access for 3 years after closure.

The permitting authority may determine that the closure plan must include provisions for monitoring the air for methane gas or leachate collection for more than 3 years. For example, if the biosolids placed on the surface disposal site were not stabilized, it may be necessary to monitor the air for methane gas and restrict access for a longer period to protect public health and the environment. Also, in areas of high rainfall, the permitting authority may deem it necessary to collect leachate for a longer period to ensure that the integrity of the liner is maintained.

The subsequent owner must be notified of the presence of biosolids. Should ownership of a surface disposal site change hands, the owner must provide the subsequent owner with written notification that biosolids were placed on the land.

The notification required for the subsequent owner of a surface disposal site will vary depending on when the land was sold and the provisions of the closure plan. For instance, if a surface disposal site was covered, had a

liner, and was sold 1 year after closure, the notification should inform the next owner that the property was used to dispose of biosolids and that the new owner must operate the leachate collection system, monitor the air for methane gas, and restrict public access for an additional 2 years.

Pollutant Limits for Biosolids Placed on Surface Disposal Sites

For surface disposal, a pollutant limit is the amount of pollutant allowed per unit amount of biosolids. Subpart C of Part 503 sets pollutant limits for arsenic, chromium, and nickel in biosolids. These limits apply only to active biosolids units without liners and leachate collection systems. Where applicable, representative samples of biosolids must be collected and analyzed for metals using the methods listed in the regulation (see Chapter Six for more information about sampling and analysis).

A ***liner*** is a layer of relatively impervious soil, such as clay, or a layer of synthetic material that covers the bottom of an active biosolids unit and has a hydraulic conductivity of 1×10^{-7} centimeters/second or less. The liner slows the seeping of liquid on the surface disposal site into the ground water below. A ***leachate collection system*** is a system or device installed immediately above a liner that collects and removes leachate as it seeps through the disposal site. Biosolids placed on an active biosolids unit with a liner and leachate collection system do not have to meet pollutant limits, based on the assumption that these systems prevent pollutants from migrating to ground water.

There are two options for meeting the pollutant limits for arsenic, chromium, and nickel in active biosolids units without using liners and leachate collection systems, as summarized in Table 3-1 and discussed below. The ***first option*** is to ensure that the levels of arsenic, chromium, and nickel are below the pollutant limits listed in Table 3-2. These limits are based on how

TABLE 3-1
How To Meet Pollutant Limits for Surface Disposal of Biosolids

Meet 1 of the 2 options.

Option 1:

Make sure that the levels of arsenic, chromium, and nickel are not above the levels listed in Table 3-2, which are based on the distance between the active biosolids unit's boundary and the property line of the surface disposal site.

Option 2:

Meet the site-specific pollutant limits for arsenic, chromium, and nickel, if site-specific limits have been set by the permitting authority.

TABLE 3-2
Option 1—Pollutant Limits

Location in the Part 503 Rule	Distance from the Boundary of Active Biosolids Unit to Surface Disposal Site Property Line (meters)	Pollutant Concentration*		
		Arsenic (mg/kg)	Chromium (mg/kg)	Nickel (mg/kg)
Table 2 of Section 503.23	0 to less than 25	30	200	210
	25 to less than 50	34	220	240
	50 to less than 75	39	260	270
	75 to less than 100	46	300	320
	100 to less than 125	53	360	390
	125 to less than 150	62	450	420
Table 1 of Section 503.23	Equal to or greater than 150	73	600	420

* Dry-weight basis (basically, 100% solids content).

far the boundary of each active biosolids unit is from the surface disposal site property line. For example, the limits are 73 milligrams per kilogram (mg/kg) for arsenic, 600 mg/kg for chromium, and 420 mg/kg for nickel if the boundary of the active biosolids unit closest to the site's property line is greater than 150 meters away.

There may be more than one active biosolids unit at a surface disposal site. If the boundary of a second active biosolids unit on the same site is 75 meters from the property line, then the arsenic limit for that second unit would be 46 mg/kg. Thus different active biosolids units on the same site can have different pollutant limits, based on the closest distance between the active biosolids unit boundaries and the property line of the surface disposal site.

The ***second option*** for meeting pollutant limits is to meet "site-specific" limits set by the permitting authority, who would determine the limits after evaluating site data. The owner/operator of the surface disposal site must request site-specific limits when applying for a permit. The permitting authority then must determine whether site-specific pollutant limits are appropriate for the particular site.

Site-specific limits may be justified if the site conditions vary significantly from those assumed in the risk assessment used to derive the Part 503 pollutant limits. In general, if the depth to ground water is considerable or a natural clay layer underlies the site, the permittee may consider requesting site-specific pollutant limits.

Management Practices for Surface Disposal of Biosolids

The Part 503 rule includes management practices that must be followed when biosolids are placed on a surface disposal site. Most of these management practices apply to all surface disposal sites. A few, however, apply only to sites with liners and leachate collection systems or to sites with covers. (A cover can be soil or other material placed over the biosolids.) The required management practices for surface disposal sites are summarized in Table 3-3 and discussed in more detail below.

Protection of Threatened or Endangered Species

This requirement applies to persons who place biosolids on land where there is potential for harming certain species of plants, fish, or wildlife or their habitat. Biosolids cannot be placed on an active biosolids unit in a

TABLE 3-3
Management Practices for Surface Disposal Sites

Biosolids placed on a disposal unit must not harm threatened or endangered species
The active biosolids unit must not restrict base flood flow
The active biosolids unit must be located in a geologically stable area: — must not be located in an unstable area — must not be located in a fault area with displacement in Holocene time (unless allowed by the permitting authority) — if located in a seismic impact zone, must be able to withstand certain ground movements
The active biosolids unit cannot be located in wetlands (unless allowed in a permit)
Runoff must be collected from the surface disposal site with a system capability to handle a 25-year, 24-hour storm event
Only where there is a liner, must leachate be collected and must the owner/operator maintain and operate a leachate collection system
Only where there is a cover, must there be limits on concentrations of methane gas in air in any structure on the site and in air at the property line of the surface disposal site
The owner/operator cannot grow crops on site (unless allowed by the permitting authority)
The owner/operator cannot graze animals on site (unless allowed by the permitting authority)
The owner/operator must restrict public access
The biosolids placed in the active biosolids unit must not contaminate an aquifer

surface disposal site where such disposal is likely to have an adverse affect on a threatened or endangered animal or plant species or its "critical habitat." Threatened or endangered species and their critical habitats are listed in Section 4 of the Endangered Species Act. (The Threatened and Endangered Species List can be obtained from the U.S. Fish and Wildlife Service's [FWS's] Publications Office by calling 703-358-1711.) Critical habitat is defined as any place where a threatened or endangered species lives and grows during any stage of its life cycle.

Any direct or indirect action (or the result of any direct or indirect action) in a critical habitat that diminishes the likelihood of survival and recovery of a listed species is considered destruction or adverse modification of a critical habitat. Individuals may contact the Endangered Species Protection Program in Washington, DC (703-358-2171) or FWS Field Offices listed in Appendix C for more information about threatened and endangered species considerations in their area. State departments governing fish and game also should be contacted for specific State requirements.

Restriction of Base Flood Flow

An active biosolids unit in a surface disposal site must not restrict the flow of a base flood. A ***base flood*** is a flood that has a 1 percent chance of occurring in any given year (or a flood that is likely to occur once in 100 years). This management practice reduces the possibility that an active biosolids unit might negatively affect the ability of an area to absorb the flows of a base flood. The practice also helps to prevent surface water contamination and to protect the public from the possibility of a base flood releasing biosolids to the environment.

To determine whether a surface disposal site is in a 100-year flood plain, consult the flood insurance rate maps (FIRMs) and flood boundary and floodway maps published by the Federal Emergency Management Agency (FEMA) (Flood Map Distribution Center, 6930 [A-F] San Thomas Road, Baltimore, MD 21227). States, counties, and towns usually have maps delineating flood plains as well. Other agencies that maintain flood zone maps are the U.S. Army Corps of Engineers (COE), the U.S. Geological Survey (USGS), the U.S. Soil Conservation Service (SCS), and the Bureau of Land Management (BLM).

If the owner/operator of a surface disposal site determines that the site is within a 100-year flood zone, the permitting authority has ultimate responsibility for determining whether the active biosolids unit will restrict the flow of a base flood. This assessment considers the flood plain storage capacity and the floodwater velocities that would exist with and without the presence of the biosolids unit. If the presence of the unit would cause the base flood level to rise one additional foot, then the unit restricts the flow of

a base flood, potentially causing more flood damage than would otherwise occur.

If the permitting authority determines that the active biosolids unit will restrict the flow of the base flood, it may require the unit to close or it may require remedial action to avoid the restriction of the base flood flow. Such actions might include constructing embankments or implementing an alternative unit design intended to prevent the unit from being damaged by floodwaters.

Geological Stability

Three of the management practices in the Part 503 rule concern the distance of active biosolids units from certain types of geologic formations. These management practices help ensure that biosolids units are located in geologically stable areas or that the units can withstand certain ground movements. The geologic formations covered by these management practices are fault areas with displacement in Holocene time, unstable areas, and seismic impact zones:

> ***Fault***—A crack in the earth along which the ground on either side may move. Such ground movement is called displacement. An active biosolids unit must be located at least 60 meters from a fault that has displacement measured in Holocene time (recent geological time of approximately the last 11,000 years). Requiring this distance from a fault helps ensure both that the structures of a biosolids unit will not be damaged if ground movement occurs in a fault area and that leachate will not spread through faults into the environment. This management practice must be followed unless the permitting authority has determined otherwise.
>
> ***Unstable Area***—Land where natural or human activities might occur that could damage the structures of an active biosolids unit and allow the release of pollutants into the environment. Unstable areas include land where large amounts of soil are moved, such as by landslides, where the surface lowers or collapses when underlying limestone or other materials dissolve. An active biosolids unit cannot be located in an unstable area. This restriction protects the structures of a biosolids unit from damage by natural or human forces. Owner/operators of surface disposal sites may need to perform local geological studies to determine that unstable conditions do not exist at their sites.
>
> ***Seismic Impact Zone***—An area in which certain types of ground movements ("horizontal ground level acceleration") have a 10 percent or greater chance of occurring at a certain level (measured as "0.10 gravity") once in 250 years. The USGS keeps records of the location of these areas. When a surface disposal site is located in a seismic impact zone, each active biosolids unit must be designed to withstand the maximum recorded horizontal ground level acceleration. This

management practice helps ensure that the containment structures, such as the liner and leachate collection system, of a biosolids unit will not crack or collapse because of ground movement and that leachate will not be released due to seismic activity. Various seismic design methods have been developed for biosolids units located in seismic impact zones. Appropriate design modifications may include shallower unit side slopes and a more conservative design for dikes and runoff controls. Also, contingencies for the leachate collection system should be considered, in case the primary system becomes ineffective.

If these management practices are followed, it is less likely that pollutants in biosolids will be released into the environment because of unstable geological conditions. Individuals can determine whether property is within a geologically unstable area using maps that are available through the USGS, Earth Science Information Center, 12201 Sunrise Valley Drive, Reston, VA, 22092 (800-872-6277). States also have geological surveys that map the locations of geologically unstable areas. (For example, in California guidelines for identifying fault areas are available from the California Division of Mines and Geology.)

Protection of Wetlands

Wetlands are areas in which the soils are filled with water ("saturated") during part of the year and that support vegetation typically found in saturated soils. Examples of wetlands include swamps, marshes, and bogs. Wetlands perform important ecological functions, such as holding floodwaters, serving as habitat and providing sources of food for numerous species including 60% of the endangered species, and reducing soil erosion. Wetlands also hold pollutants, preventing them from contaminating other areas.

An active biosolids unit cannot be located in a wetland unless the owner/operator holds a valid permit issued under Section 402 (a National Pollutant Discharge Elimination System [NPDES] permit) or Section 404 (a dredge and fill permit) of the Clean Water Act. Controlling where active biosolids units are located protects wetlands from possible contamination when biosolids are placed in an active biosolids unit.

If the owner/operator of a surface disposal site suspects that all or some portion of an active biosolids unit is in a wetland, he or she should contact the local COE District Office to request a wetland delineation. The assessment used to determine whether there are wetlands present must be conducted by a qualified and experienced team of experts in soil science and botany/biology. Criteria for identifying wetlands have been developed by a federal task force and appear in a manual published by the COE (***Federal Manual for Identifying and Delineating Jurisdictional Wetlands***, 1989).

The state agency regulating activities in wetlands also should be asked to inspect the area in question. The definition of a wetland and the regulatory requirements for activities in wetlands may be different at the State level.

Collection of Runoff

Runoff is rainwater or other liquid that drains over the land and runs off the land surface. Runoff from an active biosolids unit might be contaminated with biosolids. Runoff from an active biosolids unit must be collected and disposed according to the permit requirements of the NPDES and any other applicable requirements. The runoff collection system must have the capacity to handle runoff from a 25-year, 24-hour storm event (a storm that is likely to occur once in 25 years for a 24-hour period). This requirement helps ensure that runoff (which may contain pollutants) from an active biosolids unit is not released into the environment. The peak flow of water and the total runoff volume of water during the 25-year, 24-hour storm must be calculated to ensure that the extent of stormwater controls is adequate to collect runoff from such a storm.

Information about storm events usually can be obtained from local planning agencies, civil works departments, or zoning boards.

Collection of Leachate

Leachate is fluid from excess moisture in biosolids or from rainwater percolating down through the active biosolids unit from the land surface. If an active biosolids unit has a liner and a leachate collection system, two additional management practices in the Part 503 rule apply.

The first management practice requires that the leachate collection system be operated and maintained according to design requirements and engineering recommendations. The owner/operator of the surface disposal site is responsible for ensuring that the system is always operating according to design specifications and is properly and routinely maintained (e.g., pumps are periodically cleaned and serviced; and the system is periodically inspected to detect clogs and flushed to remove deposited solids).

The second management practice requires that leachate be collected and disposed in accordance with applicable requirements. Leachate should be collected and pumped out by a system placed immediately above a liner. If leachate is discharged to surface water as a point source, then an NPDES permit is required. Otherwise, leachate may be used to irrigate adjacent land or discharged to a POTW. It is recommended that the leachate be tested to determine whether some treatment is appropriate before irrigating or discharging it to a POTW.

Both management practices must be followed while the unit is active and then for 3 years after the unit is closed, or for a longer period if required by the permitting authority.

These management practices help prevent pollutants in biosolids placed on surface disposal sites from being released into the environment. For example, if leachate is not collected regularly, or if the leachate collection system is not operated and maintained properly, then the liner could be damaged by the weight of the leachate pressing against it and the leachate could leak into the ground water. As mentioned above, the leachate collection requirements only apply to active biosolids units and closed units with a liner and leachate collection system; the requirements apply for a minimum of 3 years after unit closure.

The Part 503 rule regulates active biosolids units without liners and leachate collection systems through the pollutant limits discussed in the previous section and through other management practices in the regulation.

Limitations on Methane Gas Concentrations

The Part 503 rule includes a management practice that limits concentrations of methane gas in air because of its explosive potential. Methane, an odorless and highly combustible gas, is generated at surface disposal sites when biosolids are covered by soil or other material (e.g., geomembranes), either daily or at closure. The gas can migrate and be released into the environment. To protect site personnel and the public from risks of explosions, air must be monitored for methane gas continuously within any structure on the site and at the property line of the surface disposal site. Only surface disposal sites *that cover biosolids units* (either daily or at closure) must meet this management practice. When biosolids units are not covered, the air does not have to be monitored for methane gas.

This management practice limits the amount of methane gas in air in both active and closed biosolids units. When a cover is placed on an active biosolids unit, the methane gas concentration in air in any structure within the property line of a surface disposal site must be less than 25% of the lower explosive limit (LEL) (i.e., 1.25%). The LEL is the lowest percentage (by volume) of methane gas in air that supports a flame under certain conditions (at 25°C and atmospheric pressure). For methane, the LEL is 5%. Therefore, if 5% of the LEL is 50,000 ppm methane, then air in any structure within the property line must not exceed 12,500 ppm methane.

A methane gas monitoring device must be installed so that methane concentrations in the air inside all structures on the property are continuously measured and the measurement can be read by any individual before entering the structure. (The act of entering the building could create enough of a spark to ignite explosive levels of methane gas.)

For air at the property line of a surface disposal site with a covered biosolids unit, the limit for methane gas concentration is the LEL (i.e., 5%). In some cases, the permitting authority may determine that a methane monitoring device at one downwind location on the property line is adequate to meet this requirement because the wind patterns are consistent. In other cases, where wind conditions at the site are highly variable, more than one device may be necessary to provide adequate protection.

Methane gas concentrations must be monitored at all times when the biosolids units are active and for 3 years after the last active biosolids unit on the site is closed. If unstabilized biosolids are disposed at a site, the permitting authority may require methane gas to be monitored for longer than 3 years after closure because of the higher potential for methane generation with unstabilized biosolids.

Methane monitoring devices allow the user to read the level of methane as a percent of the LEL. Some can be equipped with alarms, which may be desirable in structures with a potential for allowing the concentration of methane gas to reach explosive levels. Various methods (e.g., venting systems, positive or negative air pressure systems) are available to reduce methane gas concentrations.

Restrictions on Crop Production

Food, feed, or fiber crops may not be grown on an active biosolids unit unless the owner or operator of the surface disposal site can demonstrate to the permitting authority that through management practices public health and the environment are protected from any reasonably anticipated adverse effects of certain pollutants that may be present in biosolids. If the owner/operator wishes to grow crops on the site, he or she must obtain a permit that requires the implementation of certain management practices to ensure that the levels of pollutants taken up by crops do not negatively affect the food chain in regard to animals or humans.

These special management practices might include testing crops and animal tissue for the presence of pollutants if animal feed is produced on the site, or setting a monitoring schedule for the crops and any animal feed products derived from crops grown on the site.

Restrictions on Grazing

Animals must not be grazed on an active biosolids unit unless the owner/operator of a surface disposal site can demonstrate to the permitting authority that public health and the environment are protected from any reasonably anticipated adverse effects of certain pollutants that may be present in biosolids. If the owner/operator wishes to graze animals on the site, he or she must obtain a permit. The permit could require specified management practices, such as monitoring the concentration of pollutants

in any animal product (dairy or meat). This restriction on grazing helps ensure that unsafe levels of pollutants do not find their way into animals from which people obtain food.

In this document, a site where a special permit allows the production of crops and/or grazing, is considered a ***dedicated beneficial use site.***

Restrictions on Public Access

Public access to a surface disposal site must be restricted while an active biosolids unit is on the site and then for 3 years after the last active biosolids unit has been closed. This management practice helps to minimize public contact with any pollutants, including pathogens, that may be present in biosolids placed on an active biosolids unit. It also keeps people away from areas where there is a potential for a methane gas explosion, as discussed above.

Fencing off an area and installing gates that lock might be necessary to restrict access in densely populated areas. Natural barriers, such as hedges, trees, embankments, or ditches, along with warning signs, might be adequate in less-populated areas. In remote areas, it might be sufficient to post warning signs that say, "Do not enter," "No trespassing," or "Access restricted to authorized personnel only."

Protection of Ground Water

This management practice states that biosolids placed on an active biosolids unit must not contaminate an aquifer. An aquifer is an area below the ground that can yield water in large enough quantities to supply wells or springs. ***Contaminating an aquifer*** in this instance means introducing a substance that can cause the level of nitrate in ground water to increase above regulated limits. This management practice also requires that the owner/operator obtain proof that ground water is not contaminated. This proof must be either by way of (1) a ground-water monitoring program developed by a qualified ground-water scientist, or (2) certification by a ground-water scientist that ground water will not be contaminated by the disposal of biosolids at the site.

Usually, certification is an option only if the site has a liner and a leachate collection system. It is generally infeasible for a ground-water scientist to certify that ground water will not be contaminated in the absence of a liner, unless the depth to ground water is considerable and there is a natural clay layer under the soil or unless the amount of biosolids placed on the site is quite small (e.g., at the agronomic or reclamation rate).

Only nitrate-nitrogen levels in ground water are addressed by this management practice. Nitrate-nitrogen levels in ground water must not exceed the maximum contaminant level (MCL) of 10 mg/liter or must not increase an existing exceedance of the ground water MCL for

nitrate-nitrogen. Potential pollutants other than nitrate are addressed by pollutant limits, which are discussed in the previous section.

Pathogen and Vector Attraction Reduction Requirements for Surface Disposal Sites

Pathogens are disease-causing organisms, such as certain bacteria and viruses, that might be present in biosolids. ***Vectors*** are animals, such as rats or insects, that might be attracted to biosolids and can spread disease after coming into contact with the biosolids. The Part 503 rule includes requirements concerning the control of pathogens and the reduction of vector attraction for biosolids placed on a surface disposal site. Biosolids can be placed on an active biosolids unit only if the pathogen and vector attraction reduction requirements are met (see Table 3-4 and discussion below).

For pathogen reduction, the biosolids placed on an active biosolids unit must meet either "Class A" or "Class B" pathogen requirements, or a cover

TABLE 3-4
Pathogen and Vector Attraction Reduction Requirements for Surface Disposal Sites

Pathogen Reduction Requirements (see Chapter Five)

Options (must meet one of these):

- Place a daily cover on the active biosolids unit
- Meet one of six Class A pathogen reduction requirements (see Table 5-1)
- Meet one of three Class B pathogen reduction requirements, except Site Restrictions (see Table 5-5)

Vector Attraction Reduction Requirements (see Chapter Five)

Options (must meet one of these):

- Place a daily cover on the active biosolids unit
- Reduce volatile solids content by a minimum of 38% or less under specific laboratory test conditions with anaerobically and aerobically digested biosolids
- Meet a specific oxygen uptake rate (SOUR)
- Treat the biosolids in an aerobic process for a specified number of days at a specified temperature
- Raise the pH of the biosolids with an alkaline material to a specified level for a specified time
- Meet a minimum percent solids content
- Inject or incorporate the biosolids into soil

(soil or other material) must be placed on the active biosolids unit at the end of each day. If a daily cover is placed on the active biosolids unit, no other pathogen reduction requirements apply. If the biosolids meet Class B requirements, the "site restrictions" that apply to Class B do not have to be followed because the management practices for surface disposal already include these site restrictions.

For vector attraction reduction, one of several options listed in Table 3-4 must be met. Representative samples of biosolids must be collected and analyzed to demonstrate that the pathogen and vector attraction reduction requirements have been met using the methods listed in the regulation (see Chapter Six for more information on sampling and analysis).

Pathogen and vector attraction reduction requirements, including Class A and Class B pathogen requirements, are discussed in more detail in Chapter Five and in Subpart D of the Part 503 rule. In most cases, owners or operators of surface disposal sites will place a daily cover on the biosolids unit to meet pathogen and vector attraction reduction requirements.

Frequency of Monitoring Requirements for Surface Disposal Sites

The monitoring of several different parameters is required at surface disposal sites, as shown in Table 3-5. Monitoring is required for surface disposal sites without liners to determine levels of arsenic, chromium, and nickel in biosolids. Monitoring is required in both lined and unlined sites to show that the chosen pathogen and vector attraction reduction requirement is being met and to measure the amount of methane gas in air at a covered surface disposal site. How frequently biosolids must be monitored is determined according to the amount of biosolids placed on an active biosolids unit, as shown in Table 3-6. The permitting authority may require more frequent monitoring; for example, if the pollutant and pathogen levels in the biosolids are highly variable.

After biosolids have been monitored for 2 years at the frequency specified in Table 3-6, the permitting authority may reduce the frequency of monitoring for arsenic, chromium, nickel, and, under limited circumstances, pathogens in biosolids placed on an active biosolids unit. The frequency may be reduced, for example, if the pollutant levels in biosolids do not vary greatly or if pathogens are never detected when using Class A Alternative 3 to meet pathogen reduction requirements. (See Chapter Five for details about pathogen reduction alternatives.) At the least, monitoring must be performed once a year.

Methane gas in air must be monitored continuously, both at the property line of the surface disposal site and within each structure at the site, if an active biosolids unit is covered. Methane gas monitors can be installed permanently to continuously test the air and provide readings of methane

TABLE 3-5
Monitoring Required at Surface Disposal Sites

What Must Be Monitored:	In
Arsenic	Biosolids
Chromium	Biosolids
Nickel	Biosolids
Pathogens	Biosolids for several options
Vector attraction reduction	Biosolids for several options
Methane gas	Air in each structure on site
Methane gas	Air at surface disposal site property line

levels as a percent of the LEL. Monitoring must be continued as long as any covered biosolids unit on the site is active and then for 3 years after the last biosolids unit has been closed, if covered at closure.

Recordkeeping Requirements for Surface Disposal Sites

Certain information must be recorded and kept for 5 years from the time the biosolids are placed on a surface disposal site. A separate set of records must be kept by a person who prepares biosolids for placement on a surface disposal site and by the owner/operator of a surface disposal site.

TABLE 3-6
Frequency of Monitoring for Surface Disposal of Biosolids

Amount of Biosolids* (metric tons per 365-day period)	Amount of Biosolids (English tons)		Minimum Frequency
	Avg. per day	per 365 days	
Greater than zero but less than 290	>0 to <0.85	>0 to <320	Once per year
Equal to or greater than 290 but less than 1,500	0.85 to <4.5	320 to <1,650	Once per quarter (four times per year)
Equal to or greater than 1,500 but less than 15,000	4.5 to <45	1,650 to 16,500	Once per 60 days (six times per year)
Equal to or greater than 15,000	≥45	≥16,500	Once per month (twelve times per year)
Methane gas in air			Continuously with methane monitoring device if biosolids unit is covered

* Amount of biosolids (other than domestic septage) placed on active biosolids units—dry-weight basis.

These sets of specific recordkeeping requirements for surface disposal sites are described below.

Records That Must Be Kept by the Preparer of Biosolids for Placement on a Surface Disposal Site

The preparer of biosolids to be placed on an active biosolids unit must develop and keep the following information for 5 years:

- the concentrations of arsenic, chromium, and nickel in biosolids for active biosolids disposal units without a liner and leachate collection system with boundaries that are 150 meters or more from the surface disposal site's property line;
- a certification statement, as worded in Figure 3-2; and
- a description of how certain pathogen and vector attraction reduction requirements are met.

Records That Must Be Kept by the Owner/Operator of a Surface Disposal Site

An owner/operator of a surface disposal site on which biosolids are placed must develop and keep the following information for 5 years:

- the concentrations of arsenic, chromium, and nickel in biosolids for active biosolids units with boundaries less than 150 meters from the property line or for active biosolids units with site-specific limits;
- a certification statement, as worded in Figure 3-3;
- a description of how the management practices for surface disposal

FIGURE 3-2
Certification Statement Required for Recordkeeping: Preparer of Biosolids Placed on Surface Disposal Site

"I certify, under penalty of law, that the pathogen requirements in [insert §503.32(a), §503.32(b)(2), §503.32(b)(3), or §503.32(b)(4) when one of these requirements is met] and the vector attraction reduction requirements in [insert one of the vector attraction reduction requirements in §503.32(b)(1) through §503.32(b)(8) when one of these requirements is met] have/have not been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the [pathogen requirements and vector attraction reduction requirements if appropriate] have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

_____ _____
Signature Date

FIGURE 3-3
Certification Statement Required for Recordkeeping: Owner/Operator of Surface Disposal Site

"I certify, under penalty of law, that the management practices in §503.24 and the vector attraction reduction requirement in [insert one of the requirements in §503.33(b)(9) through §503.33(b)(11), if one of those requirements is met] have/have not been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices [and the vector attraction reduction requirements, if appropriate] have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

_____ _____
Signature Date

sites are being met; and

a description of how certain vector attraction reduction requirements are being met.

Reporting Requirements for Surface Disposal Sites

The Part 503 regulation includes reporting requirements only for those Class 1 and 1 mgd or greater facilities described in the first chapter. These facilities must present the information developed for recordkeeping purposes to the permitting authority by February 19th of each year.

Regulatory Requirements for Surface Disposal of Domestic Septage

The regulatory requirements for the surface disposal of septage are not as extensive as those for biosolids. The requirements for surface disposal of domestic septage include meeting the same management practices that are required for the surface disposal of biosolids and one of the vector attraction reduction alternatives 9 to 12 (listed in Table 5-8 and discussed in Chapter Five). Note that vector attraction reduction 12 would require a determination that the pH of the septage had been raised to 12 for a period of 30 minutes. The person who places the domestic septage on the surface disposal site must certify that vector attraction reduction has been achieved (see Figure 3-4) and develop a description of how it was achieved. The certification and description must be kept on file for 5 years.

There are no pathogen requirements for the surface disposal of domestic septage.

FIGURE 3-4
Certifications Required When Domestic Septage Is Placed on a Surface Disposal Site

An individual placing domestic septage on a surface disposal site must retain the following certification statement for 5 years:

> "I certify, under penalty of law, that the vector attraction reduction requirements in §503.33(b)(12) have/have not been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the vector attraction requirements have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

The owner or operator of the surface disposal site must retain the following certification statement for 5 years:

> "I certify, under penalty of law, that the management practices in §503.24 and the vector attraction reduction requirements in [insert §503.33(b)(9) through §503.33(b)(11) when one of those requirements is met] have/have not been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices [and the vector attraction requirements, if appropriate] have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

_____ _____

Signature Date

Common Questions and Answers

Q: What distinguishes long-term storage from surface disposal; for example, for a lagoon in which biosolids are kept for 20 years before eventual use or disposal?

A: If the facility's owner/operator has a plan for final use or disposal, the area may be considered long-term storage rather than disposal.

Q: If biosolids are stored in a lagoon for 20 years and the generator has no intention or ever removing the biosolids from the lagoon, is the lagoon a surface disposal site? If so, what requirement would apply?

A: The facility would be considered a surface disposal site since there is no intent to ever move the biosolids. The lagoon is subject to the surface disposal requirements under Part 503.

Q: How should biosolids from a "closed" surface disposal site be regulated if they are removed from the site and subsequently disposed?

A: Biosolids at a surface disposal site that has been previously "closed" but which is subsequently disturbed or the biosolids relocated are regulated under the section of Part 503 that regulates the subsequent disposal method.

Q: Do the general requirement and management practice exemptions for EQ biosolids extend only to land application? If EQ biosolids are surface disposed, must they meet all surface disposal management practices?

A: The EQ biosolids concept and its exemptions apply only to land application. Biosolids that may meet the requirements for EQ biosolids must still comply with all the requirements under Part 503 if they are sent for disposal at a surface disposal site, municipal solid waste landfill, or biosolids incinerator.

Q: If a liner and a leachate collection system is in place at a site, does its presence constitute compliance with the ground-water protection requirements?

A: If a ground-water scientist certifies that the liner and the leachate collection system will adequately protect ground water, then the ground-water protection requirements are satisfied.

***Q*: If a site owner claims to have an in situ liner in place, could the permitting authority ask for proof of the impermeability of the native soils?**

A: The permitting authority could require verification that the liner's hydraulic conductivity is less than 1×10^{-7} centimeters/second.

***Q*: Can biosolids be land applied to a surface disposal site after it has been closed?**

A: Yes. You can apply CPLR, EQ, or PC biosolids to the site according to the land application provisions of the rule.

***Q*: Can a surface disposal site be located less than 60 meters from a fault?**

A: Yes. A surface disposal site may be located less than 60 meters from a fault if the permitting authority allows it.

***Q*: Can the permitting authority waive the unstable area prohibition?**

A: No.

***Q*: Is the nitrogen measurement for aquifer contamination taken directly below the surface disposal site?**

A: Yes.

***Q*: With regard to public access restrictions, are hunters allowed to go into a restricted area?**

A: The site owner must make a good faith effort (such as posting "no trespassing" signs) to restrict all public access (including hunters), but does not have to physically prohibit all access. The rule does not define restricting access, but EPA never intended that, for instance, the entire site would be ringed in barbed wire.

***Q*: Can a liner consist of native soils?**

A: Yes. A liner can consist of native soils provided the soils meet the permeability requirements of Part 503.

***Q*: What advice is there for facilities with stockpiles of biosolids that do not meet the ceiling concentration limits?**

A: Biosolids must meet the ceiling concentration limits for pollutants in order to be land applied. The owner/operator of such a facility could

take the biosolids to a municipal solid waste landfill, surface disposal site, or a biosolids incinerator, if the biosolids can meet the applicable requirements for that practice. If land application is the preferred practice, the facility could mix its biosolids (containing pollutants above ceiling concentration limits) with other lower-pollutant-level biosolids to meet the ceiling concentration limit requirement.

Q: What if an applier wishes to land apply biosolids to a reclamation site, but the biosolids do not meet the ceiling concentration limit for zinc?

A: The permitting authority may recommend that the biosolids be placed on the reclamation site according to the surface disposal requirements. The permitting authority also might allow crops to be grown under specified conditions for dedicated beneficial use.

Chapter 4

Incineration of Biosolids

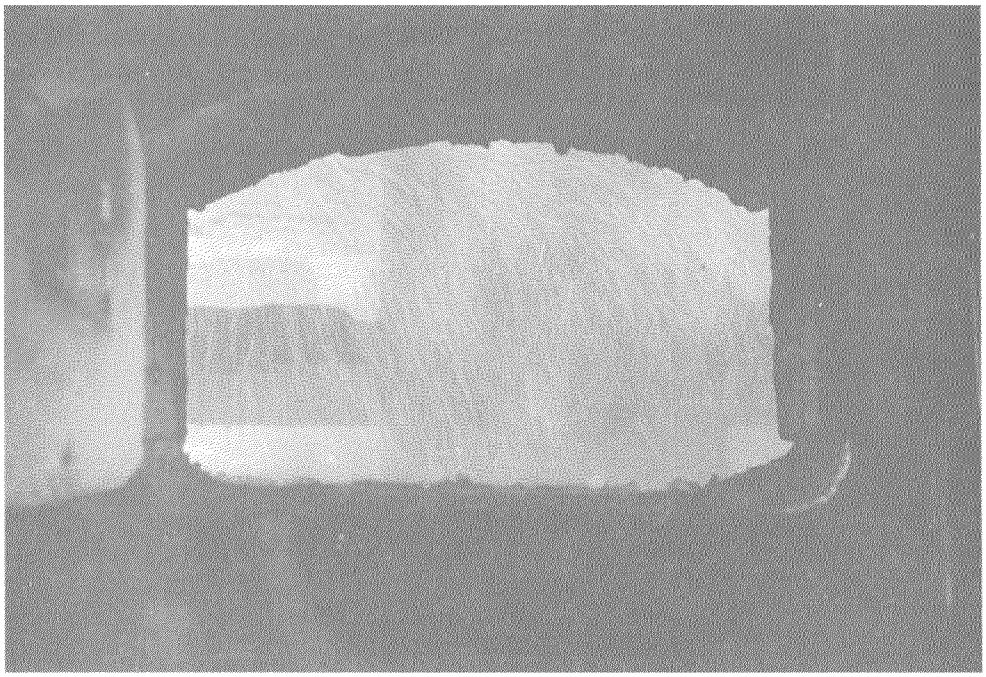
What Is Biosolids Incineration?

Biosolids incineration is the firing of biosolids at high temperatures in an enclosed device. Anyone who fires biosolids in an incinerator, except as described below, must meet the requirements in Subpart E of the Part 503 rule.

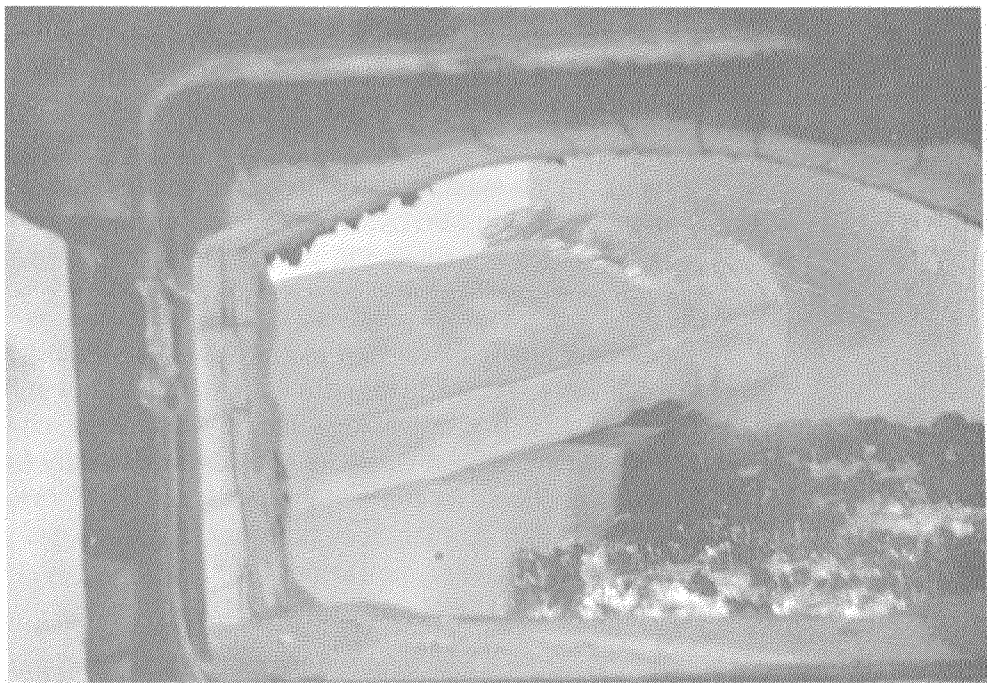
Incineration systems generally consist of an incinerator (furnace) and one or more air pollution control devices (APCDs). The most commonly used incinerators are multiple-hearth, fluidized-bed, and electric infrared furnaces. Most APCDs are used to either remove small particles and their adhering metals in the exhaust gas or to further decompose organics. Examples of metal-removing APCDs are wet scrubbers, dry and wet electrostatic precipitators, and fabric filters. Afterburners, another type of APCD, are used to burn organics in exhaust gases more completely.

Auxiliary fuel is often used to enhance the burning of biosolids. Any additives to biosolids that are fired in a biosolids incinerator, such as natural gas, fuel oil, grit, screenings, scum, wood chips, coal, dewatering chemicals, and municipal solid waste, is considered auxiliary fuel. If municipal solid waste accounts for more than 30 percent (by dry weight) of the mixture of biosolids and auxiliary fuel, however, the municipal solid waste is not considered auxiliary fuel under Part 503. (Instead, the process would be covered by 40 CFR Parts 60 and 61.)

Nonhazardous incinerator ash generated during the firing of biosolids is not covered by the Part 503 rule when it is used or disposed. Instead, it must be disposed according to the solid waste disposal regulations in 40 CFR Part 258;



Biosolids being burned in a biosolids incinerator in Columbus, Ohio.



Biosolids mass is greatly reduced when incinerated, and the residues can be beneficially used (Columbus, Ohio).

however, if the ash is applied to the land or placed on other than a municipal solid waste landfill, the regulations in 40 CFR Part 257 must be followed.

Hazardous wastes are not considered auxiliary fuels under Part 503. Thus, an incinerator that burns hazardous wastes with biosolids is considered a hazardous waste incinerator, not a biosolids incinerator, and is covered by 40 CFR Parts 261 through 268.

Subpart E of the Part 503 rule covers requirements for biosolids incineration, including pollutant limits for seven metals, and limits for total hydrocarbons, general requirements and management practices, frequency of monitoring requirements, and recordkeeping and reporting requirements. These biosolids incineration requirements are discussed in this chapter.

Pollutant Limits for Biosolids Fired in a Biosolids Incinerator

A pollutant limit is the amount of pollutant allowed per unit amount of biosolids before incineration. Subpart E of the Part 503 rule regulates seven metals—arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel. The limits protect human health from the reasonably anticipated harmful effects of these pollutants when biosolids are incinerated. The approaches for determining the limit for each pollutant and for total hydrocarbons are summarized in Table 4-1 and discussed below.

Beryllium and Mercury Pollutant Limits

Levels of beryllium and mercury emitted from a biosolids incinerator must meet the National Emission Standards for Hazardous Air Pollutants (NESHAPs, 40 CFR Part 61).

The NESHAP for beryllium requires that the total quantity of beryllium emitted from each incinerator not exceed 10 grams during any 24-hour period. The NESHAP for beryllium does not apply if written approval has been obtained from the Regional Administrator (1) when the ambient concentration of beryllium in the proximity of the biosolids incinerator does not exceed $0.01 \mu g/m^3$ when averaged over a 30-day period, or (2) if the biosolids incinerator operator can prove (with historical data) that the biosolids fired in the incinerator do not contain beryllium.

The NESHAP for mercury requires that the total quantity of mercury emitted into the atmosphere from all incinerators at a given site does not exceed 3,200 grams during any 24-hour period.

The NESHAP regulations should be consulted for specific requirements except for monitoring frequency, which is shown in Table 4-6.

TABLE 4-1
Summary of Pollutant Limits for Biosolids Incineration

Pollutant	How To Figure Out Pollutant Limits	Determine Dispersion Factor (DF)	Determine Control Efficiency (CE)	Use National Ambient Air Quality Standard (NAAQS)	Use Risk Specific Concen-tration (RSC)	Use Correction Factor for Oxygen	Use Correction Factor for Moisture
Pollutant Limits							
Arsenic	Use equation for arsenic	Yes	Yes	No	Yes	No	No
Beryllium	Use NESHAPs[a]	No	No	No	No	No	No
Cadmium	Use equation for cadmium	Yes	Yes	No	Yes	No	No
Chromium	Use equation for chromium	Yes	Yes	No	Yes	No	No
Lead	Use equation for lead	Yes	Yes	Yes	No	No	No
Mercury	Use NESHAPs[a]	No	No	No	No	No	No
Nickel	Use equation for nickel	Yes	Yes	No	Yes	No	No
Operational Standard							
Total Hydrocarbons or Carbon Monoxide[b]	Limit is 100 ppm_v	No	No	No	No	Yes	Yes

Note: Each of the requirements mentioned (e.g., dispersion factor, NAAQS) is explained in the text.

[a] National Emissions Standards for Hazardous Air Pollutant requirements are summarized in the text.

[b] THC or CO determinations are technology-based standards that in the judgment of EPA protect public health and the environment from the reasonably anticipated adverse effects of organic pollutants in the exit gas of biosolids incinerator.

Control Efficiency, Dispersion Factor, Feed Rate, and Pollutant Limit Calculations for Lead

A person firing biosolids (e.g., the manager of an incineration operation) must determine the pollutant limit for lead in biosolids by using the equation in Figure 4-1. The equation requires determination of certain characteristics of the incineration operation such as control efficiency, the dispersion factor, and the feed rate (see Figure 4-2). The permitting authority can provide

FIGURE 4-1
Equation for Calculating the Pollutant Limit for Lead

The equation for determining the pollutant limit for lead is:

$$C_{lead} = \frac{0.1 \ x \ NAAQS \ x \ 86{,}400}{DF \ x \ (1 - CE) \ x \ SF} \qquad \text{(Eq. 4 of Section 503.43)}$$

Where:

C	=	The pollutant limit (allowable daily concentration of lead in biosolids, in milligrams per kilogram [mg/kg] of total solids, dry-weight basis)
0.1	=	The allowable ground level concentration of lead from biosolids is 10 percent of the NAAQS for lead.
NAAQS	=	National Ambient Air Quality Standard for lead (in micrograms per cubic meter—$\mu g/m^3$) (currently this standard is $1.5 \mu g/m^3$)
DF	=	Dispersion factor (in micrograms per cubic meter per gram per second [$\mu g/m^3/g/sec$]; based on an air dispersion model)
CE	=	Biosolids incinerator control efficiency for lead (in hundredths; based on a performance test)
SF	=	Biosolids feed rate (in dry metric tons per day—dmt/day)
86,400	=	Time conversion factor (number of seconds per day)

Example:

If:

the dispersion factor is 3.4 ($\mu g/m^3/g/sec$)

the control efficiency is 0.916

the biosolids feed rate is 12.86 dmt/day

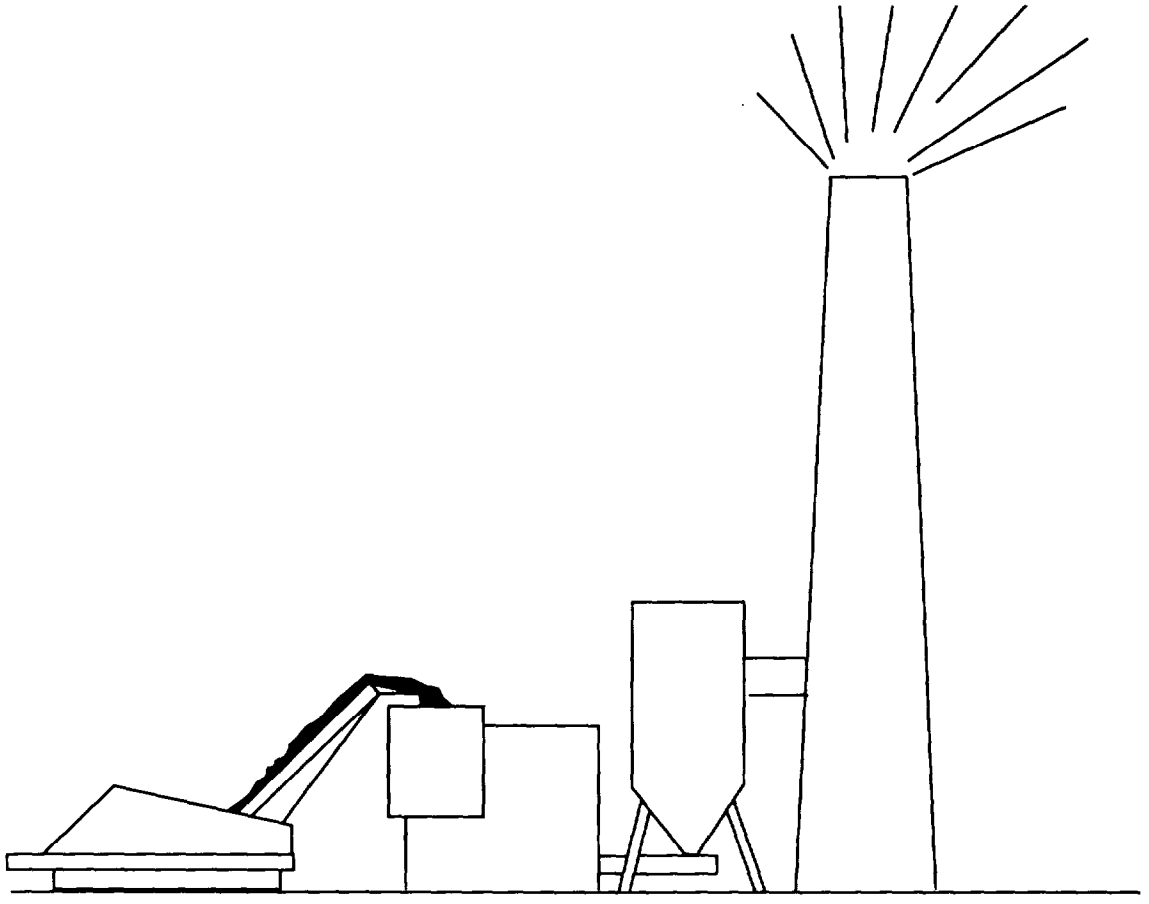
the NAAQS for lead is 1.5 $\mu g/m^3$

Then:

$$C_{lead} = \frac{0.1 \ x \ 1.5 \ \mu g/m^3 \ x \ 86{,}400}{3.4 \ (\mu g/m^3/g/sec) \ x \ (1 - 0.916) \ x \ 12.86 \ dmt/day}$$

$$C_{lead} = 3{,}529 \ mg/kg$$

FIGURE 4-2
Several Factors Affect the Pollutant Limits for Biosolids Fired in an Incinerator



Feed Rate	Control Efficiency	Dispersion Factor
The rate at which biosolids are fed to the incinerator influence the emission of pollutants	The incineration process and the air pollution control devices, if any, remove some pollutants in the biosolids	The surrounding structures and terrain influence how pollutants are dispersed in the air

Individuals at ground level in the surrounding area are exposed to some fraction of the pollutants originally present in biosolids

guidance for developing information about an incinerator's control efficiency and dispersion factor, which are described briefly below:

> ***Control efficiency*** measures the degree to which a biosolids incinerator furnace in conjunction with an air pollution control system, if used, remove a particular pollutant. For example, if a quantity of biosolids fed to an incinerator contains 100 grams of lead, and 1 gram of lead is released from the stack, the incinerator has a 99 percent control efficiency for lead.
>
> A ***dispersion factor*** is the ratio of the increase in the concentration of a pollutant in the air at or beyond the property line of an incinerator site relative to the rate pollutants are emitted from the stack. The dispersion factor is determined through an "air dispersion model," in which particular site conditions are considered, such as type of terrain or adjacent buildings, whether an area is urban or rural, the temperature and velocity of the gas in the incinerator stack, and the emission rate for the pollutant.

Control efficiency is determined through a performance test of the incinerator, as specified by the permitting authority. Generally, the permitting authority will require that the performance test be conducted under conditions that represent normal operating circumstances. The incinerator will be allowed to operate with more flexibility, however, if the performance test covers a broader range of operational parameters. The control efficiency determination is based on the concentrations of regulated metals in the biosolids, the concentrations of regulated metals in the incinerator air emissions, and documentation on the incinerator, as well as APCD operating conditions (e.g., biosolids feed rate, exhaust flow rate, combustion temperature, and biosolids characteristics), during the test.

The permitting authority should be consulted on which air dispersion model to use. Air dispersion models range from simple screening tools to complex computer models. Screening techniques, though inexpensive, tend to be more conservative in their predictions, resulting in higher estimates of pollutants emitted. Complex models require qualified air quality modelers to perform analyses, but result in more accurate estimations. Guidance about the appropriate model(s) to use is provided in ***Guideline on Air Quality Models (Revised)(Appendix W of 40 CFR Part 51)***, U.S. EPA, EPA-450/2-78-027R, August 1993.

Stack height is an important consideration in determining a dispersion factor. For incinerators with stack heights of 65 meters or less, the stack height should be factored into the air dispersion model. For incinerators with stack heights above 65 meters, the stack height measurement used in the air dispersion model is based on "good engineering practices," as presented in another regulation (40 CFR 51.100). Good engineering practices utilize an equation that considers the size of the surrounding buildings to

determine the correct value to use in the model. In general, the higher the stack, the more dispersion occurs.

The incinerator operator usually determines the biosolids feed rate based on the design capacity of the incinerator and the rate at which biosolids are generated and must be disposed. The biosolids feed rate is needed to calculate biosolids pollutant limits in the equations shown in Figures 4-1 and 4-5. Feed rate itself can be determined based on either (see Figure 4-3):

> the average daily design capacity for all biosolids incinerators within a site,
>
> or
>
> the average daily amount of biosolids fired in all incinerators within the property line of a site for the number of days that the incinerator operates during a 365-day period.

Biosolids incinerator operators will have more flexibility if they use the design capacity to calculate the feed rate. This calculation results in stricter pollutant limits than a calculation based on the average amount of biosolids fired daily; however, basing the feed rate on design capacity allows incinerator operators to increase their feed rate from a more typical less-than-design-capacity operation to maximum-design-capacity operation without exceeding the permitted pollutant limits. If, on the other hand, the feed rate in the permit was calculated on the average daily amount of biosolids fired and the operator wished to increase the feed rate, permission generally would have to be obtained from the permitting authority.

Many incinerator facility operators are finding that they are not limited by biosolids pollutant concentrations under the Part 503 rule. Figure 4-4 provides incinerator test data that are typical for most biosolids incineration facilities. The figure shows allowable metal concentration rates that are significantly higher than actual limits. Thus, incinerator operators should not expect to encounter difficulty meeting the more strict pollutant limits that were calculated based on incinerator design capacity.

Often the Part 503 rule requirements can be met for most metals even if control efficiency is low, given the dispersion factors typically found in the field.

Information about **lead** is also required to use the equation in Figure 4-1. Emission standards have been set nationally for several substances. These limits, known as National Ambient Air Quality Standards (NAAQS, 40 CFR 50.12), protect human health and the environment from the possible harmful effects of pollutants in air. The manager of a biosolids incinerator must use the NAAQS for lead in the lead equation. The current NAAQS for lead is 1.5 micrograms per cubic meter ($\mu g/m^3$); if the NAAQS for lead changes in the future, the number used in the equation also must change.

FIGURE 4-3
Examples of Two Methods for Calculating the Biosolids Feed Rate for Use in the Pyollutant Limit Calculations

A site has three incinerators. Their design capacities are as follows:

Unit 1: 100 dry metric tons per day (dmt/day)

Unit 2: 100 dmt/day

Unit 3: 200 dmt/day

Part 503 allows the operator to choose one of two methods to calculate the biosolids feed rate, which is used in the pollutant limit calculations:

Method 1—Design Capacity for All Incinerators

Calculate the total design capacity for all incinerators at the site:

Total capacity = 100 dmt/day + 100 dmt/day + 200 dmt/day = 400 dmt/day

Method 2—Average Daily Feed Rate for All Incinerators

Case 1.

For the first 20 days of the year, unit 1 operated at 50 dmt/day; for the first 100 days of the year, unit 2 operated at 50 dmt/day and unit 3 operated at 100 dmt/day.

Calculate the total amount of biosolids fired in a 365-day period:

Unit 1: 50 dmt/day x 20 days = 1,000 dmt (shut down 345 days)

Unit 2: 50 dmt/day x 100 days = 5,000 dmt (shut down 265 days)

Unit 3: 100 dmt/day x 100 days = 10,000 dmt (shut down 265 days)

Total = 1,000 dmt + 5,000 dmt + 10,000 dmt = 16,000 dmt

Calculate the average daily amount of biosolids fired during the total number of days the incinerators operated during a 365-day period:

$$\text{Average} = \frac{16{,}000 \text{ dmt}}{100 \text{ days}} = 160 \text{ dmt/day (rounded).}$$

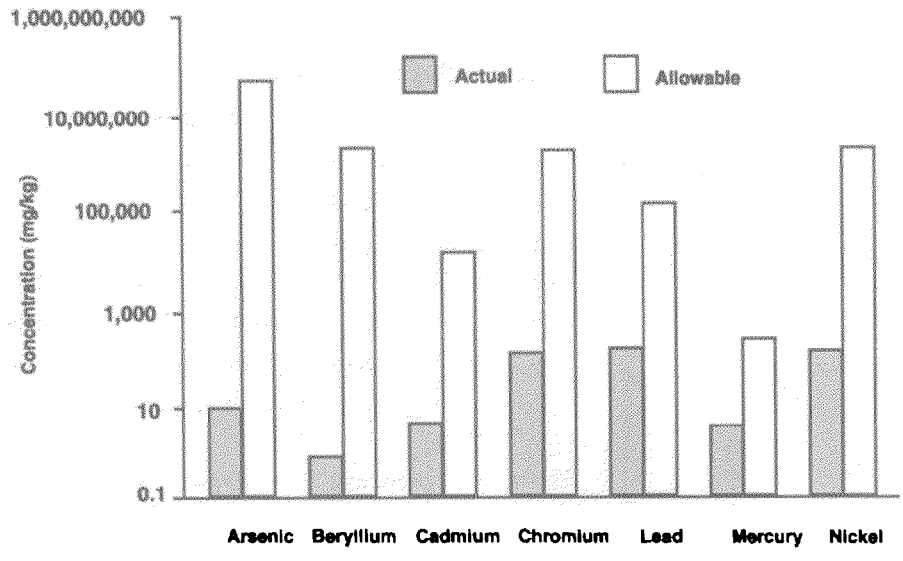
Case 2.

If the incinerators in the above example did not operate at the same time, but instead operated sequentially, the average would be based on the total number of days any incinerator at the site was operated, which is 220 days. In that case, the average daily feed rate would be:

$$\frac{16{,}000 \text{ dmt}}{220 \text{ days}} = 73 \text{ dmt/day (rounded).}$$

For greater flexibility, the operator may want to consider using Method 1 to calculate pollutant limits to have greater latitude in the amount of biosolids fed to the incinerator.

FIGURE 4-4
Allowable vs. Actual Byiosolids Metal Concentrations*



Source: *Meeting the Challenge of Federal 503 Regulations for Sludge Incinerators*, G.P. Van Durme, P.M. Martin, and J.M. Rowan, 1993, Kansas City, MO.

* Data are for one of several sites investigated.

Arsenic, Cadmium, Chromium, and Nickel Pollutant Limits

As with lead, the pollutant limits for arsenic, cadmium, chromium, and nickel in biosolids fired in a biosolids incinerator are calculated using the equation presented in Figure 4-5. Also, the control efficiencies, dispersion factor, and biosolids feed rates must be determined to calculate the limits for these four pollutants. (For an explanation of control efficiency, dispersion factor, and feed rate, see the preceding discussion on the pollutant limit for lead.)

Instead of using a NAAQS, however, as is done for lead, risk specific concentrations (RSCs) are used to calculate limits for arsenic, cadmium, chromium, and nickel. RSCs, which are based on human health concerns, represent the allowable increase in the average daily ground-level ambient air concentrations of pollutants at or beyond the property line of the site where the biosolids incinerator is located. RSCs for arsenic, cadmium, and nickel are listed in Table 4-2.

In contrast, the RSC for chromium is based on either (1) the type of incinerator used, or (2) analytical sampling and an equation (see Table 4-3). The analysis involves sampling stack gas to determine the ratio of hexavalent chromium to total chromium analytes. In lieu of testing,

FIGURE 4-5
Equation for Calculating the Pollutant Limits for Arsenic, Cadmium, Chromium, and Nickel

The equation for determining the pollutant limits for arsenic, cadmium, chromium, and nickel is:

$$C = RSC \times \frac{86{,}400}{DF \times (1 - CE) \times SF} \qquad \text{(Eq. 5 of Section 503.43)}$$

Where:

C	=	The pollutant limit (allowable daily concentration of arsenic, cadmium, chromium, or nickel in milligrams per kilogram [mg/kg] of total solids, dry-weight basis)
RSC	=	Risk specific concentration (the allowable increase in the average daily ground-level ambient air concentration for a pollutant at or beyond the property line of the site in micrograms per cubic meter [$\mu g/m^3$] [from Table 4-2 or Table 4-3])
86,400	=	Conversion factor (seconds per day)
DF	=	Dispersion factor (in micrograms per cubic meter per gram per second [$\mu g/m^3/g/sec$]; based on an air dispersion model)
CE	=	Control efficiency for arsenic, cadmium, chromium, or nickel (in hundredths; based on a performance test)
SF	=	Biosolids feed rate (in dry metric tons per day [dmt/day])

Example for Arsenic:

If:

the RSC is 0.023 $\mu g/m^3$

the dispersion factor is 3.4 $\mu g/m^3/g/sec$

the control efficiency is 0.975

the biosolids feed rate is 12.86 dmt/day

Then:

$$C_{arsenic} = \frac{0.023\ g/m^3 \times 86{,}400}{3.4\ (\mu g/m^3/g/sec) \times (1 - 0.975) \times 12.86\ dmt/day}$$

$$C_{arsenic} = 1{,}818\ mg/kg$$

If the dispersion factor were 0.6 instead of 3.4 $\mu g/m^3/g/sec$, then the allowable concentration for arsenic would be 3.4/0.6, or 5.667 times greater at 10,300 mg/kg.

TABLE 4-2
Risk Specific Concentrations for Arsenic, Cadmium, and Nickel

Pollutant	Risk Specific Concentrations (RSC) (micrograms per cubic meters)
Arsenic	0.023
Cadmium	0.057
Nickel	2.0

Source: Table 1 of Section 503.43.

incinerator operators can use the values given in Table 4-3, which are based on incinerator type.

Limit Exceedance

If measurements in biosolids for beryllium and mercury (where required) and lead, arsenic, cadmium, chromium, or nickel are higher than the pollutant limits derived as discussed above, the biosolids incinerator will be "in violation" until adjustments are made that allow the limits to be met. Such adjustments include, but are not limited to, improvements in biosolids quality through pretreatment efforts, reduction in the biosolids feed rate, or improved furnace operations and/or the addition of APCDs to improve the control efficiency. Better control efficiency will allow higher pollutant limits. If significant furnace or APCD improvements are made, however, the performance test must be repeated. Then the approved operating conditions under which emissions were in compliance during the performance test must be maintained whenever the incinerator is operating.

Total Hydrocarbons

Organic compounds that are emitted as a result of incomplete combustion or the generation of combustion byproducts (e.g., benzene, phenol, vinyl chloride) can be present in biosolids incinerator emissions. Because these compounds can be harmful to the public health, the Part 503 rule regulates the emission of organic pollutants from biosolids incinerators through an operational standard that limits the amount of total hydrocarbons (THC)—or carbon monoxide (CO)—allowed in stack gas. The Part 503 rule as amended is structured to use THC or CO to represent all organic compounds, as discussed below.

TABLE 4-3
Risk Specific Concentration To Use When Calculating the Pollutant Limit for Chromium

For the equation in Figure 4-5, use RSC from either option 1 (based on type of incinerator) or option 2 (derived from the equation below), as specified by the permitting authority.

Option 1: RSC From Table 2 of Section 503.43

Type of Incinerator	RSC (micrograms per cubic meter)
Fluidized bed with wet scrubber	0.65
Fluidized bed with wet scrubber and wet electrostatic precipitator	0.23
Other types with wet scrubber	0.064
Other types with wet scrubber and wet electrostatic precipitator	0.016

or

Option 2 Equation: RSC Using Equation 6 of Section 503.43

$$RSC = \frac{0.0085}{r}$$

Where:

r = The decimal fraction of the hexavalent chromium concentration in the total chromium concentration measured in the exit gas from the biosolids incinerator stack in hundredths. This is an analytical measurement based on an average of representative samples.

Delay and Stay of Requirements for Total Hydrocarbon Measurement

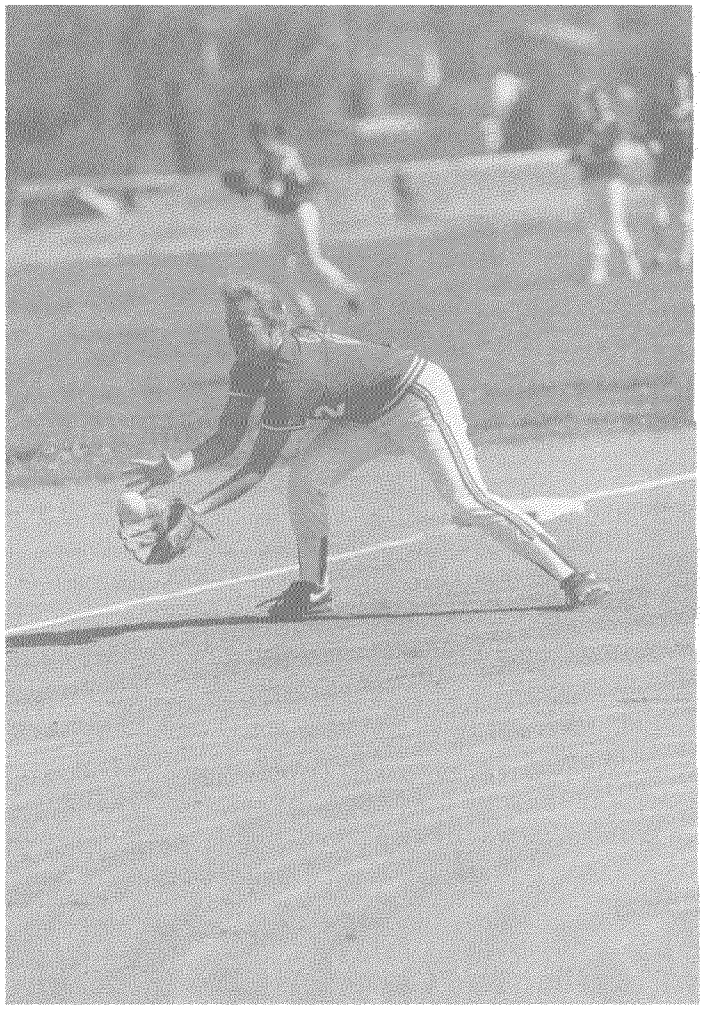
According to a recent amendment of the Part 503 rule, for incinerators not exceeding 100 ppm_v (parts per million, volume basis) of CO in the exhaust gas, EPA will allow continuous CO monitoring as a surrogate for THC monitoring. Moreover, EPA has determined that operators of biosolids incinerators will not have to monitor for THC or CO until either a permit has been issued or other Federal action has been taken, such as *Federal Register* notification, even if issuance does not occur until after February 19, 1995.

Total Hydrocarbon and Carbon Monoxide Measurement

The THC concentration (or CO) is used to represent all organic compounds in the exit gas covered by the Part 503 rule. EPA does not require that

biosolids themselves be monitored for THC (or CO), as is required for metals (see discussions above on pollutant limits for beryllium and mercury, lead, and arsenic, cadmium, chromium, and nickel). Instead, the stack gas must be monitored for THC (or CO) because organic pollutants could be present due to incomplete combustion of organic compounds or the generation of byproducts of combustion.

The Part 503 rule allows a monthly average concentration of up to 100 ppm_v of THC (or CO) in the stack gas. Thus, an incineration facility operator firing biosolids must continuously monitor THC (or CO) levels in the stack gas to ensure that the monthly average concentration of THC (or CO) is at or below the limit. The monthly average THC (or CO) concentration is the arithmetic mean of the hourly averages; the hourly averages must be calculated based on at least two readings taken each hour that the incinerator operates in a day (i.e., in a 24-hour period).



Residue from biosolids incineration is used as water-absorbent surface material on ballfields in Columbus, Ohio.

THC (or CO) must be measured using a flame ionization detector with a sampling line heated to 150°C or higher. The THC (or CO) concentration measurement taken from the stack must be corrected for moisture content and oxygen (as described below) before being compared to the 100 ppm_v limit.

The Agency will be issuing separate guidance on the procedures for the analysis, installation, calibration, and maintenance of THC (or CO) continuous emissions monitoring (CEM) systems.

Correction for 0 Percent Moisture

The THC (or CO) concentration in the stack gas must be corrected for 0 percent moisture, using the first equation in Figure 4-6. This correction is required so that all THC (or CO) emissions can be evaluated on a standardized basis. Once the correction factor for moisture is known, the original THC (or CO) concentration must be multiplied by this correction factor.

Correction to 7 Percent Oxygen

The THC (or CO) concentration in the stack exit gas also must be corrected to 7 percent oxygen, using the second equation in Figure 4-6. This correction is required so that all THC (or CO) emissions can be evaluated on a standardized basis. Seven percent oxygen was chosen as the standard correction because this amount of oxygen, which is representative of 50 percent excess air, is frequently used for operational and measurement purposes. Once the correction factor for oxygen is known, the THC (or CO) concentration (which has already been corrected for moisture) must be multiplied by this value.

After being corrected to 7 percent oxygen and for 0 percent moisture, the THC (or CO) concentration may not be above 100 ppm_v on a monthly average basis. If the monthly average THC (or CO) concentration in the stack gas measures above 100 ppm_v, the biosolids incinerator is in violation until adjustments are made to meet the limits. These adjustments can include more careful control of furnace operations (and improvements of other procedures, if necessary) to reduce the amount of THC (or CO) released from the stack.

Management Practices for Biosolids Incineration

The management practices for biosolids incineration in the Part 503 rule cover:

- instrument operation and maintenance;
- temperature requirements;

FIGURE 4-6
Equations for Determining Correction Factors for 0 Percent Moisture and to 7 Percent Oxygen for Total Hydrocarbons or Carbon Monoxide (CO)

For the examples below, assume that the original THC (or CO monthly average) is 40 ppm_v .

(1) 0 Percent Moisture

The equation for correcting the THC (or CO) measurement for 0 percent moisture is:

$$\text{Correction factor} = \frac{1}{(1 - X)} \qquad \text{(Eq. 7 of Section 503.44)}$$

Where:

X = The decimal fraction of the percent moisture in the biosolids incinerator exit gas in hundredths

Example:

If:

X = 0.12

Then:

$$\text{Correction factor for moisture} = \frac{1}{1 - 0.12}$$

Correction factor for moisture = 1.14

Multiply the original THC (or CO) measurement (in this case, 40 ppm_v) by the correction factor for moisture:

40 ppm_v x 1.14 = 45.6 ppm_v

THC (or CO) concentration corrected for 0 percent moisture: 45.6 ppm_v

(2) 7 Percent Oxygen:

The equation for correcting the THC (or CO) measurement to 7 percent oxygen is:

$$\text{Correction factor for oxygen} = \frac{14}{(21 - Y)} \qquad \text{(Eq. 8 of section 503.44)}$$

Where:

14 = The difference between the percent oxygen in air (21 percent) and 7 percent oxygen

21 = The percent of oxygen in air

Y = The percent oxygen concentration in the biosolids incinerator stack exit gas (dry volume/dry volume)

FIGURE 4-6 (continued)
Equations for Determining Correction Factors for 0 Percent Moisture and to 7 Percent Oxygen for Total Hydrocarbons or Carbon Monoxide (CO)

Example:

If:

Y = 10 percent

Then:

$$\text{Correction factor for oxygen} = \frac{14}{(21 - 10)} = 1.27$$

Finally, multiply the THC or CO monthly average concentration (already corrected for moisture) by the correction factor for oxygen:

45.6 ppm_v x 1.27 = 58 ppm_v (rounded)

Therefore:

The THC or CO monthly average concentration in this example corrected for 0 percent moisture and to 7 percent oxygen is 58 ppm_v

operation of air pollution control devices; and

protection of threatened or endangered species.

All but the last of these management practices are necessary to ensure that the limits set for arsenic, beryllium, cadmium, chromium, lead, mercury, nickel, and THC (or CO) (see preceding discussions) are met. The required management practices are described in Figure 4-7 and discussed further below.

Instrument Operation and Maintenance

Biosolids incinerator operators must use instruments to continuously measure and record certain information, including:

THC (or CO) in the stack exit gas;

oxygen in the stack exit gas;

information used to calculate moisture content in the stack exit gas; and

combustion temperature in the furnace.

Each of the instruments used for these measurements must be installed, calibrated, operated, and maintained according to guidance provided by the permitting authority. Examples of such instruments include extractive or in situ oxygen analyzers, thermocouples to measure the temperature of a saturated stream and combustion temperature, and dewpoint detectors

FIGURE 4-7
Management Practices for Incineration of Biosolids

Instruments must be used that continuously measure and record THC (or CO) concentrations, oxygen levels, and information needed to calculate moisture content in the stack exit gas, and combustion temperature in the furnace.

These instruments must be installed, calibrated, operated, and maintained according to guidance provided by the permitting authority. Calibration procedures are specified in the Agency's new CEM guidance.

The instrument used for THC (or CO) measurements must:

— use a flame ionization detector;

— have a sampling line heated to 150°C or higher at all times; and

— be calibrated at least once every 24-hour operating period using propane.

The incinerator can be operated within the range of operating conditions set during the performance test and allowed in the permit but it must not be operated above the maximum combustion temperature set by the permitting authority based on performance test conditions.

Conditions for operating the air pollution control devices must be followed; these conditions are also set by the permitting authority based on performance test conditions.

Biosolids may not be incinerated if incineration of biosolids is likely to negatively affect a threatened or endangered species or its critical habitat as listed in Section 4 of the Endangered Species Act. ***Critical habitat*** is any place where a threatened or endangered species lives and grows during any stage of its life cycle.

(known as wet bulb/dry bulb detectors) to obtain information used to determine moisture content.

In addition, the instrument used for THC (or CO) measurements must:

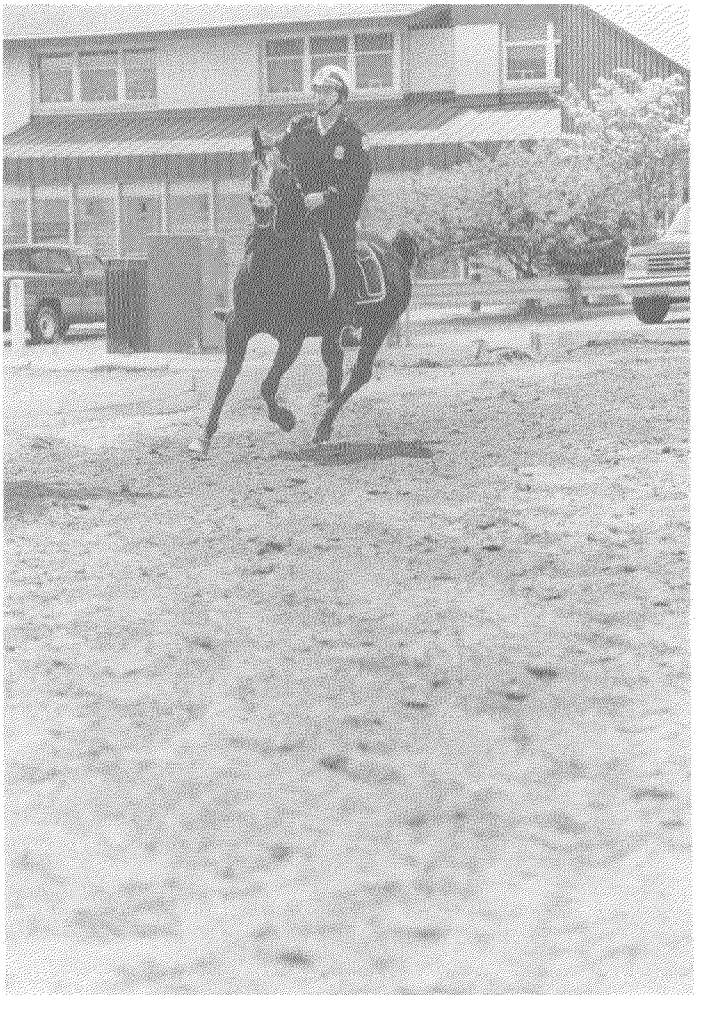
utilize a flame ionization detector;

utilize a sampling line heated to 150°C or higher at all times; and

be calibrated using propane at least once every 24-hour operating period.

Temperature Requirements

The maximum combustion temperature allowed in the incinerator furnace is set by the permitting authority based on performance test data. A limit on combustion temperature is necessary to ensure that the incinerator is operating as it did during the performance test. If biosolids are incinerated at higher temperatures than the allowed maximum temperature, the control efficiency could change and the concentration of metals in the stack gas



Biosolids incinerator ash, called flume sand, is beneficially used as a water-absorbent surface for a horse arena in Columbus, Ohio.

could increase. The incinerator would then be out of compliance until operated below the maximum allowed temperature or until shown to be in compliance with a new set of pollutant limits calculated using control efficiencies relevant to the new set of operating conditions.

Air Pollution Control Devices

Conditions for operating air pollution control devices are determined by the permitting authority from the performance test. These conditions (e.g., gas flow rate and gas temperature) ensure that the APCDs are operating as efficiently as possible. If they are not operating properly, the control efficiency could change, which would affect the ability to meet pollutant limits. Therefore, these values must be within the range established during the performance test. Examples of operating parameters for APCDs that the permitting authority might set are shown in Table 4-4.

TABLE 4-4
Operating Parameters for Air Pollution Control Devices

Based on the results of the performance test, the permitting authority sets permit conditions for certain operating parameters of the APCDs. Examples of important operating parameters are listed below:

Operating Parameter	Air Pollution Control Device	Example Measuring Instrument
Pressure drop	Venturi scrubber, impingement scrubber, mist eliminator,* fabric filter	Differential pressure gauge/transmitter
Liquid flow rate(s)	Venturi scrubber, impingement scrubber, mist eliminator, wet electrostatic precipitator (ESP)	Orifice plate with differential pressure gauge/transmitter
Gas temperature (inlet and/or outlet)	Venturi scrubber, impingement scrubber, dry scrubber, fabric filter, wet ESP	Thermocouple/transmitter
Liquid/reagent flow rate to atomizer	Dry scrubber (spray dryer absorber)	Magnetic flow meter
pH of liquid/reagent to atomizer	Dry scrubber (spray dryer absorber)	pH meter/transmitter
Atomized motor power (for rotary atomizer)	Dry scrubber (spray dryer absorber)	Wattmeter
Compressed air pressure (for dual fluid flow)	Dry scrubber (spray dryer absorber)	Pressure gauge
Compressed airflow rate	Dry scrubber (spray dryer absorber)	Orifice plate with differential pressure gauge/transmitter
Opacity	Fabric filter	Transmissometer
Secondary voltage (for each transformer/rectifier)	Wet ESP	Kilovolt meters/transmitter
Secondary currents (for each transformer/rectifier)	Wet ESP	Milliammeters/transmitter

*Types of mist eliminators include the wet cyclone, vane demister, chevron demister, and mesh pad.

Protection of Threatened or Endangered Species

The final management practice for biosolids incinerators in the Part 503 rule does not allow biosolids to be incinerated if a threatened or endangered animal or plant species or its "critical habitat" is likely to be adversely affected. Threatened and endangered species are listed in the Endangered Species Act. (The Threatened and Endangered Species List can be obtained from the U.S. Fish and Wildlife Service's [FWS's] Publications Office by calling 703-358-1711.)

Critical habitat is defined as any place where a threatened or endangered species lives and grows during any stage of its life cycle. Any direct or indirect action (or the result of any direct or indirect action) in a critical habitat that diminishes the likelihood of survival and recovery of a listed species is considered destruction or adverse modification of a critical habitat. Individuals may contact the Endangered Species Protection Program in Washington, DC, (703-358-2171) or the FWS Field Offices listed in Appendix C for more information about threatened and endangered species in their area. State departments governing fish and wildlife also should be contacted for specific State requirements.

Frequency of Monitoring Requirements for Biosolids Incineration

The person firing biosolids in a biosolids incinerator must monitor at specified intervals for certain metals in the biosolids; for the THC (or CO) concentration, oxygen content, and information needed to determine moisture in the stack exit gas; for combustion temperature in the furnace; and for certain conditions of air pollution control device operation. Representative samples of biosolids and stack gas must be collected and analyzed using the methods listed in the Part 503 rule. These monitoring requirements are summarized in Table 4-5 and are discussed below.

TABLE 4-5
Monitoring Requirements for Biosolids Incineration

Must monitor:
concentration of metals (arsenic, cadmium, chromium, lead, mercury, and nickel) in biosolids
concentration of beryllium in the stack gas, unless the permitting authority approves a biosolids method
concentration of THC (or CO) in stack exit gas
oxygen concentration in stack exit gas
information needed to determine moisture content in stack exit gas
combustion temperature in the furnace
operating conditions of air pollution control devices (conditions are set by the permitting authority based on performance test data)
biosolids feed rate

Monitoring for Metals

Biosolids must be monitored for the concentration of metals for which pollutant limits have been set, including arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel. The permitting authority will determine how often the facility operator must monitor for beryllium and mercury. For the other metals (arsenic, cadmium, chromium, lead, and nickel), the minimum frequency for monitoring is based on the amount of biosolids incinerated (see Table 4-6). The greater the amount of biosolids incinerated, the more frequently metals must be monitored.

Continuous Monitoring

As shown in Table 4-6, certain monitoring must be done continuously. Continuous monitoring is required for THC (or CO) concentrations, oxygen

TABLE 4-6
Monitoring Frequency for Biosolids Incinerators

Pollutant/Parameter	Amount of Biosolids Fired (metric tons per 365-day period, dry-weight basis)	Must Monitor at Least
Arsenic, cadmium, chromium, lead, and nickel in biosolids	Greater than zero but less than 290	Once per year
	Equal to or greater than 290 but less than 1,500	Once per quarter (four times per year)
	Equal to or greater than 1,500 but less than 15,000	Once per 60 days (six times per year)
	Equal to or greater than 15,000	Once per month (12 times per year)
Beryllium and mercury in biosolids or stack exit gas	NA	As often as permitting authority requires
THC (or CO) concentration in stack exit gas	NA	Continuously; monthly averages reported, which is the arithmetic mean of hourly averages that include at least 2 readings per hour.
Oxygen concentration in stack exit gas	NA	Continuously
Information needed to determine moisture content in stack exit gas	NA	Continuously
Combustion temperature in furnace	NA	Continuously
Air pollution control device conditions	NA	As often as permitting authority requires

levels, and information used to calculate moisture content in the stack exit gas. Continuous monitoring also is required for combustion temperature in the furnace. Because monitors operating continuously require a certain amount of downtime for periodic calibrating and maintenance, the person operating the incinerator should consult the EPA's THC (or CO) CEM guidance to determine how much downtime is acceptable.

Monitoring Conditions in Air Pollution Control Devices

Certain operating conditions must be monitored in air pollution control devices, as discussed above. The specific conditions that must be monitored are based on the type of APCDs in place and the operating parameters that are important for maintaining the control efficiency demonstrated in the performance test. The ultimate monitoring frequency for APCDs will be specified in the permit.

Recordkeeping Requirements for Biosolids Incineration

The person who incinerates biosolids must develop and keep certain records for a minimum of 5 years. The recordkeeping requirements, which are listed in Table 4-7, include information on the pollutant limits, management practices, and monitoring requirements.

Reporting Requirements for Biosolids Incineration

All Class 1 treatment works, treatment works serving a population of 10,000 or more, and treatment works with a 1 mgd or greater design flow, as described in the first chapter of this guidance, have to report the type of information contained in Table 4-7 every February 19th to the permitting authority.

TABLE 4-7
Recordkeeping Requirements for Biosolids Incineration

Records related to pollutant limits for metals:

- concentrations of arsenic, cadmium, chromium, lead, and nickel in biosolids fed to the incinerator
- information showing how the requirements for beryllium and mercury in the NESHAPs are being met, if applicable
- biosolids feed rate (for each incinerator, dry-weight basis)
- stack height
- dispersion factor
- control efficiency for arsenic, cadmium, chromium, lead, and nickel (for each incinerator)
- RSC for chromium (calculated using the equation in Table 4-3, if applicable)

Records related to the THC (or CO) limit:

- THC (or CO) monthly average concentrations in the stack exit gas
- oxygen concentration in the stack exit gas
- information used to measure moisture content in the stack exit gas

Records related to management practices and monitoring requirements:

- combustion temperatures, including maximum daily combustion temperature, in the furnace
- measurements for required air pollution control device operating conditions
- calibration and maintenance log for instruments used to measure:
  - — THC (or CO) levels in stack exit gas
  - — oxygen levels in stack exit gas
  - — moisture content in stack exit gas
  - — combustion temperatures in furnace

Common Questions and Answers

***Q*: Incinerator manufacturers have indicated that 15 months is necessary for the delivery of equipment. Add time for design, bid, agency review, and construction, and the total time for new construction could be close to 30 months. Are incinerators going to be penalized for actions beyond their control?**

A: The Clean Water Act allows 2 years for an incinerator owner/operator to attain compliance where construction of new pollution control facilities is required to meet Part 503 requirements. The permitting authority has no authority to extend this time frame. Incinerators that are not in compliance at the end of the 2-year period will be in violation. Given the reality of such situations, however, the permitting authority may choose to put the incinerator under an enforceable compliance order that includes a schedule for coming into compliance.

***Q*: What percent of incinerators currently can meet the 100-ppm_v THC (or CO) operational standard?**

A: EPA estimates that 60 to 70 percent of multiple-hearth furnaces and all fluidized-bed incinerators can meet this operational standard. Some incinerator owner/operators may have to add afterburners or improve their operations.

***Q*: Is EPA planning to provide any training on how to measure THC (or CO)?**

A: The THC (and CO) equipment manufacturers are willing to provide such training. EPA does not have any plans to provide it beyond its CEM guidance.

***Q*: What does a THC (or CO) monitoring system cost?**

A: EPA has estimates, from some of the equipment manufacturers, of $150,000 to $750,000 for the complete package, which incudes the monitor, the computer, and the oxygen and moisture measuring instruments (including installation).

***Q*: If new construction is required to meet the THC (or CO) limit (e.g., an afterburner), can monitoring and modeling for the dispersion factor be delayed until after construction is completed?**

A: The Clean Water Act allows 2 years for an incinerator owner/operator to attain compliance where construction of new pollution control facilities is required to meet Part 503 requirements. The 2-year period,

however, generally pertains only to requirements for which construction is required—in this case THC (or CO) limits. The permitting authority has some flexibility to work with owner/operators whose facilities are undergoing construction, but the permitting authority cannot extend the compliance dates. One option would be to put the incinerator under a compliance order to install the necessary equipment and have the owner/operator perform the necessary modeling after the installation.

Q: If a facility has multiple incinerator units that share one stack, how many THC (or CO) monitoring devices are required?

A: If physically permissible, only one monitoring system would be necessary. However, such factors as length of run for the sample tubing and the nature of the sensing device can have a significant influence on the determination. Furthermore, some of the analytical determinations that must accompany the THC (or CO) measurements, such as those concerning moisture and temperature, may require separate instrumentation for each stack.

Chapter 5

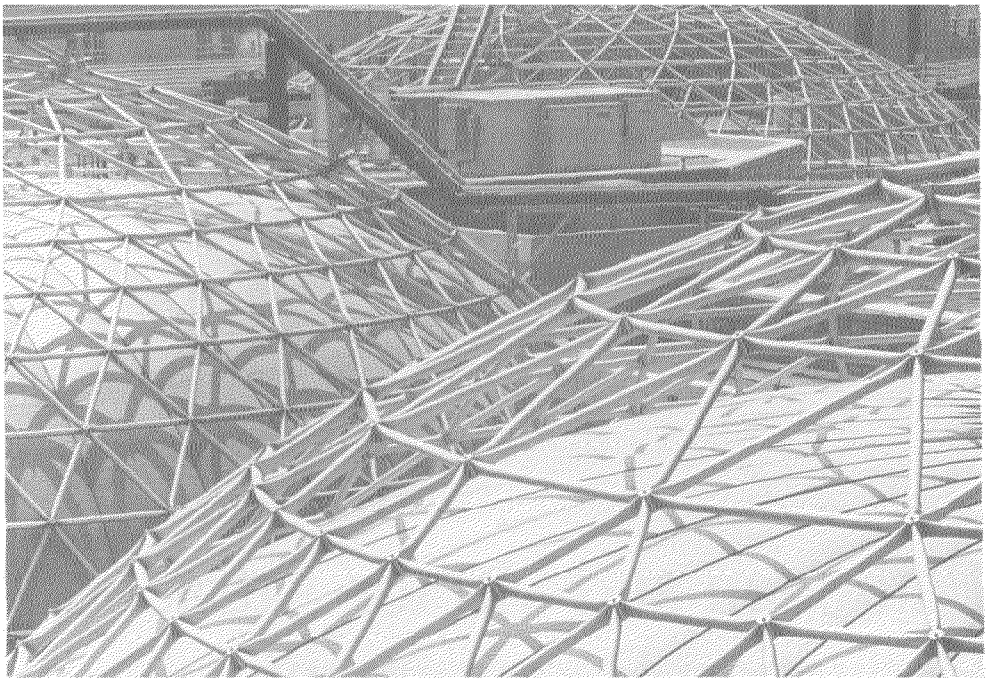
Pathogen and Vector Attraction Reduction Requirements

Why Are There Pathogen and Vector Attraction Reduction Requirements?

Pathogens are disease-causing organisms, such as certain bacteria, viruses, and parasites. Vectors are organisms, such as rodents and insects, that can spread disease by carrying and transferring pathogens. Subpart D of the Part 503 rule covers alternatives for reducing pathogens in biosolids (including domestic septage), as well as options for reducing the potential for biosolids to attract vectors.

The Subpart D alternatives concern the designation of biosolids as "Class A" or "Class B" in regard to pathogens. These classifications indicate the density (numbers/unit mass) of pathogens in biosolids where applicable. The requirements for land application or surface disposal of biosolids vary depending on the class of pathogen reduction achieved. Biosolids have to meet applicable requirements for both pathogen and vector attraction reduction to be in compliance with the rule.

This chapter describes the pathogen alternatives and vector attraction reduction options in the Part 503 rule. For more detail, the reader is referred to an EPA publication entitled, ***Control of Pathogens and Vector Attraction in Sewage Sludge*** (EPA/625/R-92/013), December 1992.



Anaerobic digesters in Columbus, Ohio, reduce pathogens and vector attraction to produce Class B biosolids.

To Whom Do These Requirements Apply?

The pathogen and vector attraction reduction requirements in Subpart D of the Part 503 rule apply to biosolids, including domestic septage, and their application to or placement on the land for beneficial use or disposal. Domestic septage applied to nonpublic contact sites (i.e., agricultural land, forests, and reclamation sites) is covered by a simplified portion of the rule that is explained in a separate EPA guidance document (***Domestic Septage Regulatory Guidance: A Guide to the EPA 503 Rule***, EPA/832-B-92-005).

Depending on how biosolids are used or disposed and which pathogen alternative and vector attraction reduction option are relied on, compliance with the pathogen and vector attraction requirements of Subpart D is the responsibility of persons who:

- generate biosolids that are either land applied or surface disposed;
- derive a material from biosolids that are either land applied or surface disposed;
- apply biosolids to the land;
- place biosolids on a surface disposal site; and
- own or operate a surface disposal site.

Pathogen Reduction Alternatives

The Part 503 pathogen reduction alternatives ensure that pathogen levels in biosolids are reduced to levels considered safe for the biosolids to be land applied or surface disposed. Subpart D includes criteria to classify biosolids as Class A or Class B with respect to pathogens. These classifications are based on the level of pathogens present in biosolids that are used or disposed.

If pathogens (*Salmonella* sp. bacteria, enteric viruses, and viable helminth ova) are below detectable levels, the biosolids meet the Class A designation. Biosolids are designated Class B if pathogens are detectable but have been reduced to levels that do not pose a threat to public health and the environment as long as actions are taken to prevent exposure to the biosolids after their use or disposal. When Class B biosolids are land applied, certain restrictions must be met at the application site; other requirements have to be met when Class B biosolids are surface disposed. The land application restrictions allow natural processes to further reduce pathogens in the biosolids before the public has access to the site. In general, Class A corresponds to the existing 40 CFR Part 257 "Process to Further Reduce Pathogens (PFRP)" designation, and Class B roughly corresponds to the existing 40 CFR Part 257 "Process to Significantly Reduce Pathogens (PSRP)" designation. There are several important differences in approach between the existing Part 257 and the new Part 503 requirements for pathogen and vector attraction reduction:

1 Whereas Part 257 required the use of specifically listed or approved treatment technologies to treat biosolids, the Part 503 rule provides flexibility in how the pathogen and vector attraction reduction requirements are met. The pathogen reduction requirements of the Part 503 rule can be met either by:

—using certain specified technologies to treat the biosolids as before, or

—showing that the quality of the biosolids meets certain performance results.

2 The Part 503 rule requires either pathogen or pathogen indicator measurements for all Class A alternatives and pathogen indicator measurements for the first of the three Class B alternatives.

3 The Part 503 rule separates pathogen reduction requirements from vector attraction reduction requirements, as follows:

—The Class A and B designations refer only to the reductions achieved in pathogens.

—Vector attraction reduction is governed by a separate set of requirements described in a later section of this chapter.

—There is, however, still a requirement that both pathogen and vector attraction reduction requirements be met, and for Class A biosolids the pathogen reduction requirements must be met before or at the same time as most of the vector attraction reduction requirements, thereby minimizing the potential for regrowth of pathogenic bacteria.

Class A Pathogen Requirements

The Part 503 rule lists six alternatives for treating biosolids so they can be classified Class A with respect to pathogens. These alternatives are summarized in Table 5-1 and are discussed in detail below. Any one of these six alternatives may be met for the biosolids to be deemed Class A. Two of these alternatives follow closely with 40 CFR Part 257 pathogen requirements by allowing use of PFRPs and equivalent technologies.

TABLE 5-1
Summary of the Six Alternatives for Meeting Class A Pathogen Requirements

In addition to meeting the requirements in one of the six alternatives listed below, the requirements in Table 5-2 must be met for all six Class A alternatives.

Alternative 1: Thermally Treated Biosolids

Biosolids must be subjected to one of four time-temperature regimes.

Alternative 2: Biosolids Treated in a High pH-High Temperature Process

Biosolids must meet specific pH, temperature, and air-drying requirements.

Alternative 3: Biosolids Treated in Other Processes

Demonstrate that the process can reduce enteric viruses and viable helminth ova. Maintain operating conditions used in the demonstration after pathogen reduction demonstration is completed.

Alternative 4: Biosolids Treated in Unknown Processes

Biosolids must be tested for pathogens—*Salmonella* sp. or fecal coliform bacteria, enteric viruses, and viable helminth ova—at the time the biosolids are used or disposed, or, in certain situations, prepared for use or disposal.

Alternative 5: Biosolids Treated in a PFRP

Biosolids must be treated in one of the Processes to Further Reduce Pathogens (PFRP) (see Table 5-4).

Alternative 6: Biosolids Treated in a Process Equivalent to a PFRP

Biosolids must be treated in a process equivalent to one of the PFRPs, as determined by the permitting authority.

Table 5-2 lists several requirements that must be met for all six of the Class A alternatives. Perhaps the most significant of the requirements is to avoid regrowth of bacteria as indicated by the results of a fecal coliform or *Salmonella* test.

Alternative 1 for Meeting Class A: Thermally Treated Biosolids

This alternative applies when specific thermal heating procedures are used to reduce pathogens. Equations are used to determine the length of heating time at a given temperature needed to obtain Class A pathogen reduction (i.e., reduce the pathogen content to below detectable levels). The equations take into consideration the solid-liquid nature of the biosolids being heated, along with the particle size and how particles are brought into contact with the heat. The equations also take into consideration that the internal structure of the mixture can inhibit mixing. For example, a safety factor is included in the equation for Regime C (see Table 5-3) that adds more time for heating because less information is available about operational parameters that could influence the degree of pathogen destruction per unit of heat input. The rule identifies and provides equations for four different acceptable heating regimes.

The minimum indicated boundary conditions (i.e., solids content, mixing with the heat source, time of heating, and operating temperature) are given

TABLE 5-2
Pathogen Requirements for All Class A Alternatives

The following requirements must be met for ***all*** six Class A pathogen alternatives.

Either:

the density of fecal coliform in the biosolids must be less than 1,000 most probable numbers (MPN) per gram total solids (dry-weight basis),

or

the density of *Salmonella* sp. bacteria in the biosolids must be less than 3 MPN per 4 grams of total solids (dry-weight basis).

Either of these requirements must be met at one of the following times:

- when the biosolids are used or disposed;
- when the biosolids are prepared for sale or give-away in a bag or other container for land application; or
- when the biosolids or derived materials are prepared to meet the requirements for EQ biosolids (see Chapter 2).

Pathogen reduction must take place before or at the same time as vector attraction reduction, except when the pH adjustment, percent solids vector attraction, injection, or incorporation options are met.

below for each of the four thermal heating regimes. Any one of these four thermal heating regimes may be used. The equation specified for a particular heating regime is then used to calculate the actual time and temperature for operating the system within the boundaries of the applicable regime. In addition to the requirements for each regime, the requirements in Table 5-2 must be met.

The four regimes are listed in Table 5-3; some example calculations follow.

Example 1: Biosolids contain 10 percent solids and are heated with a biosolids dryer at 55°C. What is the required minimum time for achieving Class A pathogen status? The minimum time would be 63 hours if the operator followed Regime A in Table 5-3. Under Regime A the temperature cannot be lower than 50°C or the time shorter than 20 minutes.

$$Time = \frac{131{,}700{,}000}{10^{0.14\,(temperature)}} = \frac{131{,}700{,}000}{10^{0.14\,(55)}} = \frac{131{,}700{,}000}{50{,}118{,}723} = 2.6\ days\ [63\ hours]$$

TABLE 5-3
The Four Time-Temperature Regimes for Class A Pathogen Reduction Under Alternative 1

Regime	Applies to:	Requirement	Time-Temperature Relationship*
A	Biosolids with 7% solids or greater (except those covered by Regime B)	Temperature of biosolids must be 50°C or higher for 20 minutes or longer	$D = \frac{131{,}700{,}000}{10^{0.14t}}$ (Equation 2 of Section 503.32)
B	Biosolids with 7% solids or greater in the form of small particles and heated by contact with either warmed gases or an immiscible liquid	Temperature of biosolids must be 50°C or higher for 15 seconds or longer	$D = \frac{131{,}700{,}000}{10^{0.14t}}$
C	Biosolids with less than 7% solids	Heated for at least 15 seconds but less than 30 minutes	$D = \frac{131{,}700{,}000}{10^{0.14t}}$
D	Biosolids with less than 7% solids	Temperature of sludge is 50°C or higher with at least 30 minutes or longer contact time	$D = \frac{50{,}070{,}000}{10^{0.14t}}$ (Equation 3 of Section 503.32)

* D = time in days; t = temperature in degrees Celsius.

Example 2: Biosolids contain 10 percent solids and are treated in a biosolids dryer for about 1.5 minutes (0.001 day). What is the required minimum temperature? The minimum temperature to achieve Class A pathogen status would be 79°C if the operator followed Regime B in Table 5-3. Under this regime, the temperature cannot be lower than 50°C or the time shorter than 15 seconds and the biosolids must be in the form of small particles (e.g., from a steam drier) in intimate contact with the drying unit. Otherwise, Regime A would apply.

$$Time = \frac{131{,}700{,}000}{10^{0.14\ (temperature)}} = 0.001$$

$$0.001\ [10^{0.14\ (temp)}] = 131{,}700{,}000$$

$$Temperature = 79^{o}C$$

Alternative 2 for Meeting Class A: Biosolids Treated in a High pH–High Temperature Process

This alternative describes conditions of a specific temperature–pH process that is effective in reducing pathogens to below detectable levels. The process conditions required by the regulation are:

elevating the pH to greater than 12 (measured at 25°C) for 72 hours or longer;

maintaining the temperature above 52°C for at least 12 hours during the period that the pH is greater than 12;

air drying to over 50 percent solids after the 72-hour period of elevated pH; and

meeting all the requirements in Table 5-2.

Alternative 3 for Meeting Class A: Biosolids Treated in Other Known Processes

This alternative requires comprehensive monitoring of enteric viruses and viable helminth ova during each monitoring episode until demonstration has shown that the process achieves adequate reduction of pathogens. The presence of enteric viruses and viable helminth ova have to be shown in the biosolids prior to pathogen treatment to document the effectiveness of the treatment process.

The tests and requirements are:

Once shown to be present prior to treatment, the density of enteric viruses in the biosolids after pathogen treatment must be less than 1 plaque- forming unit (PFU) per 4 grams of total solids (dry-weight basis).

Likewise, the density of viable helminth ova in the biosolids after pathogen treatment must be less than 1 per 4 grams of total solids (dry-weight basis).

All the requirements in Table 5-2 must be met.

Acceptable pathogen testing procedures are given in Chapter 6 and in the document ***Control of Pathogens and Vector Attraction in Sewage Sludge*** noted earlier in this chapter.

Alternative 3 is useful for demonstrating that a new process fully meets Class A pathogen requirements under the tested set of operating parameters. Subsequent testing for enteric viruses and viable helminth ova is unnecessary whenever the tested set of operating parameters has been met. It is important to realize that the tested set of operating parameters may have included ranges of values.

If no enteric viruses or viable helminth ova are present before treatment, then the tested batch of biosolids can be considered Class A. The tests, however, must be repeated during each subsequent monitoring episode until:

pathogens are detected before the process and demonstrated to have been reduced to below detectable levels after the process, or

after 2 years of testing with no detection of pathogens before the process, the permitting authority modifies the monitoring requirements for enteric viruses and viable helminth ova. (The permitting authority may choose not to modify the monitoring requirements, but if it does, in no case could the monitoring frequency for enteric viruses and viable helminth ova be less than once per year.)

Once the process has been demonstrated to process achieve the required pathogen reduction, the process must be operated under the same conditions that were used during the demonstration.

As already mentioned, monitoring for fecal coliform or *Salmonella* sp. bacteria is always required in accordance with the requirements listed in Table 5-2.

Alternative 4 for Meeting Class A: Biosolids Treated in Unknown Processes

This alternative is used in situations where:

a biosolids treatment process is unknown, or

the biosolids were treated in a process operating under less-stringent conditions than those under which the biosolids could qualify as Class A under any of the other alternatives.

This alternative requires that the biosolids be analyzed for *Salmonella* sp. bacteria, enteric viruses, and viable helminth ova at each of the following times:

- when the biosolids (or materials derived from biosolids) are used or disposed;
- when biosolids are prepared for sale or for give-away in a bag or other container for application to the land; or
- when the biosolids are prepared to meet the EQ requirements (see Chapter 2).

As in Alternative 3, the required test results for this alternative are:

- The density of viruses in the biosolids must be less than 1 PFU per 4 grams of total solids (dry-weight basis).
- The density of viable helminth ova in the biosolids must be less than 1 per 4 grams of total solids (dry-weight basis).
- All the requirements in Table 5-2 must be met.

Although biosolids must meet the same pathogen test results as in Alternative 3, Alternative 4 requires testing of each batch of the biosolids that is used or disposed, rather than just monitoring the operating parameters, after the demonstration that the process reduces pathogens.

Alternative 5 for Meeting Class A: Biosolids Treated in a PFRP

Alternative 5 provides continuity with the 40 CFR Part 257 regulation. This alternative states that biosolids are considered to be Class A if:

- they are treated in one of the PFRPs listed in Table 5-4, and
- all requirements in Table 5-2 are met.

To meet these requirements, the biosolids treatment processes must be operated according to the conditions listed in Table 5-4. This list is very similar to the list of PFRP technologies in 40 CFR Part 257, with two major differences:

- All requirements related to vector attraction reduction have been removed (see the vector attraction reduction requirements discussed later in this chapter).
- The three processes listed in Part 257 that are PFRP only if combined with a PSRP (gamma ray irradiation, high-energy irradiation, and pasteurization) are PFRPs under Part 503.

Under this alternative, treatment processes classified under 40 CFR Part 257 can continue to be operated; however, microbiological monitoring (as described in Table 5-2) must now be performed to ensure that pathogen density levels are below detection limits and that pathogen regrowth has not resulted in detectable levels being present at the time of use or disposal.

TABLE 5-4
Processes to Further Reduce Pathogens (PFRPs) Listed in Appendix B of 40 CFR Part 503

1. Composting

Using either the within-vessel composting method or the static aerated pile composting method, the temperature of the biosolids is maintained at 55°C or higher for 3 days.

Using the windrow composting method, the temperature of the biosolids is maintained at 55°C or higher for 15 days or longer. During the period when the compost is maintained at 55°C or higher, the windrow is turned a minimum of five times.

2. Heat Drying

Biosolids are dried by direct or indirect contact with hot gases to reduce the moisture content of the biosolids to 10 percent or lower. Either the temperature of the biosolids particles exceeds 80°C or the wet bulb temperature of the gas in contact with the biosolids as the biosolids leave the dryer exceeds 80°C.

3. Heat Treatment

Liquid biosolids are heated to a temperature of 180°C or higher for 30 minutes.

4. Thermophilic Aerobic Digestion

Liquid biosolids are agitated with air or oxygen to maintain aerobic conditions, and the mean cell residence time of the biosolids is 10 days at 55° to 60°C.

5. Beta Ray Irradiation

Biosolids are irradiated with beta rays from an accelerator at dosages of at least 1.0 megarad at room temperature (ca. 20°C).

6. Gamma Ray Irradiation

Biosolids are irradiated with gamma rays from certain isotopes, such as Cobalt 60 and Cesium 137, at room temperature (ca. 20°C).

7. Pasteurization

The temperature of the biosolids is maintained at 70°C or higher for 30 minutes or longer.

Alternative 6 for Meeting Class A: Biosolids Treated in a Process Equivalent to a PFRP

Under Alternative 6, biosolids are considered to be Class A if:

- they are treated by any process determined to be equivalent to a PFRP by the permitting authority, and
- all requirements in Table 5-2 are met.

Composting can eliminate pathogens in biosolids (Columbus, Ohio).

The Part 503 rule gives the permitting authority responsibility for determining equivalency. To be equivalent, a treatment process must be able *to* ***consistently reduce*** pathogens to levels comparable to the reduction achieved by listed PFRPs. The process must be equivalent in its ability to achieve Class A status with respect to enteric viruses and viable helminth ova as long as it is operated under the same conditions that produced the required reductions.

Equivalency determinations can be made both on a site-specific and a national basis. A site-specific equivalency determination only pertains to one particular operation run at one location under the specified conditions. It cannot be assumed to apply to the same process performed at a different location, or for any modification of the process. A process that is able to consistently produce the required pathogen reductions at different locations across the country, however, may qualify for a recommendation of national equivalency (i.e., a recommendation that the process will likely be equivalent wherever it is operated in the United States).

The EPA's Pathogen Equivalency Committee (PEC) is available as a resource to provide recommendations on equivalency determinations to the permitting authority and guidance to the regulated community. See ***Control of Pathogens and Vector Attraction in Sewage Sludge*** (noted earlier in this chapter) for more details about the PEC.

Class B Pathogen Requirements

Class B pathogen requirements can be met using one of three alternatives, as listed in Table 5-5 and described below. Unlike a Class A biosolids, in which pathogens are at levels below detectable limits, Class B biosolids may contain some pathogens. For this reason, the Class B requirements for land application of biosolids also include site restrictions that prevent crop harvesting, animal grazing, and public access for a certain period of time until environmental conditions have further reduced pathogens. The land application site restrictions for Class B biosolids are summarized in Table 5-6. Management practices rather than site restrictions prevent exposure to the pathogens in biosolids for surface disposed Class B biosolids.

Alternative 1 for Meeting Class B: The Monitoring of Indicator Organisms

Alternative 1 requires that seven samples of treated biosolids be collected shortly before biosolids use or disposal, ***and*** that the geometric mean fecal coliform density of these samples be less than 2 million colony-forming units (CFU) or most probable number (MPN) per gram of biosolids (dry-weight basis). EPA suggests that these seven samples be collected over a 2-week period. This approach uses fecal coliform density as an indicator of the average density of bacterial and viral pathogens. Acceptable pathogen testing procedures are given in Chapter 6.

EPA recommends that seven samples be taken over the 2-week period preceding use or disposal because the test methods used to determine fecal coliform density (membrane filter methods and the multiple tube dilution method) have poor precision and biosolids quality can vary. Using at least seven samples should provide a sufficiently representative sampling of the biosolids.

TABLE 5-5
Summary of the Three Alternatives for Meeting Class B Pathogen Requirements

Alternative 1: The Monitoring of Indicator Organisms

Test for fecal coliform density as an indicator for all pathogens. The geometric mean of seven samples shall be less than 2 million MPNs per gram per total solids or less than 2 million CFUs per gram of total solids at the time of use or disposal.

Alternative 2: Biosolids Treated in a PSRP

Biosolids must be treated in one of the Processes to Significantly Reduce Pathogens (PSRP) (see Table 5-7).

Alternative 3: Biosolids Treated in a Process Equivalent to a PSRP

Biosolids must be treated in a process equivalent to one of the PSRPs, as determined by the permitting authority.

TABLE 5-6
Site Restrictions for Class B Biosolids Applied to the Land

Food Crops with Harvested Parts That Touch the Biosolids/Soil Mixture

Food crops with harvested parts that touch the biosolids/soil mixture and are totally above the land surface shall not be harvested for 14 months after application of biosolids.

Food Crops with Harvested Parts Below the Land Surface

Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of biosolids when the biosolids remain on the land surface for 4 months or longer prior to incorporation into the soil.

Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of biosolids when the biosolids remain on the land surface for less than 4 months prior to incorporation into the soil.

Food Crops with Harvested Parts That Do Not Touch the Biosolids/Soil Mixture, Feed Crops, and Fiber Crops

Food crops with harvested parts that do not touch the biosolids/soil mixture, feed crops, and fiber crops shall not be harvested for 30 days after application of biosolids.

Animal Grazing

Animals shall not be grazed on the land for 30 days after application of biosolids.

Turf Growing

Turf grown on land where biosolids are applied shall not be harvested for 1 year after application of the biosolids when the harvested turf is placed on either land with a high potential for public exposure or a lawn, unless otherwise specified by the permitting authority.

Public Access

Public access to land with a high potential for public exposure shall be restricted for 1 year after application of biosolids.

Public access to land with a low potential for public exposure shall be restricted for 30 days after application of biosolids.

Alternative 2 for Meeting Class B: Biosolids Treated in a PSRP

Class B Alternative 2 provides continuity with the 40 CFR Part 257 regulation. Under this alternative, biosolids are considered to be Class B if they are treated in one of the PSRPs listed in Table 5-7. The listed processes are similar to the PSRPs listed in the Part 257 regulation, except that all conditions related to reduction of vector attraction have been removed.

TABLE 5-7
Processes to Significantly Reduce Pathogens (PSRPs) Listed in Appendix B of 40 CFR Part 503

1. Aerobic Digestion

Biosolids are agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 40 days at 20°C and 60 days at 15°C.

2. Air Drying

Biosolids are dried on sand beds or on paved or unpaved basins. The biosolids dry for a minimum of 3 months. During 2 of the 3 months, the ambient average daily temperature is above 0°C.

3. Anaerobic Digestion

Biosolids are treated in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35°C to 55°C and 60 days at 20°C.

4. Composting

Using either the within-vessel, static aerated pile, or windrow composting methods, the temperature of the biosolids is raised to 40°C or higher and maintained for 5 days. For 4 hours during the 5-day period, the temperature in the compost pile exceeds 55°C.

5. Lime Stabilization

Sufficient lime is added to the biosolids to raise the pH of the biosolids to 12 after 2 hours of contact.

Under this alternative, biosolids treated in processes included in 40 CFR Part 257 are Class B with respect to pathogens. Unlike the comparable Class A requirement, this alternative does not require microbiological monitoring for regrowth of fecal coliform or *Salmonella* sp. bacteria.

Alternative 3 for Meeting Class B: Biosolids Treated in a Process Equivalent to a PSRP

The Part 257 regulation allowed the biosolids to be treated in a process determined to be *equivalent to* a PSRP. Under Alternative 3, biosolids treated by any process determined to be equivalent to a PSRP by the permitting authority are considered to be Class B biosolids.

Part 503 gives the permitting authority responsibility for determining equivalency. The EPA Pathogen Equivalency Committee is available as a resource to provide recommendations on equivalency determinations to the permitting authorities. As with Class A, the Class B equivalency

determination can be made on either a site-specific or a national basis. See ***Control of Pathogens and Vector Attraction in Sewage Sludge*** (noted earlier in this chapter) for more details about the PEC.

Requirements for Reducing Vector Attraction

The pathogens in biosolids pose a disease risk when they are brought into contact with humans or other susceptible hosts (plant or animal). Vectors, which include flies, mosquitoes, fleas, rodents, and birds, can transmit pathogens to humans and other hosts physically through contact or biologically by playing a specific role in the life cycle of the pathogen. Reducing the attractiveness of biosolids to vectors reduces the potential for transmitting diseases from pathogens in biosolids.

The Part 503 rule contains 12 options, which are summarized in Table 5-8 and described below, for demonstrating reduced vector attraction for biosolids. (Note: Option 12 only applies to domestic septage.) These requirements are designed to either reduce the attractiveness of biosolids to vectors (Options 1 through 8 and Option 12) or prevent vectors from coming in contact with the biosolids (Options 9 through 11).

TABLE 5-8
Summary of Options for Meeting Vector Attraction Reduction

Option 1:	Meet 38 percent reduction in volatile solids content.
Option 2:	Demonstrate vector attraction reduction with additional anaerobic digestion in a bench-scale unit.
Option 3:	Demonstrate vector attraction reduction with additional aerobic digestion in a bench-scale unit.
Option 4:	Meet a specific oxygen uptake rate for aerobically digested biosolids.
Option 5:	Use aerobic processes at greater than 40°C for 14 days or longer.
Option 6:	Alkali addition under specified conditions.
Option 7:	Dry biosolids with no unstabilized solids to at least 75 percent solids.
Option 8:	Dry biosolids with unstabilized solids to at least 90 percent solids.
Option 9:	Inject biosolids beneath the soil surface.
Option 10:	Incorporate biosolids into the soil within 6 hours of application to or placement on the land.
Option 11:	Cover biosolids placed on a surface disposal site with soil or other material at the end of each operating day. (Note: Only for surface disposal.)
Option 12:	Alkaline treatment of domestic septage to pH 12 or above for 30 minutes without adding more alkaline material.

Open-air windrow composting operation near Los Angeles, California.

Option 1: Reduction in Volatile Solids Content

Under this option, vector attraction is reduced if the mass of volatile solids in the biosolids is reduced by at least 38 percent during the treatment of the biosolids. This percentage is the amount of volatile solids reduction that is attained by anaerobic or aerobic digestion plus any additional volatile solids reduction that occurs before the biosolids leave the treatment works, such as through processing in drying beds or lagoons, or by composting.

Option 2: Additional Digestion of Anaerobically Digested Biosolids

Frequently, biosolids have been recycled through the biological wastewater treatment section of a treatment works or have resided for long periods of time in the wastewater collection system. During this time, they undergo substantial biological degradation. If the biosolids are subsequently treated by anaerobic digestion for a period of time, they are adequately reduced in vector attraction. Because they will have entered the digester already partially stabilized, however, the volatile solids reduction after treatment is frequently less than 38 percent.

Under these circumstances, the 38 percent reduction required by Option 1 might not be possible. Option 2 allows the operator to demonstrate vector attraction reduction by testing a portion of the previously digested biosolids in a bench-scale unit in the laboratory. Vector attraction reduction is demonstrated if after anaerobic digestion of the biosolids for an additional 40 days at a temperature between 30° and $37^{o}C$, the volatile solids in the

biosolids are reduced by less than 17 percent from the beginning to the end of the bench test.

Option 3: Additional Digestion of Aerobically Digested Biosolids

This option is appropriate for aerobically digested biosolids that cannot meet the 38 percent volatile solids reduction required by Option 1. This includes biosolids from extended aeration plants, where the minimum residence time of biosolids leaving the wastewater treatment processes section generally exceeds 20 days. In these cases, the biosolids will already have been substantially degraded biologically prior to aerobic digestion.

Under this option, aerobically digested biosolids with 2 percent or less solids are considered to have achieved vector attraction reduction if, in the laboratory after 30 days of aerobic digestion in a batch test at 20°C, volatile solids are reduced by less than 15 percent. This test is only applicable to liquid aerobically digested biosolids.

Option 4: Specific Oxygen Uptake Rate (SOUR) for Aerobically Digested Biosolids

Frequently, aerobically digested biosolids are circulated through the aerobic biological wastewater treatment process for as long as 30 days. In these cases, the biosolids entering the aerobic digester are already partially digested, which makes it difficult to demonstrate the 38 percent reduction required by Option 1.

The specific oxygen uptake rate (SOUR) is the mass of oxygen consumed per unit time per unit mass of total solids (dry-weight basis) in the biosolids. Reduction in vector attraction can be demonstrated if the SOUR of the biosolids that are used or disposed, determined at 20°C, is equal to or less than 1.5 milligrams of oxygen per hour per gram of total biosolids (dry-weight basis). This test is based on the fact that if the biosolids consume very little oxygen, their value as a food source for microorganisms is very low and therefore microorganisms are unlikely to be attracted to them. Other temperatures can be used for this test, provided the results are corrected to a 20°C basis. This test is only applicable to liquid aerobic biosolids withdrawn from an aerobic process.

Option 5: Aerobic Processes at Greater Than 40°C

This option applies primarily to composted biosolids that also contain partially decomposed organic bulking agents. The biosolids must be aerobically treated for 14 days or longer, during which time the temperature always must be over 40°C and the average temperature must be higher than 45°C.

This option can be applied to other aerobic processes, such as aerobic digestion, but Options 3 and 4 are likely to be easier to meet for the other aerobic processes.

Option 6: Addition of Alkaline Material

Biosolids are considered to be adequately reduced in vector attraction if sufficient alkaline material is added to achieve the following:

raise the pH to at least 12, measured at 25°C, and without the addition of more alkaline material, maintain a pH of at least 12 for 2 hours; and

maintain a pH of at least 11.5 without addition of more alkaline material for an additional 22 hours.

The conditions required under this option are designed to ensure that the biosolids can be stored for at least several days at the treatment works, transported, and then used or disposed without the pH falling to the point where putrefaction occurs and vectors are attracted.

Option 7: Moisture Reduction of Biosolids Containing No Unstabilized Solids

Under this option, vector attraction is considered to be reduced if the biosolids do not contain unstabilized solids generated during primary treatment and if the solids content of the biosolids is at least 75 percent before the biosolids are mixed with other materials. Thus, the reduction must be achieved by removing water, not by adding inert materials.

It is important that the biosolids not contain unstabilized solids because the partially degraded food scraps likely to be present in such biosolids would attract birds, some mammals, and possibly insects, even if the solids content of the biosolids exceeded 75 percent.

Option 8: Moisture Reduction of Biosolids Containing Unstabilized Solids

The ability of any biosolids to attract vectors is considered to be adequately reduced if the solids content of the biosolids is increased to 90 percent or greater, regardless of whether this increase was for biosolids from primary treatment. The solids increase should be achieved by removal of water and not by dilution with inert solids. Drying to this extent severely limits biological activity and strips off or decomposes the volatile compounds that attract vectors.

The way dried biosolids are handled, including their storage before use or disposal, can create or prevent vector attraction. If dried biosolids are exposed to high humidity, the outer surface of the biosolids will gain in moisture content and possibly attract vectors. This should be properly guarded against.

Option 9: Biosolids Injection

Vector attraction reduction can be demonstrated by injecting the biosolids below the ground surface. Under this option, no significant amount of biosolids can be present on the land surface within 1 hour of injection, and if the biosolids are Class A with respect to pathogens, they must be injected within 8 hours after discharge from the pathogen-reducing process.

The reason for this special consideration for Class A biosolids (assuming vector attraction has not been reduced by some other means) is that pathogens could regrow and Class A biosolids have no site restrictions to provide crop, grazing, and access protection.

Injection of biosolids beneath the soil places a barrier of earth between the biosolids and vectors. The soil removes water from the biosolids, which reduces the mobility and odor of the biosolids. Odor is usually present at the site during the injection process but quickly dissipates when injection is complete.

Option 10: Incorporation of Biosolids into the Soil

Under this option, biosolids must be incorporated into the soil within 6 hours of application to or placement on the land. Incorporation is accomplished by plowing or some other means of mixing the biosolids into the soil. If the biosolids are Class A with respect to pathogens, the time between processing and application or placement must not exceed 8 hours—the same as for injection under Option 9.

Option 11: Covering Biosolids

Under this option, biosolids placed on a surface disposal site must be covered with soil or other material at the end of each operating day. Daily covering reduces vector attraction by creating a physical barrier between the biosolids and vectors. Covering also helps meet pathogen requirements by allowing environmental conditions to reduce pathogens.

Option 12: Alkaline Treatment for Domestic Septage

This option pertains only to vector attraction reduction for domestic septage. Under this option, the pH of domestic septage must be raised to at least 12 and remain at pH 12 or above for a minimum of 30 minutes during which no additional alkaline material may be added.

Common Questions and Answers

Q: Are there any labs certified to perform the necessary pathogen tests?

A: Yes, and the correct analytical methods for pathogens are referenced in Part 503.

Q: For Class A pathogen Alternatives 1 and 2 (which use high temperatures to eliminate pathogens), is it necessary to verify the reduced level of viruses or helminth ova?

A: No.

Q: How often does a permittee have to show compliance with the vector attraction reduction requirements?

A: Compliance has to be shown at the same frequency as pollutant monitoring when vector attraction reduction Options 1 through 8 are met.

Q: Vector attraction reduction Options 2 and 3, which involve additional anaerobic or aerobic digestion, are tied to Option 1, which requires a specified reduction in volatile solids. Is it necessary to fail Option 1 before going on to Options 2 and 3?

A: Failure is not essential. The additional digestion approaches specified in Option 2 for biosolids treated anaerobically and Option 3 for biosolids treated aerobically can be followed without regard to the Option 1 volatile solids reduction requirements.

Q: Does the regulation address odor?

A: Not specifically. Volatile solids are a surrogate. No EPA standards address odor. Odor may be covered under State or local nuisance laws or under air regulations. Odor also may be covered as a special requirement under State or local public health and general welfare provisions.

***Q*: Are both Class A or B biosolids, in regard to pathogens, protective of public health and the environment, even though biosolids with Class B pathogen status may still contain pathogens and biosolids with Class A status do not?**

A: Biosolids with either Class A or Class B pathogen status are protective of human health and the environment because of the added site restrictions and management practices that are required for biosolids with Class B pathogen status, which may contain pathogens. Stated as a generally correct rule of thumb:

Class A ≅ Class B + Site Restrictions + Management Practices.

Chapter 6

Sampling and Analysis

The Part 503 rule requires sampling and analysis of biosolids for certain pollutants (metals) and pathogens and for vector attraction reduction if the biosolids are land applied, placed on a surface disposal site, or incinerated. The rule prescribes the frequency for monitoring and lists analytical methods that must be used to analyze different types of samples. The rule does not, however, provide specific instructions on how to sample. This chapter provides general information on sampling biosolids; gives an overview of sampling requirements concerning biosolids incinerator emissions; discusses the methods required by the Part 503 rule for analyzing biosolids samples; and lists publications that provide detailed information about biosolids sampling and analysis.

Guidance for Sampling Biosolids

A number of considerations relate to the care that must be taken in sampling and analyzing biosolids as well as the number of samples that must be taken to be representative. These factors include the size of the sample of biosolids material that is actually being analyzed, the accuracy of the analytical technique, the presence of other materials that might interfere with the analysis, the stability of the analyte being determined, and the potential reduction in volatile solids content of the biosolids when analyzed. Since this chapter provides only general information on sampling and analyzing biosolids, persons responsible for complying with the Part 503 rule should seek additional guidance. Sources of guidance include EPA's ***POTW Sludge Sampling and Analysis Guidance Document***, the EPA

Sewage Sludge Sampling Video, and ***Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge*** (see References), as well as the general Part 503 sampling requirements (summarized in Table 6-1) and the references to specific required analytical protocols listed in Table 6-7. Other guidance documents also are listed at the end of this chapter. If additional information is needed, the reader can contact the Regional EPA permitting authority and, where applicable, the State biosolids contact person.

Who Must Sample?

In most cases, the preparer of biosolids (usually the owner/operator of a treatment works) will be responsible for sampling the biosolids for metals, pathogens, and, where applicable, for vector attraction reduction. Often the generator is also the preparer, land applier, surface disposer, or incinerator of the biosolids. Sometimes a person other than the generator is the preparer (e.g., a person who provides additional processing that may alter the quality of the biosolids before their use or disposal). That preparer may also be required to sample the additionally processed biosolids before they are land applied, surface disposed, or incinerated. Also, the owner/operator of a surface disposal site is responsible for sampling metals under certain circumstances: when needed to meet site-specific limit requirements, or when the boundary of an active biosolids unit is less than 150 meters from the property line of the surface disposal site (see Chapter Three).

How Often Should Sampling Be Done?

The Part 503 rule includes tables listing minimum monitoring frequencies for biosolids that will be land applied, placed on a surface disposal site, or incinerated. Frequency of monitoring requirements range from once a year for facilities using or disposing of relatively small amounts of biosolids to once a month for facilities using or disposing of larger amounts of biosolids. Table 6-2 lists the frequency of monitoring requirements in Part 503. Monitoring must take place at least as often as the table indicates to demonstrate compliance with Part 503 pollutant limits and pathogen and vector attraction reduction requirements.

A number of factors were considered in establishing the frequency of monitoring requirements for the Part 503 rule. The intent was to avoid imposing any undue burden on persons preparing smaller quantities of biosolids. Also, the intent was to require sufficiently frequent monitoring, representative sampling, and quality-assured and -controlled analytical procedures so that the data collected accurately represent the metal content and pathogen and vector attraction reduction status of the biosolids being used or disposed.

TABLE 6-1
Summary of Biosolids Sampling Considerations[a]

Factors To Consider in Developing a Sampling Program	
Who Must Sample?	Preparer, land applier, surface disposer, or incinerator of biosolids.
What Must Be Sampled?	Biosolids: Metals (land application, surface disposal, incineration). Pathogens and vector attraction reduction (land application and surface disposal sites only). Nitrogen (land application only). Biosolids incinerator emissions: Total hydrocarbons (or carbon monoxide), oxygen, temperature, information needed to determine moisture content, and mercury and beryllium, when applicable. Other: Methane gas in air (surface disposal sites only).
How Often Should Sampling Be Done?	From once a year to once a month, depending on the amount of biosolids used or disposed (see Table 6-2).
How Should Sampling Be Done and How Many Samples Should Be Taken?	Take either: Grab samples[b] (individual samples) for pathogens and percent volatile solids determinations, or Composite samples[b] (several grab samples combined) for metals. No fixed number of individual samples required (except for Class B pathogens, Alternative 1, take 7 samples). Enough material must be taken for the sample to be representative. Take a greater number of samples if there is a large amount of biosolids or if characteristics of biosolids vary a lot. See Table 6-4 for guidance (e.g., continuous, instantaneous, or monthly averages required).
When To Sample?	Before use or disposal. If biosolids are used or disposed before sampling results are available, and the results subsequently show that a regulatory limit is exceeded the responsible person will be in noncompliance with Part 503. See also Table 6-3.
Where To Collect Samples?	Usually at site of preparer (e.g., treatment works). Sometimes samples must be collected at land application or surface disposal sites. Sample from moving biosolids when possible to obtain a well-mixed sample. If you must sample from a stationary location, the sample should represent the entire area. Appropriate sampling points differ for liquid or dewatered biosolids (see Table 6-5).
What Size of Sample, Sample Equipment, Storage Times?	See Table 6-6.
What Methods Should Be Used To Analyze Samples?	Part 503 requires that specific analytical methods be used for different types of samples (see Table 6-7).

[a] All information in this table is discussed in more detail in the text of this chapter.

[b] Guidance, not a Part 503 rule requirement.

TABLE 6-2
Frequency of Monitoring for Land Application, Surface Disposal, and Incineration of Biosolids

Amounts of Biosolids* (metric tons per 365-day period)	Frequency
Greater than zero but less than 290	Once per year
Equal to or greater than 290 but less than 1,500	Once per quarter (four times per year)
Equal to or greater than 1,500 but less than 15,000	Once per 60 days (six times per year)
Equal to or greater than 15,000	Once per month (twelve times per year)

* Amount of biosolids (other than domestic septage) land applied, placed on an active biosolids unit, or fired in an incinerator—dry-weight basis.

Monitoring frequency should anticipate the potential for changes in metals concentration, pathogen density, and vector attractiveness in biosolids. In general, metals contents will change little unless there is a significant reduction in the volatile solids content of the biosolids. In contrast, bacterial pathogens (not enteric viruses and viable helminth ova) can regrow in biosolids under certain conditions. Moreover, the extent of vector attraction reduction achieved using Alternatives 6 (pH adjustment) or Alternatives 7 or 8 (drying) may change.

Monitoring frequency also should take into account when biosolids are actually being used or disposed. The rule assumes, especially in regard to preparers of large amounts of biosolids, that the biosolids will be used or disposed consistently throughout the year. If biosolids are being stored for a number of months before use or disposal, a large mass could accrue. Although the Part 503 rule does not require analysis until the biosolids are used or disposed, the preparer, land applier, or disposer might want to take composite samples for analysis throughout the storage period so that sampling results are more representative and the operation affords better process control. Remember, however, that the fecal coliform and *Salmonella* sp. determinations (for Class A and B pathogen alternatives, where applicable) have to be made sufficiently close to the time biosolids are actually used or disposed to be indicative of whether the potential for regrowth has been controlled.

In general, if a person is operating in such a manner that the biosolids being used or disposed meet applicable Part 503 requirements, continuing in this manner of operation would tend to minimize the likelihood of subsequent noncompliance. Thus, a monitoring program that enables one to ensure that critical operating parameters continue to be met is good practice.

Given the varying nature of the many different processes that need to be monitored for and controlled, it is not possible to provide one simple guidance suggestion for when to monitor for various Part 503 required parameters. Table 6-3 summarizes additional important monitoring considerations for each of the various parameters.

How Many Samples Should Be Taken?

Although the Part 503 rule establishes frequency of monitoring requirements for biosolids, it does not specify how many samples need to be taken. (There is one exception—for Class B, Alternative 1 pathogen requirements, the regulation states that seven samples must be collected.) Is one sample enough for most monitoring? Are 20 too many? The appropriate number of samples to take depends on conditions at each site. More than one sample is usually necessary to accurately represent a particular stream or batch of biosolids. ***The key is to obtain a representative sample***, as is required by the Part 503 rule.

In general, the more samples taken, the greater the chance that the sampling results will be representative of the biosolids at a particular facility. Also, the larger the amount of biosolids a facility uses or disposes, the greater the number of samples that will be needed to obtain a representative sample. A greater number of samples should be taken if the characteristics of the biosolids vary considerably (e.g., if the solids content or pathogen levels vary significantly from one batch to another). Table 6-4 provides guidance on the types of biosolids samples that must be collected to assess the level of metals and pathogens, and to monitor other parameters. The type of parameter limit (e.g., instantaneous, monthly averages) will affect the determination of how many samples should be taken.

Important factors to consider when determining how many samples to take include:

Standard deviation. Find out the extent of the variation from the average result (the mean). This concept is known as the standard deviation. The standard deviation is determined by taking the square root of the arithmetic average of the squares of the deviations from the mean in a frequency distribution. The greater the standard deviation, the greater the number of individual samples that should be taken to get a representative sample.

Addition of commercial/industrial pollutants to sewage system. Determine whether pollutants are being added (or "cycled") into the sewage system by commercial or industrial processes. If cycling of pollutants is occurring, it is advisable to collect more samples to ensure that they include the high pollutant levels (or "spikes") that can come from commercial or industrial discharges.

TABLE 6-3
Monitoring Considerations for Key Parameters

Parameter	Validity of Analytical Data over Time and When Sampling/Analysis Must Occur
	METALS
Metals	Data remain valid for biosolids if no significant change in volatile solids. Determine monitoring frequency in accordance with monitoring frequency requirements.
	PATHOGENS CLASS A
Applies to All Class A Pathogen Reduction Alternatives (PRA):	Because regrowth of fecal coliform and *Salmonella* sp. can occur, monitoring should be done sufficiently close to the time of biosolids use or disposal so data are available and no additional regrowth occurs: (a) before land application or suface disposal, or (b) when biosolids are prepared for sale or give-away in a bag or other container for land application, or (c) when biosolids are prepared to meet EQ requirements. Once destroyed, enteric viruses and viable helminth ova do not regain viability.
	Additional Information on Each Class A Pathogen Category
Class A PRA 1: Thermal Treatment, Moisture, Particle Size & Time Dependent	Data remain valid as long as biosolids remain dry before use. Time, temperature, and moisture content should be monitored continuously to ensure effectiveness of treatment.
Class A PRA 2: High pH, High Temperature	Monitor to ensure that pH 12 (at 25°C) is maintained for more than 72 hours.
Class A PRA 3: Enteric Virus & Viable Helminth Ova To Establish Process	To establish a process, determine with each monitoring episode until the process is shown to consistently achieve this status. Then monitor process at sufficient frequency to ensure its validity.
Class A PRA 4: Enteric Virus & Viable Helminth Ova for Unknown Process	Do not know whether enteric virus or viable helminth ova were present and destroyed or just not detected. Monitor representative sample of biosolids material: (a) to be used or disposed, or (b) when prepared for sale or give-away in a bag or other container for land application, or (c) when prepared to meet EQ requirements.
Class A PRA 5: PFRP	Monitor at sufficient frequency to show compliance with time and temperature or irradiation requirements in Table 5-6.
Class A PRA 6: PFRP Equivalent	Monitor at sufficient frequency to show compliance with PFRP or equivalent process requirements.

TABLE 6-3 (continued)
Monitoring Considerations for Key Parameters

	PATHOGENS CLASS B
Class B PRA 1: Fecal Coliform	Measure the geometric mean of 7 samples taken over a 2-week period sufficiently close to the time of use or disposal so that (i) data are available and (ii) no additional regrowth occurs before use or disposal.
Class B PRA 2:	Monitor at sufficient frequency to show that the PSRP requirements in Table 5-7 are met.
Class B PRA 3:	Monitor at sufficient frequency to show that the equivalent PSRP requirements are met.
	VECTOR ATTRACTION REDUCTION
Vector Attraction Reduction (VAR) 1: 38% Volatile Solids Reduction (VSR)	Once achieved, no further attractiveness to vectors. If a batch process, determine VSR for each batch. If for a continuous process, determine VSR based on material being put in and withdrawn. Monitor at sufficient frequency to verify that the necessary VSR operating conditions are met.
VAR 2 for Anaerobic Digestion: If Cannot Meet VAR 1 Lab Test **VAR 3 for Aerobic Digestion: If Cannot Meet VAR 1 Lab Test** **VAR 4: SOUR Test for Aerobic Processes**	Once achieved, no further attractiveness to vectors. If a batch process, determine VSR for each batch. If unable to show VSR, then conduct lab test. Monitor at sufficient frequency to verify that biosolids are meeting the necessary operating conditions.
VAR 5: Aerobic >40°C	Monitor at sufficient frequency to show that biosolids are achieving an average temperature of 45°C over a 2-week period.
VAR 6: Adding Alkaline Material	Determine pH over time for each batch. VAR has been achieved as long as the pH does not drop such that putrefaction begins prior to land application or surface disposal.
VAR 7: Moisture Reduction No Unstabilized Primary Solids	To be achieved only by the removal of water. VAR has been achieved as long as the moisture level remains below 30%.
VAR 8: Moisture Reduction Primary Unstabilized Solids	To be achieved only by the removal of water. VAR has been achieved as long as the moisture level remains below 10%.

(continued on next page)

TABLE 6-3 (continued)
Monitoring Considerations for Key Parameters

VAR 9: Injection into Soil	No significant amount of biosolids remains on soil surface within 1 hour after injection.
VAR 10: Incorporation into Soil	Biosolids must be incorporated into soil within 6 hours after being placed on the soil surface.
VAR 11: Covered with Soil Surface Disposal	Surface disposed biosolids must be covered daily.
VAR 12: Domestic Septage pH Adjustment	Preparer must ensure that pH is 12 for more than 30 minutes for each batch of domestic septage treated with alkaline material.

Results of previous samples. If previous sampling results show that biosolids contain pollutants or pathogens at levels close to the regulatory limits specified in Part 503, then consider taking a greater number of samples to determine if the biosolids are approaching or have reached the regulatory limit. The closer the biosolids come to the regulatory limits, the more critical sampling results become.

Whether the biosolids are well mixed. Well-mixed biosolids provide a more representative sample. If a particular batch or stream of biosolids is well mixed, then fewer samples need to be taken. If the biosolids are not well mixed, then more samples should be taken.

Special methods have been developed by EPA's Office of Wastewater Management to determine how many samples should be collected when biosolids must be sampled at land application or surface disposal sites rather than where generated. These methods involve the use of mathematical concepts such as sample means, standard deviations, and confidence intervals, which are explained in EPA's ***POTW Sludge Sampling and Analysis Guidance Document*** (see References).

How Is Sampling Done?

There are two basic types of samples: grab samples and composite samples. Because a grab sample is a single sample collected at a specific time and location, it is representative of the composition of a material being sampled only at that particular moment and place.

The other type of sample, the composite sample, is made up of several grab samples taken over a period of time and/or from different locations. In most cases, a composite sample is more representative than a grab sample because the composite can reveal information about the composite's subsamples of material from several locations and time periods. Thus,

TABLE 6-4
Types of Limits for Which Sampling Must Be Done

Use or Disposal Practice	Parameter	Nature of Determination
Land Application	Pollutant Limits:	
	Ceiling Limit Concentrations (Table 2-1 in this document, or Table 1 in Part 503.13)	Instantaneous—may not be exceeded
	Pollutant Concentrations—PC or EQ biosolids (Table 2-1 in this document, or Table 3 in Section 503.13)	Monthly averages
	Nitrogen	Representative value used to determine agronomic rate
	CPLR (Table 2-1 in this document, or Table 2 in Section 503.13)	May not be exceeded at any site
	APLR (Table 2-1 in this document, or Table 4 in Section 503.13)	May not be exceeded during a 365-day period
Surface Disposal	Methane gas	Continuously monitored in air; instantaneous—may not be exceeded
	Metals	Instantaneous—may not be exceeded
Incineration	Metals (except beryllium and mercury)	Daily concentration; if required to report once per month, average of each day operated during the month
	Total hydrocarbons (THC) or Carbon-monoxide (CO)	Continuously monitored; monthly average is reported, which is the arithmetic mean of hourly averages with a minimum of 2 readings per hour
	Oxygen	Continuously monitored
	Temperature	Continuously monitored
	Moisture	Continuously monitored

(continued on next page)

TABLE 6-4 (continued)
Types of Limits for Which Sampling Must Be Done

Use or Disposal Practice	Parameter	Nature of Determination
	Pathogens (or Indicators):	
	Class A Pathogens: Fecal coliform	Part 503 rule specifies a density of <1,000 fecal coliform/g total solids (dry-weight basis). Guidance (EPA/625/R-92/013) suggests the geometric mean of a minimum of 7 individual grab samples taken over a 14-day period, similar to the fecal coliform determination for Class B.
	Salmonella sp.	Part 503 rule specifies a density of <3 MPN *Salmonella* sp./4 g total solids (dry-weight basis). Guidance (EPA/625/R-92/013) suggests the arithmetic mean of a minimum of 7 individual grab samples taken over a 14-day period.
Land Application and Surface Disposal	Enteric virus	Part 503 rule specifies a density of <1 PFU/4 g total solids (dry-weight basis). Guidance (EPA/625/R-92/013) suggests that one composite sample of 7 grab samples be made over a 14-day period and that the arithmetic mean of 4 duplicate analyses of that composite be determined.
	Viable helminth ova	Part 503 rule specifies a density of <1 viable ova/4 g total solids (dry-weight basis). Guidance (EPA/625/R-92/013) suggests that one composite sample of 7 grab samples be made over a 14-day period and that the arithmetic mean of 4 duplicate analyses of that composite be determined.
	Class B Pathogens: Fecal coliform	Part 503 rule specifies the geometric mean of 7 individual samples. Guidance suggests that they be taken over a 14-day period; the rule states that the geometric mean may not exceed ≤2 million MPN or CFUs/g total solids (dry-weight basis).

Note: CFUs = colony-forming units

MPN = most probable number

whenever possible and appropriate, composite sampling should be conducted (e.g., for metals). Take several grab samples, combine them, and then send the composite sample to a laboratory for analysis.

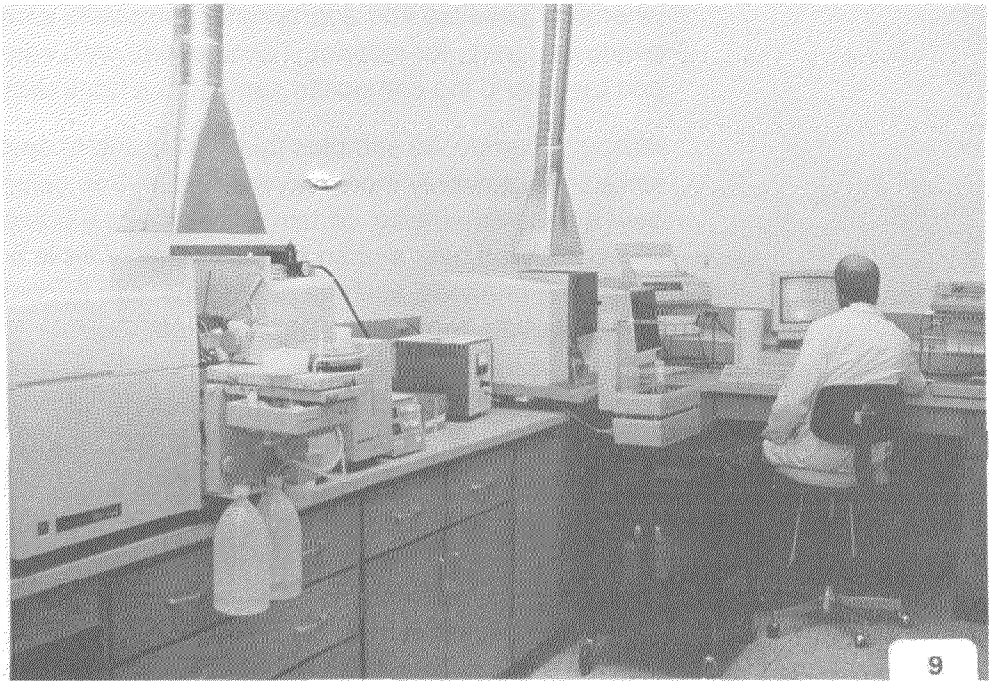
Although composite samples taken over one to several weeks and properly stored are generally more representative than composite samples gathered over a short timeframe, certain tests require a composite sample that has been gathered over a short period of time. This is because tests of biosolids for certain analytes, such as pathogens, can become invalid due to ease of contamination, regrowth, or rapid die-off.

When Should Samples Be Taken?

Part 503 states that biosolids must meet the requirements of the rule at the time of their use or disposal or at the time they are prepared if distributed in bags or meeting EQ status. Sampling and analysis should take place before use or disposal so that analytical results can be available ahead of time. Biosolids could be sampled and analyzed for metals content a considerable period of time before use or disposal, provided no significant additional reduction in volatile solids content has occurred. Certain pathogen and vector attraction reduction determinations, however, would need to be made close to the time of use or disposal to meet the rule's requirements. In some cases (e.g., with some of the pathogen and vector attraction reduction alternatives) sampling may need to be conducted over the applicable period of time to show that reduction of parameters has been achieved. See also Tables 6-3 and 6-4.

Waiting to establish sampling results before use or disposal is critical to avoid exceeding limits if the levels of one or more pollutants or pathogens in the biosolids being tested are close to the regulatory limits or if there is a high potential for pollutant spikes. If initial sampling results for a particular biosolids material indicate that pollutant levels are well below the regulatory limits, later sampling results might also be expected to show that pollutant levels will not exceed those limits. If, however, you suspect that pollutant levels are close to the regulatory limits, then waiting for results before using or disposing of the biosolids will avoid a situation in which a detected exceedance results in noncompliance.

Establishing compliance before use or disposal also helps ensure that a particular batch of biosolids is available for additional sampling if necessary. For example, suppose that a batch of biosolids was land applied before sampling results were returned from the laboratory and that when the sampling results became available, they indicated unusually high levels of a pollutant in excess of the regulatory limit. Resampling might be appropriate to determine whether a laboratory error was made. If biosolids have already been used or disposed prior to an exceedance determination, the permitting authority would have to decide what actions to take to ensure protection of



A laboratory technician analyzes samples of composted biosolids in Aurora, Illinois.

public health and the environment. The enforcement authority also would have to make a determination about actions it might take that could lead to penalties and fines.

Where Should the Samples Be Taken?

In general, more representative sampling occurs when the biosolids being sampled are moving rather than stationary. The movement of biosolids tends to cause mixing and thus a more uniform entrainment of solids and pollutants. Depending on the type of biosolids material (liquid, dewatered, or dried) and the treatment process, certain sampling points will provide better samples. Table 6-5 lists some of the better places to sample biosolids.

Liquid biosolids should generally be sampled from pipelines, or preflushed pipeline ports. Whenever possible, the sampling locations should be as far downstream in the treatment works as possible to take advantage of the maximum mixing that will occur and to capture the most representative sample of biosolids that will be used or disposed. For example, sampling before digestion would not be representative of the pathogen or metals levels that would be present after digestion. Sometimes liquid biosolids may need to be sampled from lagoons. This should be done in such a way that the floating, suspended, and sediment layers of the biosolids are all included. The sample can be obtained using a liquid waste sampler, known as a coliwasa (described in EPA Solid Waste Method 846), or, if the biosolids are quite thick, by using a coring device.

TABLE 6-5
Sampling Points for Biosolids

Biosolids Type	Sampling Point
Anaerobically Digested	Collect sample from taps on the discharge side of positive displacement pumps.
Aerobically Digested	Collect sample from taps on discharge lines from pumps. If batch digestion is used, collect sample directly from the digester. Cautions: 1. If biosolids are aerated during sampling, air entrains in the sample. Volatile organiccompounds may be purged with escaping air. 2. When aeration is shut off, solids may settle rapidly.
Thickened	Collect sample from taps on the discharge side of positive displacement pumps.
Heat Treated	Collect sample from taps on the discharge side of positive displacement pumps *after* decanting. Be careful when sampling heat-treated biosolids because of: 1. High tendency for solids separation. 2. High temperature of sample (temperature >60°C as sampled) can cause problems with certain sample containers due to cooling and subsequent contraction of entrained gases.
Dewatered, Dried, Composted, or Thermally Reduced	Collect sample from material collection conveyors and bulk containers. Collect sample from many locations within the biosolids mass and at various depths.
Dewatered by Belt Filter Press, Centrifuge, Vacuum Filter Press	Collect sample from biosolids discharge chute.
Dewatered by Biosolids Press (plate and frame)	Collect sample from the storage bin; select four points within the storage bin, collect equal amount of sample from each point and combine.
Dewatered by Drying Beds	Divide bed into quarters, grab equal amounts of sample from the center of each quarter and combine to form a composite sample of the total bed. Each composite sample should include the entire depth of the biosolids material (down to the sand).
Compost Piles	Collect sample directly from front-end loader while biosolids are being transported or stockpiled within a few days of use.

A more representative sample of dewatered biosolids (e.g., with a solids content of 10 to 40 percent) can be obtained by sampling from moving conveyor belts or front-end loaders that are moving a pile of biosolids (i.e., biosolids from drying beds, outdoor drying windrows, compost storage piles, or dried-out lagoons should be sampled, if possible, when moved). If the biosolids sample must be taken with the biosolids in place, samples from the entire area should be taken and combined (e.g., samples from a compost pile should be taken at various depths and along the length of the pile and then mixed together).

In most cases, biosolids are sampled at the end of a treatment process, just prior to their use or disposal. In some instances, sampling may need to be carried out at a storage, surface disposal, or land application site because of the possibility of a change in pollutant, pathogen levels, or vector attractiveness during the period between treatment and use or disposal.

What Types of Sampling Equipment Should Be Used?

Sampling equipment (e.g., coring devices, coliwasas, pitchers, conduits, shovels, trowels, containers) must be made of materials that will not contaminate or react with the biosolids. Suitable sampling equipment materials generally include glass, stainless steel, and plastic (Teflon, polyethylene, polypropylene). Any steel equipment used must not be galvanized or zinc coated because it will contaminate the sample. Moreover, all equipment should be kept clean to avoid contamination. For samples used to demonstrate compliance with Class A pathogen requirements, sampling equipment should be sterilized prior to sampling. Requirements for sample containers are often listed in the description of the analytical method (see below).

How Large a Sample Is Needed? How Long Can the Sample Be Stored?

It is important both to collect the correct amount of biosolids needed to perform sample analysis and to preserve and store samples properly. Table 6-6 lists appropriate containers, sample sizes, and preservation and storage times for sampling biosolids for metals and pathogens. Wide-mouthed containers are recommended for biosolids sampling.

What If a Test Result Does Not Meet the Part 503 Requirements?

To answer this question, it is important to clarify, first of all, that no violation occurs unless biosolids have been used or disposed and pollutant contents exceed regulatory requirements. Second, it is necessary to clarify whether a monthly average determination (e.g., for pollutant concentration limits or Class B pathogen status for land application) or an instantaneous determination (e.g., ceiling concentration limit for land application) is at issue. Land application would be in compliance even if some of the daily or weekly biosolids metal determinations included in the monthly average exceeded the pollutant concentration regulatory limits but the averages did not. Likewise, land application would be in compliance, even if one or more of the 7 fecal coliform densities exceeded the Part 503 regulatory limit, provided the geometric mean of all 7 densities did not.

Consider the same question for land application ceiling concentration limits. What if one of several samples of the mass of biosolids being analyzed was above the Part 503 regulatory limit? Does this mean that the particular batch of biosolids is out of compliance and cannot be land applied? The answer is

TABLE 6-6
Proper Conditions for Biosolids Sampling

Parameter	Wide-Mouthed Container	Preservative[a]	Maximum Storage Time[a]	Minimum Volume[b]
Metals				
Solid and semi-solid samples	P,G	Cool, 4°C	6 months	300 mL
Liquid (mercury only)	P,G	HNO_3 to pH <2	28 days	500 mL
Liquid (all other liquid metals)	P,G	HNO_3 to pH <2	6 months	1,000 mL
Pathogen Density and Vector Attraction Reduction				
Pathogens	G,P,B,SS	1. Cool in ice and water to <10°C if analysis delayed >1 hr, or	6 hours	1-4 liters[c]
		2. Cool promptly to <4°C, or	24 hours (bacteria and viruses) 1 month (helminth ova)	
		3. Freeze and store samples to be analyzed for viruses at 0°C[d]	2 weeks	
Vector attraction reduction		Varies[b]	Varies[b]	1-4 liters[c]

[a] Preservatives should be added to sampling containers prior to actual sampling episodes. Storage times commence upon addition of sample to sampling container. Shipping of preserved samples to the laboratory may be, but is generally not, regulated under Department of Transportation hazardous materials regulations.

[b] Varies with analytical method. Consult 40 CFR Parts 136 and 503.

[c] Reduced at the laboratory to approx. 300 mL samples.

[d] Do not freeze bacterial or helminth ova samples.

P = Plastic (polyethylene, polypropylene, Teflon)

G = Glass (non-etched Pyrex)

B = Presterilized bags (for dewatered or free-flowing biosolids)

SS = Stainless steel (not steel- or zinc-coated)

Source: 40 CFR Part 136, and EPA, December 1992.

yes, the material could not be land applied unless treated to reduce the ceiling concentration below the regulatory limit.

If a sample result were discovered to exceed certain limits after the biosolids are land applied for any of the above cases, the biosolids would be out of compliance and the responsible person would be subject to enforcement actions. The permitting authority will decide what action to take when a requirement is not met. If the failure is substantial, the permitting authority might withhold approval for—or may no longer allow—land application, surface disposal, or incineration of the biosolids. If the failure is slight, the permitting authority might allow reasonable efforts to be made to bring the process into compliance.

Determining the accuracy of a given sample result affects the ability to achieve compliance. In many sampling efforts, some results might not accurately represent the material being sampled as well as other samples would (these are known as outliers). Some outliers may indicate noncompliance when other, more representative samples show compliance. Also, laboratory errors may indicate sample failure when in fact the sample should have passed. To account for outliers and lab errors, the person doing the monitoring should take a greater number of samples over a long timeframe. If most samples in a rigorous sampling effort show compliance, it is more likely that a single sample failure is an outlier or due to laboratory error. It should be noted, however, that a large number of samples is needed to prove that a sample result is an outlier.

Other Sampling Considerations

Other factors that need to be considered when developing sampling procedures for biosolids include:

Regrowth potential for bacteria. Under certain conditions, some types of bacteria may regrow in biosolids. The possibility for regrowth depends on whether conditions such as temperature, pH, and other factors make the biosolids an advantageous food source for the bacteria. Because of this potential, the Part 503 rule requires sampling for fecal coliform or *Salmonella* sp. bacteria as close as possible to the time of biosolids use or disposal for the Class A and B pathogen alternatives where such determinations are required.

Proper quality assurance and quality control procedures. QA/QC procedures appropriate for collecting samples for metals and for performing microbiological analysis should be defined and followed. (EPA's ***POTW Sludge Sampling and Analysis Guidance Document*** provides guidance on sampling and QA/QC procedures. See also, lists of contacts at the end of this document.)

Packaging procedures. Ensure that packaging does not alter the biosolids' character or quality. Shipping containers should be kept upright, tightly sealed, cushioned, insulated, and refrigerated to keep the sample at approximately 4°C but without freezing the sample.

Shipping time. The sample should reach the lab within 24 hours to ensure that proper temperature conditions are maintained. U.S. Department of Transportation regulations prohibit shipping acidified samples without the proper manifest and hazard markings. Use of acidified samples should be avoided because shipping is costly.

Proper sample documentation. Documentation is important for ensuring QA/QC. Documentation includes clearly marked labels with all appropriate identifying information; a chain-of-custody record that documents the transfer of the sample material from person-to-person; and a log book that records all sampling activities.

Personnel safety. Personnel handling biosolids samples should take precautions to minimize contact with pathogens and pollutants that may be present in biosolids. Rubber or latex gloves and waterproof garments should be worn to prevent direct contact. Personnel should follow procedures that limit the production of explosive gases within the samples; preserving and refrigerating samples suppresses biological activity that produces such gases. In addition, sampling personnel should take precautions to avoid injury when sampling high-pressure biosolids lines or lines containing high-temperature, thermally conditioned biosolids.

Sampling Emissions for Biosolids Incineration

Another type of sampling required by Part 503 concerns metals in biosolids fired in an incinerator and total hydrocarbon (THC) (or carbon monoxide—CO) emissions from the incinerator's exhaust stack. Methods for sampling biosolids incinerator emissions are very detailed and should be performed by experienced professionals.

Chapter Four provides a brief discussion of the performance testing required for biosolids incinerators. Testing personnel will sample biosolids, sample the stack gases, and document the operating conditions of the furnace during the test (i.e., temperature, pressure, voltage, and operation of air pollution control devices). The performance test, which is run to represent normal incinerator operating conditions, generates information that is used to establish acceptable operating conditions for the incinerator and to calculate maximum pollutant levels for the biosolids fired in the incinerator.

Maintaining compliance with the required THC (or CO) regulatory limits is also discussed in Chapter Four of this document.

Analytical Methods for Biosolids Samples

The Part 503 rule requires that specific methods be used for analyzing biosolids samples for metals, pathogens, and vector attraction reduction. Table 6-7 lists these methods.

Sources of Additional Information on Sampling and Analysis of Biosolids

Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge
U.S. EPA, Office of Research and Development, Cincinnati, OH. Phone (614) 292-6717. EPA/625/R-92/013, December 1992.

POTW Sludge Sampling and Analysis Guidance Document
U.S. EPA, Permits Division, Washington, DC. 1st edition, August 1989. NTIS PB 93-227957. Phone (800) 553-6847. Revised 2nd edition scheduled for publication in September 1994.

TABLE 6-7
Analytical Methods for Biosolids Sampling[a]

Sample Type	Method
Enteric Viruses	ASTM Designation: D 4994-89, Standard Practice for Recovery of Viruses from Wastewater Sludges, Annual Book of ASTM Standards: Section 11. Water and Environmental Technology, ASTM, Philadelphia, PA, 1992.
Fecal Coliform	Part 9221 E or Part 922 D, Standard Methods for the Examination of Water and Wastewater, 18th edition, American Public Health Association, Washington, DC, 1992.
Helminth Ova	Yanko, W.A., Occurrence of Pathogens in Distribution and Marketing Municipal Sludges, EPA/600/1-87/014, 1987. PB 88-154273/AS, National Technical Information Service, Springfield, VA; (800) 553-6847.
Inorganic Pollutants	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA Publication SW-846, 3rd edition (1986) with Revision I. 2nd edition. PB 87-120291, National Technical Information Service, Springfield, VA. 3rd edition Doc. No. 955-001-00000-1, Superintendent of Documents, Government Printing Office, Washington, DC.
***Salmonella* sp. Bacteria**	Part 9260 D, Standard Methods for Examination of Water and Wastewater, 18th edition, American Public Health Association, Washington, DC, 1992; or, Kenner, B.A. and H.P. Clark, Detection and Enumeration of *Salmonella* and *Pseudomonas aeruginosa*, J. Water Pollution Control Federation, 46(9):2163-2171, 1974.
Specific Oxygen Uptake Rate	Part 2710 B, Standard Methods for the Examination of Water and Wastewater, 18th edition, American Public Health Association, Washington, DC, 1992.
Total, Fixed, and Volatile Solids	Part 2540 G, Standard Methods for the Examination of Water and Wastewater, 18th edition, American Public Health Association, Washington, DC, 1992.
Percent Volatile Solids Reduction Calculation[b]	Environmental Regulations and Technology—Control of Pathogens and Vectors in Sewage Sludge, EPA/625/R-92/013, U.S. Environmental Protection Agency, Cincinnati, OH, 1992; (614) 292-6717.

[a] These analytical methods are required by the Part 503 rule.

[b] This analytical method is provided as guidance in the Part 503 rule.

Common Questions and Answers

Q: Most facilities will not wait several weeks for laboratory results before shipping biosolids off site for use or disposal. What action will be taken when the laboratory results show that biosolids that have already been land applied actually exceeded pollutant ceiling concentration limits?

A: The preparer will be in violation for noncompliance. The ceiling concentration limits in Part 503 are instantaneous, not-to-exceed values; thus, exceeding the concentrations is a violation. If the biosolids quality is unusually close to the ceiling concentration limits, the facility may need to require pretreatment or to take other suitable steps to enhance the quality. EPA will enforce the rule as is warranted, using all remedies at its disposal, including injunctive relief and/or penalty actions.

Q: Are there any measures in the Part 503 rule that deal with small communities that cannot afford to achieve immediate compliance for monitoring biosolids and are not able to receive financial aid?

A: There are no specific provisions in the Part 503 rule that deal with the financial status of a preparer. In developing the frequency of monitoring requirements, however, EPA based the stipulations on the amount of biosolids being used or disposed. Therefore, smaller facilities that use or dispose of smaller amounts of biosolids will generally be required to monitor less frequently than larger facilities.

Q: Do Part 503 frequency of monitoring requirements apply in the same manner to biosolids that are being stored for a significant period of time prior to land application as to those biosolids that are being land-applied throughout the year generally in accordance with their generation or preparation?

A: The frequency of monitoring requirements in the Part 503 rule were established for biosolids that are being land-applied generally in accordance with their generation or preparation. The overriding consideration for monitoring biosolids that have been stored for a period of months prior to being land-applied over a short time period is to obtain a representative sample that reflects the current status of the biosolids.

Q: How should biosolids be monitored that have been stored for a number of months prior to being land applied during a short time period compared to biosolids that are being land applied generally in accordance with their generation or preparation? How frequently should you monitor? What is the potential for liability if the biosolids being land-applied fail to meet the ceiling limits, pollutant concentration limits, or pathogen and vector attraction reduction requirements?

A: The following two cases are given to help answer the frequency of monitoring questions. In both of the following cases the assumption is made that the facility generates or prepares over 15,000 DMT of biosolids during the year. In ***Case 1*** the biosolids are land applied 12 months during the year generally in accordance with their generation/preparation, and in ***Case 2*** they are stored for 11 months and then land applied during the 12th month. The answer for ***Case 1*** is as described in the frequency of monitoring tables in the Part 503 rule. The answer to ***Case 2*** involves the need for taking a sample that is truly representative of the mass of biosolids that is about to be land applied. The exact method chosen to gain a representative sample for ***Case 2*** will depend on a careful examination of the circumstances.

Pollutant Ceiling Limits

For ***Case 1*** the answer is rather straightforward. The frequency of monitoring table in the Part 503 rule requires facilities that are generating or preparing and land applying 15,000 DMT of biosolids throughout the year to take one representative sample for analysis each month. If any analyzed sample exceeded the ceiling limits in a given month, the biosolids represented by that sample could not be land applied unless that batch of biosolids underwent further treatment to reduce the content of the exceedant pollutant to below its ceiling limits. If the exceedant batch of biosolids was added to other non-exceedant batches, then the entire combined batch of biosolids would have to undergo treatment and additional sampling and analysis to show its compliance with pollutant ceiling limits.

For ***Case 2***, the answer is different. The generator, preparer, or land applier, in conjunction with the permitting authority, could decide on more than one approach for frequency of monitoring—as long as sample(s) taken were representative. One approach (Case 2A) might be to take one or more representative composite samples of the entire 15,000 DMT batch of stored biosolids for analysis. Another approach (Case 2B) might be to take 12 monthly representative samples as the biosolids are being generated or prepared and put into storage. Other approaches might also be appropriate.

Failure to meet pollutant ceiling limits for Case 2A monitoring would require additional treatment and testing to show compliance. *If you were following the monthly sampling and analysis Case 2B option, what would happen if one of your monthly samples exceeded the ceiling limits?* The batch of biosolids that the sample represented could not be land applied unless you provided additional treatment to reduce the pollutant levels in the exceedant batch to below the ceiling limits. If the exceedant batch was added to other non-exceedant biosolids of batches, then the entire mixture of batches would have to undergo additional treatment, sampling, and analysis to show that the pollutant ceiling limits were not exceeded.

Additional treatment processes that could be used to reduce the pollutant content in the exceedant biosolids to below the ceiling limits for either ***Case 1 or 2*** could involve composting, lime treatment, or blending with biosolids that contain lower levels of pollutants.

Pollutant Concentration Limits

Assume in ***Case 1*** that you were trying to meet the pollutant concentration limits so that the biosolids could be used with a PC or EQ classification. Assume also that weekly composite samples were taken and analyzed as a basis for determining the average monthly pollutant concentrations.

Could the PC or EQ classification for your biosolids be retained if the pollutant levels in any of the weekly composite samples exceeded the pollutant concentration limits? As long as the average of all of those samples taken within a given month did not exceed the pollutant concentration limit, your biosolids would still have a PC or EQ classification—provided they also met necessary pathogen and vector attraction reduction requirements. (Remember that you must report the results of all analyses made.)

Assume in ***Case 2*** that you were trying to meet the pollutant concentration limits and use the biosolids with a PC or EQ classification. As for Case 2 pollutant ceiling limits, you, in conjunction with the permitting authority, could decide on more than one approach for taking a representative sample of the stored biosolids. For Case 2A suppose that your sampling and analysis was performed just prior to the month the biosolids were being land applied, and that you took more than one representative sample during that month. Suppose further that one of the representative samples exceeded one of the pollutant concentration limits. *Would your 15,000 DMT of biosolids meet the pollutant concentration limits as long as the average of all those representative samples taken during that month meet the limits?* Yes. Depending on the circumstances, however, you might be required to remix the 15,000 DMT of biosolids and take and test several more representative samples to demonstrate compliance with the pollutant concentration limits.

For Case 2B, suppose that all biosolids generated by the facility were commingled during the 11-month storage period and that at least one of the monthly samples exceeded the pollutant concentration limits. Assume further that all the stored biosolids were land applied during the 12th month. *Could the biosolids be classified as PC or EQ if the mean of the 12 monthly analyzed samples did not exceed the pollutant concentration limits?* Yes. Depending on the circumstances, however, you might be required to remix the 15,000 DMT of biosolids and take and test several more representative samples to demonstrate compliance with the pollutant concentration limits.

Cumulative Pollutant Loading Rate (CPLR) Monitoring

Assume that you analyzed for pollutant concentrations as described immediately above and found that the concentration of metal pollutants in your tested biosolids exceeded those concentrations listed in Section 503.13, Table 3, but were less than the ceiling limits in Section 503.13, Table 1. By whatever monitoring method you used to sample representatively and determine pollutant contents, you would have to keep track of and meet all other Part 503 requirements for land applying those biosolids.

Pathogen and Vector Attraction Reduction

For both ***Cases 1 and 2***, the current guidance for determining if biosolids meet Class B pathogen requirements (where pathogen indicator measurements are applicable) is to take a minimum of seven samples for analysis that are representative of the material that will be used or disposed. As long as the geometric mean of the pathogen indicator concentration does not exceed the limit, the biosolids meet the Class B pathogen classification. Guidance also suggests that the same seven samples could be used to determine vector attraction reduction (VAR) for those VAR processes that require analysis. Similar steps could be taken to determine biosolids compliance with Class A pathogen status.

It is important that the samples of the biosolids be taken and analyzed for pathogen and VAR close enough to the time of land application to be reflective of current status, but not so close that the results are not available until after the biosolids have been land applied. If the delayed results showed that the land applied biosolids were not in compliance, then you would be subject to a potential enforcement action.

References

A Guide to the Biosolids Risk Assessment Methodology for the EPA 503 Rule. U.S. EPA, Office of Wastewater Management. EPA/832-B-93-005. Available late in 1994.

Biosolids Recycling: Beneficial Technology for a Better Environment. U.S. EPA, Office of Wastewater Management. EPA/832-R-93-009. June 1994.

Domestic Septage Regulatory Guidance: A Guide to the EPA 503 Rule. U.S. EPA, Office of Wastewater Management. EPA/832-B-92-005. September 1993.

Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge. U.S. EPA, Office of Research and Development. EPA/625/R-92/013. December 1992.

Guidance for Writing Permits for the Use or Disposal of Sewage Sludge (Draft). U.S. EPA, Office of Wastewater Management. March 1993. Final available late in 1994.

Guideline on Air Quality Models (Revised) (Appendix W of 40 CFR Part 51). U.S. EPA, EPA/450/2-78-027R. August 1993.

Land Application of Sewage Sludge: A Guide for Land Appliers on the Record Keeping and Reporting Requirements of the Federal Standards for the Use or Disposal of Sewage Sludge, 40 CFR Part 503. U.S. EPA, Office of Wastewater Enforcement and Compliance. EPA/831-B-002b. June 1994.

Methods Manual for Compliance with the BIF (Boilers and Industrial Furnaces) Regulations. U.S. EPA, Office of Solid Waste. EPA/530/SW-91-010. December 1990.

POTW Sludge Sampling and Analysis Guidance Document. U.S. EPA, Permits Division, Washington, DC. 1st edition, August 1989. NTIS: PB93-227957. Revised 2nd edition expected in 1994.

Preparing Sewage Sludge for Land Application or Surface Disposal—A Guide for Preparers of Sewage Sludge on the Monitoring, Record Keeping, and Reporting Requirements of the Federal Standards for Use or Disposal of Sewage Sludge, 40 CFR Part 503. U.S. EPA, Office of Wastewater Enforcement and Compliance. EPA/813-B-93-002a. NTIS: PB94-102415. September 1993.

Process Design Manual: Land Application of Sewage Sludge and Domestic Septage. U.S. EPA, Center for Environmental Research Information, Cincinnati, OH. Expected to be available in early 1995.

Process Design Manual: Surface Disposal of Sewage Sludge and Domestic Septage. U.S. EPA, Center for Environmental Research Information, Cincinnati, OH. Expected to be available in early 1995.

Sewage Sludge Sampling Video. U.S. EPA, Office of Wastewater Enforcement and Compliance. 1993. Available from the Office of Water Resource Center (202-260-7786) or EPA Regional Offices.

Surface Disposal of Sewage Sludge: A Guide for Owners/Operators of Surface Disposal Facilities on the Monitoring, Record Keeping, and Reporting Requirements for the Use or Disposal of Sewage Sludge, 40 CFR Part 503. U.S. EPA, Office of Wastewater Enforcement and Compliance. EPA/831-B-93-002c. June 1994.

Technical Support Document for Incineration of Sewage Sludge. U.S. EPA, Office of Water. NTIS: PB93-110617. 1993.

Technical Support Document for Land Application of Sewage Sludge, Volumes 1 and 2. U.S. EPA, Office of Water. NTIS: PB93-110583 and PB93-110575. 1993.

Technical Support Document for Reduction of Pathogens and Vector Attraction in Sewage Sludge. U.S. EPA, Office of Water. NTIS: PB93-110609. 1993.

Technical Support Document for Surface Disposal of Sewage Sludge. U.S. EPA, Office of Water. NTIS: PB93-110591. 1993.

Most of the EPA references are available from the following:

Office of Water Resource Center (OWRC)
202-260-7786 (phone)
U.S. EPA
401 M. Street, SW. (RC-4100)
Washington, DC 20460

Center for Environmental Research Information (CERI)
513-569-7562 (phone)
513-569-7585 (fax)
26 West Martin Luther King
Cincinnati, OH 45268

National Technical Information Service (NTIS)
800-553-6847 (phone)
703-487-4650 (phone)
703-321-8547 (fax)
U.S. Dept. of Commerce
5285 Port Royal Road
Springfield, VA 22161

Education Resource Information Center (ERIC)
614-292-6717 (phone)
614-292-0263 (fax)
C/O West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064

Appendix A

Permit Application Requirements

Permits that are issued to publicly owned treatment works (POTWs) must include standards for biosolids use or disposal. In addition, EPA may issue biosolids permits to other "treatment works treating domestic sewage" (TWTDS) (i.e., other facilities that generate, change the quality of, or dispose of biosolids). Please note that this document refers to these permits as "biosolids permits" instead of "sewage sludge permits," just as it refers to sewage sludge as biosolids throughout this appendix to recognize and emphasize that these wastewater products can be used beneficially.

The EPA's biosolids management program regulations establish a framework for permitting biosolids use or disposal. The regulations require submission of a permit application that provides the permitting authority with sufficient information to issue an appropriate permit.

A permit application must include information on the entity's identity, location, and regulatory status, as well as information on the quality, quantity, and ultimate use or disposal of the biosolids.

Because the biosolids permitting regulations were promulgated several years before the Part 503 standards, they describe the required application information in broad, almost generic terms. EPA has developed an interim application form and the Agency is planning to revise the permit application regulations to reflect specifically the Part 503 standards.

The deadlines for submitting permit applications were revised in 1993 and are as follows:

Applicants requiring site-specific pollutant limits in their permits (e.g., biosolids incinerators) and persons requesting site-specific limits (e.g., some surface disposal sites) were required to submit applications by August 18, 1993.

All other applicants with National Pollutant Discharge Elimination System (NPDES) permits are required to submit biosolids permit applications at the time of their next NPDES permit renewals.

So-called biosolids-only (non-NPDES) facilities that are not applying for site-specific limits, and are not otherwise required to submit a full permit application, only need to submit limited screening information and must have done so by February 19, 1994.

The permit application information that must be submitted depends on the type of facility and which biosolids use or disposal practices the facility employs. Questions on permit applications should be directed to the appropriate State and EPA Regional Biosolids Coordinators listed in Appendix B.

Biosolids-Only Entities

Some of the limited screening information submitted by a person with a biosolids-only operation (i.e., biosolids from a non-discharging treatment works that treats domestic sewage) typically will include the:

name, address, and phone number of the person who prepares the biosolids;

name and address of the person who either owns or leases the land;

location of the land either by street address or by latitude and longitude;

indication of whether the entity is a privately owned treatment works (POTW), Federally owned treatment works, blending or treatment operation, surface disposal site, or biosolids incinerator;

the amount of biosolids generated (and/or received from another facility), treated, and used or disposed;

available data on pollutant concentrations in the biosolids;

treatment to reduce pathogens and vector attraction properties of the biosolids;

identification of other facilities receiving the biosolids for further processing or for use or disposal; and

information on sites where the biosolids are used or disposed.

Other Entities Submitting Full Permit Applications

A full permit application includes much more comprehensive information than the limited screening information described above for [biosolids]-only entities. Some of the information contained in a full permit application typically will include the following:

A. General Information:

name, address, and phone number of the person who prepares the biosolids;

name and address of the person who either owns or leases the land;

location of the land either by street address or by latitude and longitude;

indication of whether the entity is a POTW, Federally owned treatment works, blending or treatment operation, surface disposal site, or biosolids incinerator;

indication of whether the entity is a Class I sludge management facility (i.e., a pretreatment POTW or another facility designated Class I by the permitting authority);

the NPDES permit number (if any) and the number and type of any relevant Federal, State, or local environmental permits or construction approvals applied for or received;

whether any biosolids use or disposal occurs on Native American lands;

a topographic map showing biosolids use or disposal facilities and water bodies 1 mile beyond the property boundary and drinking water wells 1/4 mile beyond the property boundary;

data on methods used to determine pathogen and vector attraction reduction status; and

data on pollutant concentrations in the biosolids.

B. Information on Generation of Biosolids or Preparation of a Material from Biosolids:

the amount of biosolids generated;

if biosolids are received from off site, the amount received, the name and address of the offsite facility, and any treatment the biosolids have received;

description of any treatment at the applicant's facility to reduce pathogens and vector attraction properties of the biosolids;

description of any bagging and distribution activities for the biosolids; and

if biosolids are provided to another facility for further treatment, the amount provided, the name and address of the receiving facility, and any treatment occurring at the receiving facility.

C. Information on Land Application of Bulk Biosolids (if the facility's biosolids are land applied):

the amount of bulk biosolids applied to the land;

the nitrogen content of bulk biosolids applied to the land;

the name and location of land application sites, and a copy of the land application plan if all sites have not been identified;

the name and address of the owner and the person who applies bulk biosolids to each site;

the site type and the type of crop or other vegetation grown;

description of any processes at each land application site to reduce vector attraction properties of the biosolids;

ground-water monitoring data, if available;

if bulk biosolids are subject to cumulative pollutant loading rates, information on how the necessary tracking and notification requirements will be met; and

if bulk biosolids are applied to the land in a different State, information on how the permitting authority in the receiving State will be notified.

D. Information on Surface Disposal of Biosolids (if the facility's biosolids are placed on a surface disposal site):

the amount of biosolids placed on surface disposal sites; and

the name, address, contact person, and permit number(s) for each surface disposal site, regardless of whether the applicant is the owner/operator.

In addition, the following information is required for each active biosolids unit that the applicant owns or operates:

the amount of biosolids placed on the active biosolids unit;

whether the active biosolids unit has a liner and leachate collection system and, if so, a description of each;

if biosolids are received from off site, the amount received, the name and address and permit number(s) of the offsite facility, and any treatment the biosolids have received;

description of any processes used at the active biosolids unit to reduce vector attraction properties of the biosolids;

demonstration that the active biosolids unit will not contaminate an aquifer;

- description of methane monitoring and closure plans; and
- if the applicant is requesting site-specific pollutant limits, information to support such a request.

E. Information on Incineration of Biosolids (if the facility's biosolids are fired in a biosolids incinerator):

- the name, address, contact person, mailing address, location, and relevant permit number(s) of each biosolids incinerator in which the applicant's biosolids are fired;
- the amount of biosolids from the applicant's facility that is incinerated;
- information to demonstrate compliance with National Emission Standards for Hazardous Air Pollutants (NESHAPs) for beryllium and mercury for each biosolids incinerator the applicant owns or operates;
- information on the other regulated metal pollutants (arsenic, cadmium, chromium, lead, and nickel) for biosolids that are incinerated;
- information to demonstrate compliance with the operational standard for total hydrocarbons (or carbon monoxide) for each biosolids incinerator the applicant owns or operates;
- the dispersion factor, control efficiency, and operating parameters for each biosolids incinerator the applicant owns or operates; and
- identification of monitoring equipment and air pollution control equipment used on each incinerator the applicant owns or operates.

All permit applications must be signed and certified. The permitting authority may request additional information to assess biosolids use or disposal practices, determine whether to issue a permit, or to identify appropriate permit requirements.

Appendix B

Federal and State Biosolids Contacts*

EPA Regional Biosolids* Coordinators

REGION 1

Thelma Hamilton (WMT-ZIN)
JFK Federal Bldg.
One Congress St.
Boston, MA 02203
(617) 565-3569
Fax (617) 565-4940

REGION 2

Alia Roufaeal
Water Management Division
26 Federal Plaza
New York, NY 10278
(212) 264-8663
Fax (212) 264-9597

REGION 3

Ann Carkhuff (3WM55)
841 Chestnut St.
Philadelphia, PA 19107
(215) 597-9406
Fax (215) 597-3359

REGION 4

Vince Miller
Water Division
345 Courtland St., NE.
Atlanta, GA 30365
(404) 347-3012 (ext. 2953)
Fax (404) 347-1739

*Also known as Sewage Sludge Contacts or Coordinators.

REGION 5

Ash Sajjad (5WQP-16J)
Water Division
77 W. Jackson Blvd.
Chicago, IL 60604-3590
(312) 886-6112
Fax (312) 886-7804

REGION 6

Stephanie Kordzi (6-WPM)
Water Management Division
1445 Ross Ave., #1200
Dallas, TX 75202-2733
(214) 665-7520
Fax (214) 665-6490

REGION 7

John Dunn
Water Management Division
726 Minnesota Ave.
Kansas City, KS 66101
(913) 551-7594
Fax (913) 551-7765

REGION 8

Bob Brobst (8WM-C)
Water Management Division
999 18th St., Suite 500
Denver, CO 80202-2405
(303) 293-1627
Fax (303) 294-1386

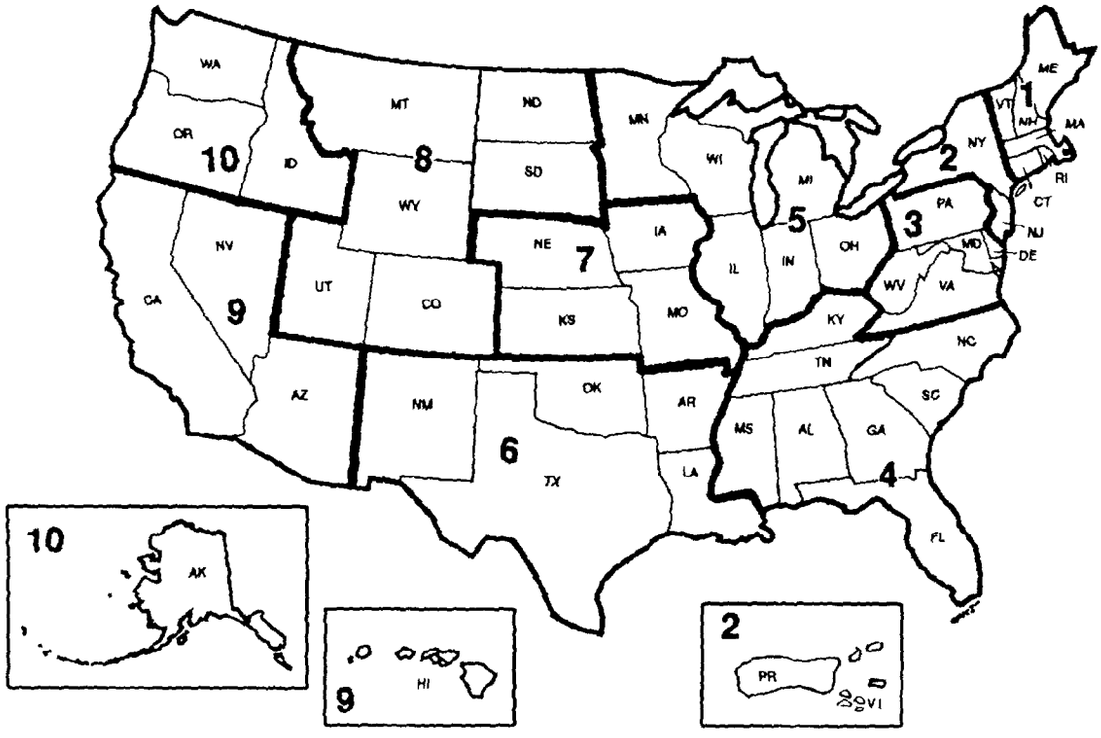
REGION 9

Lauren Fondahl
Permits Section
75 Hawthorne St. (W-5-2)
San Francisco, CA 94105
(415) 744-1909
Fax (415) 744-1235

REGION 10

Dick Hetherington (WD-184)
Water Management Division
1200 Sixth Ave.
Seattle, WA 98101
(206) 553-1941
Fax (206) 553-1775

U.S. EPA Regions



Region—State	Region—State	Region—State
4—Alabama	1—Maine	3—Pennsylvania
10—Alaska	3—Maryland	1—Rhode Island
9—Arizona	1—Massachusetts	4—South Carolina
6—Arkansas	5—Michigan	8—South Dakota
9—California	5—Minnesota	4—Tennessee
8—Colorado	4—Mississippi	6—Texas
1—Connecticut	7—Missouri	8—Utah
3—Delaware	8—Montana	1—Vermont
3—Washington, DC	7—Nebraska	3—Virginia
4—Florida	9—Nevada	10—Washington
4—Georgia	1—New Hampshire	3—West Virginia
9—Hawaii	2—New Jersey	5—Wisconsin
10—Idaho	6—New Mexico	8—Wyoming
5—Illinois	2—New York	9—American Samoa
5—Indiana	4—North Carolina	9—Guam
7—Iowa	8—North Dakota	2—Puerto Rico
7—Kansas	5—Ohio	2—Virgin Islands
4—Kentucky	6—Oklahoma	
6—Louisiana	10—Oregon	

State Biosolids* Contacts

ALABAMA

Cliff Evans
Municipal Branch
Water Quality Program
Alabama Dept. of Env. Mgmt.
1751 Cong. W.L. Dickinson Dr.
Montgomery, AL 36130
(205) 271-7816

ALASKA

Bill Fagan (Technical Assistance)
Alaska Dept. of Env. Conservation
Room 103
410 Willoughby Avenue
Juneau, AK 99811
(907) 465-5142

Dick Marcum (Permits)
Alaska DEC, Suite 105
410 Willoughby Avenue
Juneau, AK 99811
(907) 465-2614

ARIZONA

Melanie Barton
Solid Waste Section
Arizona Dept. of Environmental Quality
3033 N. Central Avenue
Phoenix, AZ 85012
(602) 207-4319

ARKANSAS

Daniel Clanton
Arkansas Dept. of Pollution Control Ecology
P.O. Box 8913
Little Rock, AR 72219
(501) 570-2826

Jamal Sulaimian
Arkansas Dept. of Pollution
8001 National Drive
Little Rock, AR 72209
(501) 562-7444

CALIFORNIA

Mark Bradley
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95801
(916) 654-6498

Scott McFarland
CA Integrated Waste Mgmt. Board
8800 Cal Centre Drive
Sacramento, CA 95826
(916) 255-2931

COLORADO

Phil Hegeman
Water Quality Control Division
Colorado Dept. of Public Health and the Environment
4300 Cherry Creek Dr. South
Denver, CO 80222
(303) 692-3598

*Also known as Sewage Sludge Contacts or Coordinators.

CONNECTICUT

Bob Norwood and Warren Herzig
Dept. of Environmental Protection
Water Compliance Unit
79 Elm Street
Hartford, CT 06106
(203) 424-3746
(203) 424-3801

DELAWARE

Ron Graeber
Waste Utilization Program
Large Wastewater Systems Branch
Dept. of Natural Resources and
Environmental Control
P.O. Box 1401, 89 Kings Highway
Dover, DE 19903
(302) 739-4761

Bob Zimmerman/Jenny McDermott
Branch Administrators
Waste Utilization Program
Division of Water Resources
Dept. of Natural Resources and
Environmental Control
P.O. Box 1401, 89 Kings Highway
Dover, DE 19903
(302) 739-5731

DISTRICT OF COLUMBIA

Ronald Eng
Water Resources Management
Division
2100 M.L.K. Ave., SE., Suite 203
Washington, DC 20032
(202) 404-1120

FLORIDA

Juliene Gissendanner
Domestic Waste Section
Florida Dept. of Env. Regulation
Twin Towers Office Building
2600 Blairstone Road
Tallahassee, FL 32399-2400
(904) 488-4525

GEORGIA

Nancy Prock
Municipal Permitting Program
Environmental Protection Div.
Georgia DNR
4244 International Pkwy., Suite 110
Atlanta, GA 30354
(404) 362-2680

HAWAII

Dennis Tulang
Wastewater Branch
Hawaii Dept. of Health
P.O. Box 3378
Honolulu, HI 96801
(808) 586-4294

IDAHO

Jerry Yodder
Permits & Enforcement
Division of the Environment
Dept. of Health and Welfare
1410 North Hilton
Boise, ID 83706-1253
(208) 334-5856

ILLINOIS

S. Alan Keller
Illinois EPA, Permits Section
P.O. Box 19276
2200 Churchill Road
Springfield, IL 62794-9276
(217) 782-0610

INDIANA

Dennis Lassiter
Permits Section
Indiana Dept. of Env. Mgmt.
P.O. Box 6015
105 S. Meridian
Indianapolis, IN 46206-6015
(317) 232-8732

IOWA

Billy Chen
Iowa Dept. of Natural Resources
Henry A. Wallace Bldg.
900 East Grand
Des Moines, IA 50319
(515) 281-4305

KANSAS

Ed Dillingham
Kansas Dept. of Health &
Environment
Forbes Field Building 283
Topeka, KS 66620
(913) 296-5513

KENTUCKY

Art Curtis
Facilities Construction Branch
Division of Water
Kentucky Dept. of Natural
Resources & Environmental
Protection Cabinet
Frankfort Office Park - 14 Reilly Road
Frankfort, KY 40601
(502) 564-4310

Bob Bickner/Mark Crim
Facilities Construction Branch
Division of Water
Kentucky Dept. of Natural
Resources & Environmental
Protection Cabinet
Frankfort Office Park - 14 Reilly Road
Frankfort, KY 40601
(502) 564-6716

LOUISIANA

J. Kilren Vidrine
Water Pollution Control Div.
Louisiana Dept. of
Environmental Quality
P.O. Box 82215
Baton Rouge, LA 70884-2215
(504) 765-0534

Hoa Van Hguyen
Solid Waste Div.
Louisiana Dept. of
Environmental Quality
P.O. Box 82178
Baton Rouge, LA 70884-2178
(504) 765-0249

MAINE

David Wright
Maine DEP-Sludge Residuals Unit
State House, Station 17
Augusta, ME 04333
(207) 287-2651

MARYLAND

Simin Tigari
Sewage Sludge Div.
Haz. & Solid Waste Mgmt. Admin.
MD Dept. of the Environment
2500 Broening Hwy.
Baltimore, MD 21224
(410) 631-3375

MASSACHUSETTS

Dennis (Rick) Dunn
MA DEP
1 Winter Street
Boston, MA 02108
(617) 556-1130

MICHIGAN

Barry R. Burns
Permits Section
Michigan DNR Surface W.Q. Div.
Knapp's Center, Second Floor
P.O. Box 30273
Lansing, MI 48909
(517) 335-3301

Bob Deatrick
Hydrogeologic Review Unit
Groundwater Section
Michigan DNR
P.O. Box 30241
Lansing, MI 48909
(517) 373-8411

MINNESOTA

Jorja A. DuFresne
Municipal Section
Water Quality Division
Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155
(612) 296-9292

MISSISSIPPI

Glen Odom - Chief Delegator
Municipal Permit Compliance Branch
Surface Water Quality Div.
Office of Pollution Control
Mississippi Dept. of Env. Qual.
P.O. Box 10385
Jackson, MS 39289-0385
(601) 961-5171

MISSOURI

Ken Arnold
Missouri Dept. of Natural Resources
P.O. Box 176
205 Jefferson Street
Jefferson City, MO 65102
(314) 751-6825

MONTANA

Pat Burke
Water Quality Bureau
Dept. of Health & Environ. Sciences
Cogswell Building
Helena, MT 59620
(406) 444-7343

NEBRASKA

Rick Bay
Engineering Division
Nebraska Dept. of Environ. Control
P.O. Box 94877, Statehouse Station
Lincoln, NB 68509-8922
(402) 471-4200

Rudy Fiedler (Technical Assistance)
Engineering Division
Nebraska Dept. of Environ. Control
Suite 400, The Atrium, 1200 N. Street
P.O. Box 98922
Lincoln, NB 68509-8922
(402) 471-4239

NEVADA

Mahmood Azad
Nevada Division of
Environmental Protection
333 West Nye Lane
Carson City, NV 89710
(702) 687-4670 x 3141

NEW HAMPSHIRE

Selena Makofsky
Sludge & Septage Mgmt. Section
Dept. of Environmental Services
P.O. Box 95 — Hazen Drive
Concord, NH 03301
(603) 271-3398

NEW JERSEY

Mary Jo Aiello, Chief
Bureau of Pretreatment &
Wastewater Facilities Regulation
Program
NJ DEPE (CN-029)
Trenton, NJ 08625-0029
(609) 633-3823

NEW MEXICO

Arun Dhawan
Construction Programs Bureau
New Mexico Environment Dept.
P.O. Box 2611
1190 St. Francis Drive
Santa Fe, NM 87502
(505) 827-2809

NEW YORK

Sally Rowland
Residuals Management Section
Division of Solid Waste
NY State DEC
50 Wolf Road
Room 422
Albany, NY 12233-4014
(518) 457-7336

NORTH CAROLINA

Dennis Ramsey/Donald Safrit
Water Quality Section
NC Dept. of Environmental
Management
512 N. Salisbury St.
Raleigh, NC 27626-0535
(919) 733-5083

Allen Wahab, Supervisor
Local Planning Management Unit
North Carolina Department of
Environmental Management
P.O. Box 29535
Raleigh, NC 27626-0535
(919) 733-6900

NORTH DAKOTA

Gary Bracht
Environmental Health Section
Division of Water Quality
North Dakota Dept. of Health
1200 Missouri Avenue, P.O. Box 5520
Bismark, ND 58505-5520
(701) 221-5210

OHIO

David Jensuk
Div. of Surface Water
Ohio EPA
P.O. Box 1049
1800 WaterMark Drive
Columbus, Ohio 43216-0149
(614) 644-2021

Mark Stump
Div. of Surface Water
Ohio EPA
P.O. Box 1049
1800 WaterMark Drive
Columbus, Ohio 43216-0149
(614) 644-2001

Dan Harris (co-disposal, monofill)
Div. of Solid & Infectious
Waste Mgmt.
Ohio EPA
P.O. Box 1049
1800 WaterMark Drive
Columbus, Ohio 43266-0149
(614) 644-2621

OKLAHOMA

Danny Hodges
Water Quality Service
Oklahoma State Dept. of Health
1000 N.E. Tenth
Oklahoma City, OK 73117-1299
(405) 271-7362 x127

OREGON

Mark Ronayne
Municipal Waste Section
Dept. of Environmental Quality
811 S.W. 6th Avenue
Portland, OR 97204
(503) 229-5279

PENNSYLVANIA

Steve Socash
Bureau of Waste Mgmt.
PA DER
P.O. Box 8472
Harrisburg, PA 17105-8472
(717) 787-7381

R.B. Patel
Division of Water Quality Mgmt.
PA DER
P.O. Box 8472
Harrisburg, PA 17105-8472
(717) 787-8184

RHODE ISLAND

David Chopy
RI Division of Water Resources
291 Promenade Street
Providence, RI 02908-5756
(401) 277-3961

SOUTH CAROLINA

Michael Montebello
Domestic Wastewater Division
South Carolina Dept. of Health
& Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 734-5300

SOUTH DAKOTA

Bill Geyer
SD Dept. of the Environment
& Natural Resources
Joe Foss Building
523 East Capital
Pierre, SD 57501-3181
(605) 773-3351

TENNESSEE

John McCurran
Div. of Water Pollution Control
TN Dept. of Environment and
Conservation
401 Church Street, 6th Floor Annex
Nashville, TN 37243-1534
(615) 532-0625

TEXAS

Stephen M. Bell
Construction Grants Div.
Texas Water Development Board
P.O. Box 13231, Capitol Sta.
Austin, TX 78711-3231
(512) 463-8491

Paul Curtis
Texas Natural Resources
Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087
(512) 239-4580

UTAH

Lisa Rogers
Div. of Water Quality
UT Dept. of Env. Quality
P.O. Box 144870
Salt Lake City, UT 84114-4870
(801) 538-6146

VERMONT

Katie Gehr
Wastewater Mgmt. Div.
Dept. of Environmental Conservation
103 South Main Street
Sewing Building
Waterbury, VT 05671-0405
(802) 241-3822

VIRGINIA

Cal M. Sawyer (Technical
Assistance)
Division of Wastewater Engr.
Virginia Dept. of Health
109 Governor Street
Madison Building
Richmond, VA 23219
(804) 786-1755

Martin Ferguson (Permits)
Dept. of Environmental Quality
Office of Resource Mgmt.
P.O. Box 11143
Richmond, VA 23230-1143
(804) 527-5030

WASHINGTON

Kyle Dorsey
Solid & Haz. Waste Program
Dept. of Ecology (PV-11)
Rowe 6, Building 4
4224 6th Ave., SE
Olympia, WA 98404-8711
(206) 459-6356

WISCONSIN

Greg Kester
Bureau of Wastewater Mgmt.
(WW/2)
Wisconsin DNR
P.O. Box 7921
Madison, WI 53707
(608) 267-7611

WEST VIRGINIA

Clifton Browning
Div. of Water Resources
West VA DNR
1201 Greenbrier Street
Charleston, WV 25311
(304) 558-2108

WYOMING

Larry Robinson
Water Quality Division
Dept. of Environmental Quality
Herschler Bldg., 4th Floor West
122 West 25th Street
Cheyenne, WY 82002
(307) 777-7075

Appendix C

U.S. Department of the Interior
Fish and Wildlife Service
Regional Contacts

APPENDIX C
U.S. Department of the Interior, Fish and Wildlife Service Regional Contacts

Region	Jurisdiction	Regional Directors	Assistant Regional Directors Law Enforcement
1	California, Hawaii, Idaho, Nevada, Oregon, Washington, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and the Pacific Trust Territories	Michael J. Spear Eastside Federal Complex 911 N.E. 11th Avenue Portland, Oregon 97232-4181 (503) 231-2234	David L. McMullen Eastside Federal Complex 911 N.E. 11th Avenue Portland, Oregon 97232-4181 (503) 231-6125
2	Arizona, New Mexico, Oklahoma, and Texas	John Rogers P.O. Box 1306 Albuquerque, New Mexico 87103 (505) 766-2321	John E. Cross P.O. Box 329 Albuquerque, New Mexico (505) 766-2091
3	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin	Sam Marler P.O. Box 45 Federal Bdg, Fort Snelling Twin Cities, Minnesota 55111 (612) 725-3563	William Zimmerman (Acting) Box 45 Federal Bldg, Fort Snelling Twin Cities, Minnesota 55111 (612) 725-3530
4	Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, N. Carolina, S. Carolina, Tennessee, Puerto Rico, and the U.S. Virgin Islands	James W. Pulliam, Jr. 1875 Century Blvd. Atlanta, Georgia 30345 (404) 679-4000	Monty Halcomb 1875 Century Blvd. Atlanta, Georgia 30345 (404) 679-7057
5	Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and W. Virginia	Ronald E. Lambertson 300 Westgate Center Drive Hadley, Massachusetts 01035 (413) 253-8300	Albert Hester 300 Westgate Center Drive Hadley, Massachusetts 01035 (413) 253-8274
6	Colorado, Kansas, Montana, Nebraska, N. Dakota, S. Dakota, Utah, and Wyoming	Ralph Morgenweck P.O. Box 25486 Denver Federal Center Denver, CO 80225 (303) 236-7920	Terry Gross P.O. Box 25486 Denver Federal Center Denver, CO 80225 (303) 236-7540
7	Alaska	Walter O. Stiegiltz 1100 E. Tudor Road Anchorage, Alaska 99503 (907) 785-3542	R. David Purinton P.O. Box 92597 Anchorage, Alaska 99509-2597 (907) 786-3311

COMMENTS REQUESTED ON THIS PART 503 RULE GUIDANCE

Please let us know what you think about this guidance. Please offer any suggestions you might have for future improvement using this comment sheet. Please send your comments to us at the U.S. Environmental Protection Agency, Office of Wastewater Management, Municipal Technology Branch (4204), Washington, DC 20460.

1. Is this Part 503 rule guidance useful to you?

_____

_____

_____

2. Please indicate what you like about the guidance.

_____

_____

_____

3. Please also indicate what you do not like about the guidance.

_____

_____

_____

4. Please offer suggestions for improvement of the guidance.

_____

_____

_____

5. Please offer suggestions for development of other materials that you believe would be helpful.

_____

_____

_____

6. Name and phone number (optional).

_____

_____

_____

EPA/832/R-93/003

Affix
Postage
Here

U.S. Environmental Protection Agency
Office of Wastewater Management
Municipal Technology Branch
(4204)
Washington, DC 20460

United States
Environmental Protection Agency
(4204)
Washington, DC 20460