State of Oregon
Department of Environmental Quality Memorandum

To: DEQ Water Quality Staff **Date:** December 8, 2005

From: Lauri Aunan
Administrator, Water Quality Division

Subject: Implementing Oregon's Biosolids Program
Internal Management Directive

This memorandum transmits the final version of the Internal Management Directive (IMD) for Implementing Oregon's Biosolids Program. This IMD was developed under the Water Quality Program Process for IMDs, dated February 7, 2005, and received review from external stakeholders and internal water quality permit staff and managers. The IMD was also submitted to EPA Region 10's biosolids coordinator for review.

I recognize and greatly appreciate the hard work on this IMD by water quality staff and managers. Thank you all for your time and effort in drafting and reviewing the various versions of the IMD, for the training that has been held and the training to come. We will need to "check in" on this IMD at least once a year to see how it is working and where it may need to be improved.

The purpose of this IMD is to:

- Provide policy direction for department staff to facilitate better communication with stakeholders on the applicability of federal and state biosolids program requirements,
- Reduce confusion over policy interpretation, and
- Formally incorporate into Oregon policy federal technical guidance that has been developed over the years and that is already being used in Oregon.

This IMD is vital for a consistent approach in implementing an effective statewide biosolids program. It is expected this IMD will be amended in the future to address topics that were identified as needing further discussion.

Biosolids program regional staff extensively discussed the IMD and a final discussion/training meeting was held on November 8, 2005. The IMD was also discussed with the water quality permit managers sub-group on August 24, 2005, and it was recommended that a presentation be made to water quality permitting staff on a few pertinent issues. A presentation on those issues was given to water quality staff at the statewide water quality permits workshop on November 8, 2005.

You should begin referring to this IMD which may be found at http://www.deq.state.or.us/wq/pubs/imds/biosolids.htm. Please talk with your manager or the biosolids program regional staff if you have questions. Headquarters contacts are Judy Johndohl at (503) 229-6896 and Mark Cullington at (503) 229-6442.

cc: W ater Quality Managers
Reg ional Administrators

Implementing Oregon's Biosolids Program

State of Oregon
Department of
Environmental
Quality

Internal Management Directive
December 2005

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Introduction

Purpose

The purpose of this Internal Management Directive (IMD) is to:

- Provide policy direction for department staff to facilitate better communication with stakeholders on the applicability of federal and state biosolids program requirements;
- Reduce confusion over policy interpretation; and
- Formally incorporate into Oregon policy federal technical guidance that has been developed over the years.

Why this IMD is needed

The land application of biosolids is a comprehensive practice integrating requirements under the Clean Water Act and the operational realities of agricultural management. While federal and state regulations mandate requirements for wastewater treatment, they give minimal direction on how requirements should be implemented and what operational issues are associated with biosolids land application. This IMD is needed to supplement these requirements and ensure effective and consistent decision making in implementation of the biosolids program in Oregon.

How this IMD was developed

This IMD was developed by identifying issues from past department policy documents and from discussions with staff and stakeholders as to where clarification is needed on implementing biosolids regulations. Issues were researched using federal technical guidance documents and approaches developed by other states.

When this IMD will be used

This IMD will be used by department staff responsible for implementing the state biosolids program. Department staff will use this IMD to:

- Review and approve biosolids management plans and site authorizations;
- Develop permit requirements for biosolids; and
- Address technical issues that arise during wastewater treatment facility planning and with daily operations associated with biosolids land application.

The regulated community and interested parties may find this directive useful as they develop and manage biosolids programs in accordance with state rules and federal regulations.

Is this IMD applicable to domestic septage?

This IMD focuses on biosolids, although several topics are relevant to the land application and management of domestic septage. The department intends to later develop policy specifically addressing the beneficial use of domestic septage through land application. Discussions with staff and stakeholders will identify where clarification is needed on implementing domestic septage regulations.

1. Biosolids Management Plan

Overview

A biosolids management plan is the main administrative tool of Oregon's biosolids program. It is specific to a facility and is used to guide the wastewater treatment facility's solids operations and biosolids land application activities. Together with a facility's water quality permit and land application site authorizations, the plan provides assurance that biosolids processing and management activities are addressed in a comprehensive manner and problems with compliance are minimized. Approved plan provisions are considered to be permit conditions that are enforceable, and the plan must be kept current and on file with the permit [OAR 340-050-0031(2) and (3)]. This section provides information on development of a biosolids management plan and a domestic septage management plan and why a land application plan is considered part of a biosolids management plan.

Who needs a plan and when?

Any person who intends to land apply biosolids or domestic septage must submit a solids management plan to the department for review and approval at least 60 days prior to biosolids land application commencing [OAR 340-050-0031(1)]. A land application plan as required in OAR 340-050-0031(7) may be considered a part of the biosolids management plan because the contents of the biosolids management plan must address land application. A new or renewing NPDES or WPCF permit applicant is required to submit a biosolids or domestic septage management plan and a land application plan to the department with the permit application [OAR 340-050-0015(4)]. The plan is to be developed as outlined in OAR 340-050-0031(5) and (7). For lagoon treatment systems, the permit renewal notice letter may not require a plan if it is unlikely that the permittee will remove biosolids during the next permit cycle.

Plan contents

A biosolids management plan provides a description of solids processing, management aspects of biosolids production, and land application information. Under state rules, the content and procedural requirements of a federal land application plan can be addressed in a biosolids management plan if land application is occurring. The following information must be included in the biosolids management plan as outlined in OAR 340-050-0031.

Solids Processing and Management

- Wastewater treatment process (e.g., extended aeration, SBR, non-aerated lagoon), including unit processes (e.g., headworks, primary, secondary, and tertiary treatment, disinfection system);
- Wastewater treatment design flow, flow origin (e.g., percent domestic, industrial, commercial, and domestic septage), and flow schematics;
- Solids sources and treatment (e.g., description of how primary, secondary, and tertiary solids are removed, thickened, digested, and dewatered);
- Quantities of raw and stabilized solids volumes generated annually;
- Process used to attain pathogen reduction and method used to attain vector attraction reduction, including supporting data;
- Solids storage facilities use and volume (e.g., lagoons, drying beds, on-site

designated holding areas), additional treatment occurring within these facilities, and treatment processes used to achieve adequate seasonal storage capabilities at the wastewater treatment facility or elsewhere when land application is not occurring;
- Solids handling and transport (e.g., means used to load and transport biosolids);
- Biosolids monitoring and sampling program, including biosolids analysis and certification statements; and
- Remedial procedures (e.g., contact names and phone numbers, how a failure will be corrected or how a spill will be cleaned up, etc.) in the event of:
    - A solids treatment process failure (e.g., digester breakdown or upset),
    - A solids spill at the wastewater treatment facility or solids generating source, and
    - A biosolids spill between the generating source and land application site or receiving facility (e.g., solids transferred from one facility to another where they would be processed).

Land Application
- All land application sites authorized by the department (e.g., exact location stating address, township, range, and section, and acreage) including date authorized and dates land application occurred if a site was used;
- Site monitoring, recordkeeping, and reporting procedures (e.g., site access restrictions, how and where records are maintained, how sample analyses are reported);
- Application methods and land application equipment used (e.g., type of land applicator, dispersal mechanism, amount of biosolids dispersed with vehicle speed and time of travel, width of dispersal);
- Crop management practices (e.g., annual and long-term application rates, soil testing, cropping sequences, harvest cycles, tilling practices, irrigation practices, fertilizer use);
- Site crops (including acreage of each crop) and crop assimilative capacity (nitrogen);
- Staging and field storage (if applicable), including temporary or seasonal limitations;
- Potential and known sites to be used within the term of the permit;
- Geographic location of new sites that are not specifically listed when the permit application is submitted (e.g., on a county basis or more defined area);
- Land application site selection criteria for new sites (e.g., landform type, crop, slope); and
- Site management practices to be implemented at all new sites (e.g., staging, access restrictions, how setbacks are achieved).

Plan template and review

Templates for a biosolids management plan and land application plan were developed by the department to ensure that all required elements of the plans are addressed by the permittee (see Appendix A). Although the plan templates should be the same for all facilities, each plan needs to be tailored to the specifics of a permittee's program.

Consistent use of a standardized template by facilities will facilitate department review and approval of a plan. Department comments on a draft plan should be discussed with the permittee. Prior to department approval, all elements of the biosolids management and land application plans should be understood by the permittee, and the plans must go through the public notice process (see Public Participation section).

The public notice process

As discussed in the Public Participation section and stated in OAR 340-050-0015(8), the biosolids management plan that is developed and completed with a facility's draft permit, will be part of the public participation process for the draft permit prior to issuance or renewal of the permit. During the public notice process, the public will have the opportunity to review and comment on the plan, including the land application activities [as required in 40 CFR §122.21(q)(9)(v)], and the permit.

If the land application elements of a land application plan need to be modified during the permit cycle, this would be considered a major modification under OAR 340-045-0055(2)(b) and (3)(c) would be subject to a 35 day public comment period for NPDES permits and 30 day period of WPCF permits (see Public Participation section for further discussion). Any change to a biosolids or domestic septage management plan and a land application plan requires department written approval [OAR 340-050-0031(3)].

When to update or review a plan

A biosolids management plan needs to be kept current to address new circumstances in biosolids production, treatment processes, land application activities, and the addition of newly authorized land application sites. Facilities should review their plans during preparation of the annual reports to ensure that their plans are accurate. A plan, including any revised or updated information, must be submitted to the department with an application for a new or renewed permit if land application will occur.

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2. Public Participation

Overview

Biosolids management and land application plans are subject to public participation. These requirements include:

- Public notice by the department, during the NPDES or WPCF permitting process, of the biosolids management plan and if the permittee proposes to land apply biosolids during the term of the permit, the land application plan. The opportunity for public review and comment is provided during this process, and a public hearing also may be required [OAR 340-050-0015(8)].
- Public notification (i.e., neighbor notification by mail or door-to-door visits) by the permittee when land application sites are proposed for use [40 CFR Parts 122 and 501, and OAR 340-050-0015(10)].

This section discusses the public notice process for permit issuance, plan modifications, and authorization of land application sites including sensitive sites. Methods of public notification are also discussed.

Public Notice During the Permit Issuance Process

Background on public notice during permit issuance

The NPDES or WPCF permit issuance process is generally the best time to develop or update a biosolids management plan because it ensures that the public participation requirements for biosolids activities are addressed [OAR 340-050-0015(8)]. If land application of biosolids will occur during the term of the permit, a land application plan must be included with the permit application [OAR 340-050-0015(7)]. During the permit issuance process for a new or renewed permit, the draft permit will include appropriate conditions for biosolids monitoring and reporting, and a requirement that biosolids be managed in accordance with the biosolids management plan, land application plan, and site authorization letters. The land application plan may be considered a component of the biosolids management plan.

The public notice for the proposed issuance of the permit must inform interested persons about the wastewater discharge permit activities, including any proposed biosolids land application activities, and indicate that the biosolids management plan is available for review. The public notice must be issued for a minimum of either:

- 30 days for *renewal* of a WPCF individual permit regulated under OAR 340-045, or
- 35 days for a *new* WPCF (regulated under OAR 340-045) or a *new or renewed* NPDES individual permit, unless otherwise specified in OAR 340-045-0027. If comments are received from at least 10 persons or from an organization representing at least 10 persons, a public hearing must be held prior to permit issuance and approval of the biosolids management plan. The department is required to provide a minimum of 30 days notice for a hearing if one is scheduled.

When the public comment period has ended and comments addressed, the permit would be issued and the new or updated biosolids management plan, including the land application plan, approved. Plan approval may not occur prior to the closing of the public comment period and issuance of the permit.

Public notice contents

The public participation process is coordinated by the department regional office that will be issuing the permit. The public notice describes the proposed activities, including the following minimum information:

- Name and address of the permittee and applicant and, if different, the location of the facility regulated by the permit;
- Type of facility and processes regulated by the permit, including biosolids and land application activities;
- Specific geographic locations (e.g., specific counties or smaller defined political boundary) where the permittee intends to land apply biosolids during the term of the permit;
- Description of the proposed permit action (i.e., new, renewal or modification);
- Special conditions of the permit;
- Compliance, enforcement, and complaint history, including resolutions;
- A brief description of the public comment procedures; and
- Department regional office processing the permit, including the name, address, and telephone number of a contact person from whom additional information can be obtained.

Public Notice for Plan Modifications

Plan modifications requiring public notice

40 CFR §501.15(c)(2)(ii)(E) requires a public notice and comment process for a land application plan if the plan is:

- Developed after a permit is issued or renewed,
- Developed in accordance with a compliance condition in the permit, or
- Revised to incorporate new or modified land application plan elements.

If a biosolids management plan needs to be modified to address new or revised land application elements, the plan must go through the department-initiated public notice process established for permitting actions because provisions in the management plan are considered permit conditions [OAR 340-050-0031(2)]. For example, if a new land application site is being considered for authorization and the site is not located in a county or geographical location identified in the plan and/or permit, a modification to the plan and/or permit is required. If additional conditions need to be included in the permit or existing permit conditions modified to address the new or revised plan and land application elements, the permit must also be modified through a public notice process. The department will notify the permittee by registered or certified mail of the modification and the reasons for the modification [OAR 340-045-0055(1)]. Only those permit conditions being modified would be open for public comment.

The permitting action is considered a major modification, and would be classified as either a Category III action under OAR 340-045-0055(2)(b) or Category II action under OAR 340-045-0055(3)(c). The public comment period required for a NPDES permit is a minimum of 35 days, and for a WPCF permit is a minimum of 30 days. A public hearing may be required for Category III actions. A filing fee (currently $60) and a permit modification fee (currently $600) for the modification are required under OAR 340-045-0075(4) and (5)(e), respectively. If the permit is for a septage alkaline stabilization facility, the modification requires a filing fee (currently $60) and a permit modification fee (currently $240) under OAR 340-045-0075(5)(g).

Plan modifications allowed without public notice

A facility's solids process operations or biosolids management activities may change over time, therefore the biosolids management plan needs to be updated and revised. An existing approved biosolids management plan being modified after permit issuance or renewal is not subject to the requirements for permit modification and additional public notice if there is no proposed revision to any of the land application plan elements or any activity that is a condition in the NPDES or WPCF permit. A permit modification is not needed and public notice is not required if:

- The proposed land application sites meet the site selection criteria in the approved biosolids management plan,
- The site management practices in the approved biosolids management plan will be implemented, and
- The plan went through the public notice process.

Note, however, that OAR 340-050-0031(3) requires written department approval for all changes to biosolids management plans.

Public Notice of Land Application Activities

Permittee responsibilities

A permittee intending to land apply Class B biosolids on new sites must notify the public of the proposed land application activity given that the permitting provisions in 40 CFR Parts 122 and 501 are applicable [OAR 340-050-0015(10)]. As stated in 40 CFR §122.21(q)(9)(v)(E), the applicant's land application plan must provide "for advance public notice of land application sites in the manner prescribed by State and local law. When State or local law does not require advance public notice, it must be provided in a manner reasonably calculated to apprize the general public of the planned land application."

Methods of public notification

For all proposed land application sites, providing information to neighbors about biosolids land application activities will help to educate people about the beneficial use of biosolids and address any specific concerns and questions they may have. Promoting the benefits of land applying biosolids through open communication can also increase the number of farmers interested in land application.

There are two methods typically used to meet the requirements for notification. A printed flyer from the permittee with information about biosolids land application that is mailed or left with neighbors sends a positive message about the beneficial use of biosolids. The flyer should include the permittee's contact name and phone number. Many Oregon municipalities routinely practice this 'good neighbor' policy and have found that this method of notification results in reduced complaints. A permittee may also elect to go "door-to-door" to inform neighbors of the proposed land application activity. This method provides neighbors an open opportunity to discuss any concerns they may have, and allows the permittee an opportunity to establish credibility.

Department review of public notice effort

Prior to authorizing the use of a proposed land application site identified after approval of a biosolids management plan, the department must be assured that public notification of the proposed site has occurred. To ensure that the public has adequate opportunity to comment to the permittee or the department on the proposed site, it may be beneficial to allow a 30 day comment period before issuing the site authorization letter. The department will request the permittee to submit documentation indicating:

- How notification was made and to whom (including name, address, and telephone number if known),
- Date and time of notification, and
- Result of notification (e.g., information flyer left at door, discussion with occupant).

The department expects notification to be made to:

- People living next to a proposed site who may be affected by the land application activities,
- All property owners and/or occupants within a subdivision or development that is adjacent to a land application site,
- All property owners and/or occupants contiguous to a parcel, up to the outer boundary, that is adjacent to a land application site, and
- Property owners that may be directly affected due to wind conditions and topography.

Sensitive sites and the opportunity for public comment

During the site authorization process, department staff should address potential issues of proposed new land application sites that may be sensitive with respect to protection of public health and the environment. The determination of a sensitive site should be based on the department's field evaluation and site information provided by the permittee. If department staff perceive that sensitive site issues exist or may exist, these issues should be discussed with the permittee and a recommendation may be made to select an alternative site. A proposed site application authorization request for a sensitive site that is not withdrawn by the permittee will be subject to the public participation process.

Prior to the authorization of any proposed land application site that may be sensitive with respect to residential housing, run-off potential, or threat to groundwater, OAR 340-050-0030(2) requires that an opportunity for public comment be provided, and if required a public hearing. If at least 10 people, or an organization representing at

least 10 people, indicate concerns about a proposed site during the public comment period, the department will provide an opportunity for a public hearing as required in OAR 340-050-0030(2)(a). The public notice for this action shall include a minimum of 35 days for written comments to be submitted [OAR 340-045-0027(1)(c)(C)]. If it is determined that a public hearing will be held, a minimum of 30 days notice must be provided by the department and the date and time of the public hearing shall be included in the public notice. Based on the issues regarding a sensitive site, the department may determine prior to issuance of the notice for the public comment period that a public hearing is necessary, and therefore only one public notice would be needed.

Comments received during the public comment period and the public hearing will be considered in the department's decision on authorizing the site. Final action must be taken by the department within 30 days of the closure of the public comment period or closure of the hearing's record [OAR 340-050-0030(2)(b)].

Circumstances when further public notification may be necessary

The department may find it necessary to reissue a site authorization letter to update specific conditions that may have changed at a land application site. If the changes are significant or are in response to public concerns, the department may request the permittee to notify the public of the changes.

It is important that the permittee be aware of changes in property ownership and/or occupants who may be affected by the land application activities. The permittee should provide notification of the land application activity to any new property owner(s) and/or occupant(s) who have moved into an area where notification was previously made.

Exemption to the public comment process

The State of Oregon recognizes exceptional quality (EQ) biosolids as a safe, marketable commodity with characteristics and attributes similar to readily available commercial soil amendments, and thus EQ biosolids are exempt from the public comment process prior to use or land application.

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3. Vector Attraction Reduction

Overview

Biosolids that are to be applied to the land must meet one of the requirements specified for vector attraction reduction (VAR) in 40 CFR §503.33 [OAR 340-050-0026(2)(c)]. The federal regulations outline ten VAR options which are available to wastewater treatment facilities that produce biosolids for land application (see Table 3-1, p. 13). The volatile solids reduction requirement, Option 1, is most commonly used in Oregon. To demonstrate VAR, this option is designed to represent the biosolids that are going to be land applied or marketed, not individual digester performance. This section clarifies how Option 1 should be applied through accurate sampling and valid data, and provides a summary of VAR options.

Volatile Solids Reduction - Option 1

What is volatile solids reduction?

Volatile solids are representative of the unstable, putrescible organic matter in solids derived from the treatment of domestic wastewater. Reducing volatile organic matter reduces putrescibility and odors, and thus vector attraction is reduced if a 38 percent reduction in volatile solids occurs. Option 1 for VAR, as stated in 40 CFR §503.33(b)(1), requires that at least a 38 percent reduction in volatile solids during sewage sludge treatment be achieved. This option is most appropriate for sewage sludge processed by aerobic and anaerobic biological treatment systems.

Representative sampling

To demonstrate that the volatile solids reduction requirement is met, samples should be representative of the biosolids at the point in which they will be land applied. If compliance can be met at the outlet of a digester, this is acceptable (except for composting processes) but not specifically required for compliance purposes. Performance of individual digesters for VAR purposes is not a primary concern and is monitored separately. For most treatment process scenarios, any processing after digestion, including short-term storage or dewatering, has no influence on the volatile solids content. But where further reduction may occur in blending or from lagoon storage or drying beds, it is appropriate to calculate the volatile solids loss from when sewage sludge enters the sewage sludge treatment process to the endpoint of the entire treatment process.

Sampling location

The sampling location for raw volatile solids is normally the point where solids exit a primary clarifier, or a pre-digestion unit such as a gravity thickener, gravity belt thickener, dissolved air flotation thickener (DAFT) or other thickening process unit. Both the "feed" sludge and the discharge from individual digesters should be representative composite samples to show VAR compliance for the biosolids going out for beneficial use. A digester failing to meet normal operational criteria should

not be included in the composite sample and those solids should not be blended with other digester solids for land application. Also, caution is advised for interpreting analysis from any sample where the addition of polymer has occurred during the thickening process prior to digestion. Obtaining a sample of the waste activated sludge prior to the thickening process will be more representative of what the "feed" sludge is and the overall actual volatile solids reduction that occurs during digestion.

Required number of samples

The number of samples taken should be sufficient and representative of the volume and nature of solids before and after treatment within a reporting period. The EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge*, 2003 (EPA/625/R-92/013), page 84, states that "seven or more determinations are recommended to reduce the error band around the mean to minimize the chance that a process that actually has a greater volatile solids reduction than 38% might show an average that is below this value." Since total and volatile solids don't change significantly throughout the day, time composite samples may be used. It may be appropriate to increase the number of samples when there is known differences among digesters or types of digestion processes, or there has been a known digester upset.

The Van Kleeck equation

There are a variety of equations that may be used in calculating the percent reduction of volatile solids, but the most widely used equation is the Van Kleeck formula as outlined in the EPA's Manual, *Control of Pathogens and Vector Attraction in Sewage Sludge*, 2003 (EPA/625/R-92/013), Appendix C, pages 123-126 (or as updated). Depending on solids flow rates and digester conditions, the full mass balance equation and the approximate mass balance equation may also be used (*Control of Pathogens and Vector Attraction in Sewage Sludge*, pages 120-123). Differences in results between the equations and the Van Kleeck formula may be due to decantate and grit accumulation.

The Van Kleeck equation assumes the fixed solids input equals fixed solids output, and thus is never valid when there is grit accumulation. The EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge*, 2003 (EPA/625/R-92/013), page 125, states the benefit of the equation is that the "volatile solids of the various sewage sludge and decantate streams are likely to show much lower coefficients of variation (standard deviation divided by arithmetic average) than volatile solids and fixed solids concentrations."

$$FVSR = \frac{VS_{(raw)} - VS_{(stabilized)}}{VS_{(raw)} - [VS_{(raw)} \times VS_{(stabilized)}]}$$

FVSR = Fractional volatile solids reduction (multiply by 100 to convert to percent)
$VS_{(raw)}$ = Volatile solids fraction in raw sewage sludge
$VS_{(stabilized)}$ = Volatile solids fraction in stabilized sewage sludge

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Calculating results

When a facility evaluates volatile solids on a daily or weekly basis, an arithmetic mean can be used to evaluate compliance with 40 CFR Part 503. This can be computed on a "running average" basis, so that the facility operator always knows the status regarding VAR levels.

To help account for variability in sampling results, it is recommended that wastewater treatment facilities generating solids assess biosolids quality using a statistical approach similar to that recognized by EPA. EPA expended exhaustive statistical efforts in their development of the regulations in 40 CFR Part 503, and elected to assess biosolids quality using a 95 percent confidence interval. The recommended statistical approach is the method utilizing the Student "t" statistic as presented in the EPA manual, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition*, (EPASW-846.3.3A). Discussion of this approach may be found at: http://www.epa.gov/epaoswer/hazwaste/test/pdfs/chap9.pdf.

VAR General Requirements

Monitoring frequency

The frequency of monitoring is based on 40 CFR §503.16, Table 1 and depends on the quantity of biosolids generated, prepared, or land applied by a wastewater treatment facility or land applier [OAR 340-050-0035(2)(c)] (see Table 7-1, page 34). The vector attraction reduction parameters that a treatment facility must monitor vary depending on the type of biosolids treatment and utilization method selected.

Certifying and documenting VAR

When biosolids are land applied, 40 CFR §503.17 requires written certification for the information used to determine compliance with one of the VAR requirements under 40 CFR §503.33(b), and documentation describing how the requirement was met [OAR 340-050-0035(3)]. The documentation needs to demonstrate how the operational controls and management practices achieve vector attraction reduction. The solids generating facility is required to retain its certification and documentation records for a minimum of five years [40 CFR §503.17]. Certification statements are posted on the department's web site at http://www.deq.state.or.us/wq/Biosolids/BioCerts.htm.

VAR options

The following table summarizes the ten VAR options for biosolids that will be land applied. These options were developed to either reduce the attractiveness of biosolids to vectors or to prevent vectors from coming into contact with the biosolids. Table 3-1 is from EPA's guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge*, 2003 (EPA/625/R-92/013), page 59.

Table 3-1: Vector Attraction Reduction Options

40 CFR Part 503 Requirement	What is Required?	Most Appropriate For:
Option 1 503.33(b)(1)	At least 38% reduction in volatile solids during sewage sludge treatment	Sewage sludge processed by: Anaerobic biological treatment Aerobic biological treatment
Option 2 503.33(b)(2)	Less than 17% additional volatile solids loss during bench-scale anaerobic batch digestion of the sewage sludge for 40 additional days at 30ºC to 37ºC (86ºF to 99ºF)	Only for anaerobically digested sewage sludge that cannot meet the requirements of Option 1
Option 3 503.33(b)(3)	Less than 15% additional volatile solids reduction during bench-scale aerobic batch digestion for 30 additional days at 20ºC (68ºF)	Only for aerobically digested liquid sewage sludge with 2% or less solids that cannot meet the requirements of Option 1 – e.g., sewage sludges treated in extended aeration plants. Sludges with 2% or greater solids must be diluted
Option 4 503.33(b)(4)	SOUR at 20ºC (68ºF) is ≤ 1.5 mg oxygen/hr/g total sewage sludge solids	Liquid sewage sludges (2% or less solids) from aerobic processes run at temperatures between 10 to 30ºC (should not be used for composted sewage sludges)
Option 5 503.33(b)(5)	Aerobic treatment of the sewage sludge for at least 14 days at over 40ºC (104ºF) with an average temperature of over 45ºC (113ºF)	Composted sewage sludge (For sewage sludges from other aerobic processes, it will likely be easier to meet option 3 or 4)
Option 6 503.33(b)(6)	Addition of sufficient alkali to raise the pH to at least 12 at 25ºC (77ºF) and maintain a pH ≥ 12 for 2 hours and a pH ≥ 11.5 for 22 more hours	Alkali-treated sewage sludge (alkaline materials include lime, fly ash, kiln dust, and wood ash)
Option 7 503.33(b)(7)	Percent solids ≥ 75% prior to mixing with other materials	Sewage sludges treated by an aerobic or anaerobic process (i.e., sewage sludges that do not contain unstabilized solids generated in primary wastewater treatment)
Option 8 503.33(b)(8)	Percent solids ≥ 90% prior to mixing with other materials	Sewage sludges that contain unstabilized solids generated in primary wastewater treatment (e.g., heat-dried sewage sludges)
Option 9 503.33(b)(9)	Sewage sludge is injected into soil so that no significant amount of sewage sludge is present on the land surface 1 hour after injection, except Class A sewage sludge which must be injected within 8 hours after the pathogen reduction process	Sewage sludge applied to the land or placed on a surface disposal site. Domestic septage applied to agricultural land, a forest, or a reclamation site, or placed on a surface disposal site
Option 10 503.33(b)(10)	Sewage sludge is incorporated into the soil within 6 hours after application to land or placement on a surface disposal site, except Class A sewage sludge which must be applied to or placed on the land surface within 8 hours after the pathogen reduction process	Sewage sludge applied to the land or placed on a surface disposal site. Domestic septage applied to agricultural land, forest, or a reclamation site, or placed on a surface disposal site

4. Land Application

Overview

Most Class B biosolids generated from domestic wastewater treatment facilities in Oregon are land applied on agricultural land. A land application program must ensure that the management of application operations occurs so biosolids are beneficially used. Site conditions, seasonal and day-to-day climatic conditions, and farming practices are factors that must be considered for land application programs. This section will discuss these factors and the importance of responsible management of a land application program. Site authorization requirements and certain types of land used for biosolids application are also discussed. Biosolids that meet 40 CFR Part 503 pollutant concentration limits, one of the Class A pathogen reduction alternatives in 40 CFR §503.32(a), and one of the vector attraction reduction options in 40 CFR §503.33(b)(1) through (8), are classified as exceptional quality (EQ) biosolids and may be land applied without regulatory limitations.

Site Authorization

Requirements for a land application site authorization

Permittees intending to land apply Class B biosolids to a new site must meet the following requirements prior to land application. The permittee must:

- Submit site authorization request with supporting documentation (see Appendix B) and data to the appropriate department regional biosolids specialist;
- Document that all newly proposed land application sites meet relevant site selection criteria that have been identified in the approved biosolids management plan (see Biosolids Management Plan section - Plan Contents);
- Document that the public notification process for proposed biosolids land application activity is in place. The process should include to whom notification was made and when. Documentation regarding notification and the process should be kept on file and available upon request from the department.
- Receive written site authorization from the department.

Site authorization letter

The department's review of proposed land application sites provides assurance that biosolids will be land applied in a beneficial manner. The permittee is required to provide advance notification to the department if they intend to land apply biosolids on a new site. The department issues a land application site authorization letter only after receiving information on the site and conducting a site evaluation of the soil, topography, and features requiring setbacks. A useful reference for understanding the principles and practical applications in evaluating site suitability for land application of biosolids is the *Guide to Soil Suitability and Site Selection for Beneficial Use of Domestic Biosolids*, Revised September 1995, OSU Extension Service Manual 8.

A site authorization letter outlines site management conditions that are based on the characteristics of the biosolids being land applied and the specific location where land application will occur. The letter is considered an integral part of the biosolids or domestic septage management plan, and the provisions stated in the letter are considered permit requirements and enforceable conditions under the facility's NPDES or WPCF water quality permit, or Solid Waste Disposal permit [OAR 340-050-0015(9) and OAR 340-050-0030(3)]. Appendix C outlines what should be included in a site authorization letter, as well as a biosolids management plan and a water quality permit.

Department notification to other public officials

It is important that the department's actions regarding land application site authorizations are communicated to other public officials and agencies in the county where the activity will occur. Department staff should determine if notification (e.g., phone call) of a proposed land application activity should be made to county commissioners prior to authorizing a site. This determination should be made on a case-by-case basis and in consultation with department region management. Some factors to consider if notification should be made include if the proposed site is a sensitive site or located outside the county where the permittee is located (i.e., where the biosolids are generated).

All site authorization letters will be copied to the appropriate county health department staff. If Conservation Reserve Program (CRP) land is included in the site authorization, the letter will be copied to the appropriate Farm Service Agency (FSA) county agent. In less densely populated counties, county planning staff and county commissioners will also be copied on the site authorization letter. This improves department coordination with county staff and keeps them informed if someone from the public were to contact them. A listing of county health department staff and county commissioners may be found on-line at: http://www.oregon.gov/DHS/ph/lhd/lhd.shtml.

Revocation of a site authorization

Site authorization letter conditions are considered permit requirements [OAR 340-050-0015(9) and OAR 340-050-0030(3)]. The revocation of a site authorization should be treated as a permit action and thus would require a written notice of the proposed action to the permittee, including their right for a contested case hearing. The land application site property owner, the permittee, the public, or the department may request revocation and this request should be supported by written documentation. The permit action can be considered a department initiated modification, but would still be subject to the procedure for a contested case [Oregon Revised Statute (ORS) 468.070(3)].

If there is a documented violation of a site authorization letter condition, the violation should be addressed in accordance with the department's enforcement rules. If warranted based on the nature of the violation, the department may recommend specific actions regarding use of the site until compliance is achieved.

Site Considerations

Site selection criteria

Site selection criteria must be outlined in the biosolids management plan [OAR 340-050-0031(5)(j)]. Criteria that should be considered for site selection will help to ensure that an effective biosolids or domestic septage land application program is developed. Best management practices outlined in OAR 340-050-0070 include criteria for site selection that the department should consider during the site authorization process:

- A site should be on a stable geologic formation not subject to flooding or excessive run-off from adjacent land. If periodic flooding cannot be avoided, the period of application should be restricted and soil incorporation is recommended.
- Minimum depth to permanent groundwater should be four feet and the minimum depth to temporary groundwater should be one foot at the time when application of liquid biosolids or domestic septage occurs.
- Topography should be suitable for normal agricultural operations. Liquid biosolids or domestic septage should not be land applied on bare soils when the slope exceeds 12 percent. Dewatered or dried biosolids may be land applied on well vegetated slopes up to 30 percent, and liquid biosolids or domestic septage may also be land applied if appropriate management is in place to prevent run-off.
- Soil should have a minimum rooting depth of 24 inches. The underlying substratum to at least 24 inches should not be rapidly draining so leachate will not be short circuited to groundwater.
- Saline and/or sodic soils should be avoided.

Buffer strips

Buffer strips, also known as setbacks, are necessary at a land application site to help ensure that the land application activity does not create an adverse environmental or public health condition. OAR 340-050-0070(3) allows the department to use discretion in approving sites that are in close proximity to residential areas. The following buffer strip distances outlined in OAR 340-050-0070 should be considered for site selection and approval:

- *Nuisance odors and wind drift* - Determined by the department on a case-by-case basis and depends on the method of application used, total solids content, biosolids treatment process, and proximity to sensitive areas (e.g., residential housing or public use area such as a park or golf course). An example for truck spreading (liquid) is 0 to 200 feet and for dewatered or dried biosolids is 0 to 50 feet [OAR 340-050-0070(3)(a)].
- *Proximity to well traveled highways* - Determined by the department on a case-by-case basis and depends on local conditions [OAR 340-050-0070(3)(b)]. Land application should not cause any drifting onto a highway.
- *Ditch, channel, pond, or waterway* - No bulk Class B biosolids or domestic septage should be land applied within 50 feet [OAR 340-050-0070(3)(c)].
- *Domestic water source or well* - No bulk Class B biosolids or domestic septage should be land applied within 200 feet [OAR 340-050-0070(3)(c)].

Buffer strip distances may need to be increased if a liquid product is being land

applied by means of spray irrigation. The size of a buffer strip may also be increased based on site limitations such as, but not limited to, the following:

- Percent slope of the site;
- Soil type and characteristics (e.g., infiltration rate, evidence of surface erosion);
- Type of vegetation and percent of vegetative cover; or
- Site proximity to other land uses (e.g., public facility, subdivision, school, retirement home or community, business center).

Controlled access to a land application site

Controlled access to sites where bulk Class B biosolids or domestic septage have been land applied is required for a minimum of 12 months after application [OAR 340-050-0065(4) and 40 CFR §503.32(b)(5)(vii)].

Access control is assumed by the property owner on rural private land [OAR 340-050-0065(4)], and access should be addressed through a contract agreement between the permittee and property owner. Entry may be specifically authorized though to an individual by the property owner or an authorized representative of the property owner (e.g., site manager). If there is a low potential for public exposure and the activity of the individual wanting access has a low potential for exposure (e.g., hunting, recreation activity), access to this type of site is restricted for a minimum of 30 days after application [40 CFR §503.32(b)(5)(viii)]. The property owner or authorized representative must inform the individual of the presence of biosolids and the need to take precautions to prevent any potential health hazard while on the site and after leaving the site (e.g., washing hands and footwear). Even though there may be a low potential for public exposure (e.g., remote farmland, reclamation site in an unpopulated area), public entry must still be controlled for one year.

When there is a high potential for public exposure (e.g., near a park, golf course, or athletic field), access must be controlled with fencing and posted with no trespassing signs. Signs should be written in languages appropriate to the community.

Monitoring

It may be necessary to monitor the depth to groundwater. Where liquid biosolids or treated domestic septage would be applied, the minimum depth to permanent groundwater should be four feet and the minimum depth to temporary groundwater should be one foot at the time when application occurs [OAR 340-050-0070(2)(b)]. The following factors should be considered in making a determination to require monitoring of depth to groundwater:

- Type of biosolids being land applied (e.g., percent liquid or dewatered product);
- Time of year when land application is allowed (e.g., seasonal or year-round);
- Site management practices (e.g., tillage practices, location of staging or storage areas);
- Land application site location in relation to other land uses, surface water, and depth to groundwater; and
- Presence of hydric soils or soils that indicate reduction-oxidation (redox).

There are several methods for determining soil water depth. The use of a piezometer may be considered for a specific objective such as site characterization. Personnel using this method should be technically qualified. A monitoring plan may be needed to outline specifics such as location of monitoring holes and data collection

requirements. All groundwater monitoring holes must be registered with the Oregon Water Resources department. If it is determined that a site may be sensitive with respect to depth to groundwater, the department may require monitoring of additional parameters [OAR 340-050-0025(5)].

Threatened or endangered species

Biosolids cannot be applied to land if it is likely to adversely affect a threatened or endangered species listed under Section 4 of the Endangered Species Act or its designated critical habitat [40 CFR §503.14(a)]. A listing of threatened or endangered species for Oregon may be found on U.S. Fish and Wildlife Service's web site: http://ecos.fws.gov/tess_public/TESSWebpageUsaLists?state=OR

If it is determined that a threatened or endangered species or its designated critical habitat is located on a proposed application site, land application still may be considered. If applicable management practices for the use and application of biosolids and septage are being followed, it is not likely that the land application activity will cause any adverse affect on threatened or endangered species. However, certification that applicable management practices have been met must be documented. The site authorization letter should specify conditions such as buffer zones, season of application, or other requirements to ensure that land application is not creating an adverse affect.

In Oregon, the National Environmental Policy Act (NEPA) process applies only to a federal undertaking. The process includes analysis as to if the undertaking could significantly affect the environment and the US. EPA would be responsible for consultation. The three levels of analysis are: categorical exclusion determination, preparation of an environmental assessment/finding of no significant impact (EA/FONSI), and preparation of an environmental impact statement (EIS).

Considerations of Certain Lands

SB 212 and land applying on Exclusive Farm Use (EFU) land

The 2001 Legislature passed Senate Bill 212 (SB 212) in response to growing concern of land use requirements when biosolids and reclaimed water are land applied on EFU zoned land. The legislation amended ORS 215.213 and 215.283 that defines the land application of biosolids as an allowed permitted use on EFU land although the activity is subject to the issuance of a permit or site authorization letter from the department. Septage that meets the requirements of ORS 454.800 is included as a type of substance that may be approved for land application under a license, permit, or approval of the department, and thus is considered as an allowed use and would also not require a Land Use Compatibility Statement (LUCS). Because land application is listed as an allowed use in ORS 215.213(1), counties may not impose additional land use restrictions or conditions on land application practices, beyond those specified in the statute.

A LUCS is not required per ORS 215 when transported by vehicle to EFU land where application will occur (however, ORS 215 is silent with respect to non-EFU

zoned land, therefore a LUCS should be required for non-EFU zoned land). The transportation and land application are allowed outright if done under a license, permit, or approval by the department. Treatment resulting from a process other than land application or incidental changes during transportation or storage is not allowed under SB 212. Facilities, equipment or uses on the same land where land application takes place are included as an allowed use if they are secondary or subordinate to the primary function of the land application. Treatment as a primary function would not be allowed on EFU land under ORS 215 without a LUCS.

Conservation Reserve Program (CRP) land

Agriculture land owners in Oregon may participate in the U.S. Department of Agriculture Farm Service Agency's (FSA) Conservation Reserve Program (CRP). Participants accepted in the voluntary program "set aside" a certain amount of acreage, under contract for a period of 10 to 15 years, that is planted with vegetation to help control soil erosion, improve soil and water quality, and enhance wildlife habitat.

CRP land may be used for land application of biosolids, and requirements will be site specific. All site authorization letters will be copied to the appropriate FSA county agent. Land application rates will take into consideration:

- Duration of the land application activity,
- Type of vegetative cover,
- Wildlife habitat (including mating and migratory seasons, threatened or endangered species or its designated habitat), and the
- Application cycle (e.g., annual, every other year, etc).

If more than a single application is authorized, soil sampling may be required to ensure proper nutrient management.

Airport lands

Airport lands may provide a viable option for biosolids land application. Use of a site located on airport property is under the discretion of the airport manager per Federal Aviation Administration (FAA) regulations. Documentation for the proposed land application site must include a statement indicating that approval has been granted from the airport facility manager. Lands surrounding an airport facility may also be considered for application sites. It must be determined what factors are important in authorizing use of a site at or adjacent to an airport that will comply with FAA regulations (e.g., crop type and harvest cycle, presence of wildlife). FAA concerns with land application of biosolids have generally been associated with the perception that this activity would attract birds and wildlife to the site.

Lands with an easement

In some situations, a site being proposed for land application may have an easement that has been granted by the property owner. An easement holder has the right to use a specified property for a specific purpose and length of time as stated in the easement authorization. Common uses of an easement may be for purposes of installing or maintaining utility or communication lines. Easement holders should be informed through the public notification process of the proposed land application activity. The site authorization letter should address use of the easement property for land application and include appropriate conditions such as buffer strips which should be determined on a case-by-case basis.

Climatic Factors

Winter/wet season application

Winter application of biosolids is generally unrestricted by climatic factors in the drier regions of the state (e.g., east of the Cascades). However, west of the Cascades, trafficability and access to fields for application equipment can be very limited during the wet season months. Intense and/or prolonged rainfall prior to or after a biosolids land application event may lead to decreased infiltration and potential run-off of biosolids onto buffer areas and possibly off the land application site. The potential risk of run-off should be minimized by evaluating site drainage conditions and the weather forecast prior to land applying. Sites in western Oregon suitable for non-growing season application will be on moderately well-drained to well-drained soils and can be classified as hydrologic group A or B soils in the Natural Resources Conservation Service (NRCS) soil survey for the area.

During the site authorization process, soil properties of a proposed site for land application of liquid biosolids should be assessed so conditions such as ponding and run-off can be prevented. Soil properties such as texture, structure, color and depth, as well as the moisture content and permeability of the soil, must be considered in determining at what rate infiltration will occur. Other factors that may affect infiltration include percent solids concentration of the biosolids, slope of the site, organic matter in the soil, crop management practices, and vegetative cover. Depending on the soil characteristics, application rates may need to be adjusted to reduce the possibility of ponding or run-off. All site selection criteria stated in OAR 340-050-0070 are applicable.

A useful reference for understanding the relationship between soil properties and the beneficial use of biosolids is the *Guide to Soil Suitability and Site Selection for Beneficial Use of Domestic Biosolids*, Revised September 1995, OSU Extension Service Manual 8.

Snow

The land application of biosolids is prohibited to a flooded, frozen, or snow-covered site if the biosolids could enter a wetland or other waters of the United States [40 CFR §503.14(b)]. Land application on these types of sites may occur if management practices provide assurance that the biosolids will not enter surface waters. The following are some factors that should be considered when authorizing the land application of biosolids to frozen or snow covered ground in Oregon:

- Distance from land application site to surface waters, or inventoried or delineated wetlands;
- Topography, including percent slope of the site;
- Soil moisture conditions; and
- Ground cover beneath the snow or ice.

In addition to the above factors, winter land application conditions in Oregon are dependent on the amount of snowfall, visibility, ambient air temperatures (i.e., above

or below freezing), long term weather forecast, and overall crop management practices. Land application may occur after a light snowfall, but site specific conditions must be evaluated prior to land applying to ensure adequate percolation and that movement of biosolids will not occur off-site. In western Oregon, it generally is not practical to land apply biosolids following snowfall due to saturated soil conditions and the probability of continued precipitation until the spring months. East of the Cascades, frozen soils with or without ground cover are generally suitable for application where site conditions indicate run-off is unlikely.

Wind

During land application, if wind speed is such that biosolids cannot be applied uniformly or would be blown into buffer strips, waterways, roads, trails, or ditches, or onto the application vehicle itself, application should stop immediately until the wind has stopped or decreased so no significant drifting occurs. Wind is most important when application of liquid biosolids takes place through a high-pressure nozzle. Generally, wind speeds in excess of 15 mph are unsuitable for biosolids land application.

5. Agronomic Application Rates

Overview

The land application of biosolids must meet management practices required in the federal regulations [OAR 340-050-0026(2)(d)]. 40 CFR §503.14 outlines specific management practices for biosolids or biosolids derived products that do not meet Class A pathogen reduction criteria and thus are considered a Class B product. One of these management practices requires biosolids to be applied at a rate that provides the annual total available nitrogen (N) to be less than or equal to crop requirements [40 CFR §503.14(d)]. This is to ensure that biosolids application rates are at or below an agronomic loading for nitrogen to prevent leaching losses and possible contamination of groundwater. This section discusses important considerations for determining application rates, soil testing, and how to calculate biosolids application rates.

Nitrogen availability and mineralization rates

Biosolids nitrogen is present in two forms, inorganic and organic. Inorganic or mineral N (as ammonium [NH_4+] and nitrate [NO_3-]) is typically immediately available for plant uptake, while organic N must first be biologically transformed (mineralized). The concentration of various N forms in biosolids, plus the rate of organic N mineralization, is used to determine the annual agronomic loading of biosolids. Mineralization rates vary depending on the stabilization process and duration, application method, soil temperature and moisture conditions, and season. Consideration should also be given when long-term lagoon storage occurs, as this will typically cause a reduction in the mineralization rate.

Table 5-1 shows estimated organic N mineralization rates for the first year after biosolids application (source: *Worksheet for Calculating Biosolids Application Rates in Agriculture*, 1999, WSU, OSU, and Univ. of Idaho extension agencies, and USDA Publication PNW 511). The range of values listed allows the department and the permittee the flexibility to decide on a mineralization rate based on facility specific data. The approximate value for lime stabilization process is based on research that did not demonstrate a consistent difference between N mineralized from fresh lime stabilized biosolids and N mineralized from other fresh biosolids processed through aerobic digestion, anaerobic digestion, heat-drying, or air-drying.

Table 5-1: Mineralization Rate Estimates of Organic Nitrogen in Biosolids

Biosolids Stabilization Process	First Year Mineralization Rate* (percent of organic N)
Aerobic digestion	30-45
Anaerobic digestion	20-40
Heat-drying	20-40
Lagoon stabilization	15-30
Drying bed	15-30
Composting	0-20
Lime stabilization	Approx. 30**

*Estimated mineralization rates are cumulative in 2-5 months in spring, summer, or fall.
**Value based on research by Gilmour, John, C. Cogger, L. Jacobs, and others. 2000. *Estimating Plant-Available Nitrogen in Biosolids*, (Water Environment Research Foundation, Alexandria, VA).

Other processes that affect nitrogen availability

Ammonia volatilization and denitrification are active processes affecting nitrogen availability. Ammonia loss through volatilization is affected by soil pH, soil moisture, and the land application method and rate. For example, the amount of ammonium-N retained through surface application of dewatered biosolids not immediately tilled into the soil is estimated to be 50% (*Worksheet for Calculating Biosolids Application Rates in Agriculture*, USDA Publication PNW 511). If biosolids are immediately tilled in (e.g., through soil incorporation or injection) then the maximum amount of ammonium-N is retained. Estimate values of ammonium-N retained after land application may be found in Table 2 of the *Worksheet for Calculating Biosolids Application Rates in Agriculture*, USDA Publication PNW 511.

Denitrification losses may vary widely depending on soil temperature and moisture conditions. These losses are rarely factored into agricultural application rate calculations due to variability, although they may factor into biosolids application on forest sites.

A specific approach to calculating an application rate on forest sites is found in *Managing Nitrogen from Biosolids* (Chapter 6 - Using the Nitrogen Balance Approach for Forest Systems), 1999, WA Dept. of Ecology Publication #99-508. Another useful reference for forest site management is *Biosolids Management Guidelines for Washington State* (Chapter 7 - Forest Site Design and Management), Revised 2000, WA Dept. of Ecology Publication #93-80.

The importance of soil testing

The use of soil testing to determine a correct agronomic rate for nitrogen and to verify agronomic rate estimates is highly recommended for all land application sites. The benefits of conducting soil tests for intensive agricultural programs are to:

- Assess pre-planting soil nutrient levels,
- Monitor during the growing season for optimum crop yields, and
- Verify plant uptake and low residual soil nitrate-nitrogen levels after the growing season.

Available nitrogen concentrations in soil for a given season can be affected by: other sources of nitrogen, including chemical fertilizers, cover crops, and manure; soil pH; rainfall; and carry-over from previous year's applications or crop residuals (see following subsection on Calculations for Agronomic Rate Determination). Soil testing for nutrients other than nitrogen may be needed to ascertain if proper agronomic management practices are occurring. For quality assurance purposes, it is recommended that a soil testing laboratory be used that participates in the North America Proficiency Testing Program - Performance Assessment Program (NAPT-PAP). A listing of laboratories in this program may be found on-line at: http://www.napt-pap.org/.

Soil testing for repeat applications

Sites proposed for repeated annual applications at agronomic rates must be periodically assessed for the impact of all fertilizer nitrogen, including that from biosolids. The criteria for requiring evaluation or performance monitoring is when any biosolids applications exceeds two out of three successive years at agronomic rates [OAR 340-050-0080(5)(a)]. Table 5-2 shows an example of when soil testing for carry-over nitrate-N (NO_3-N) would be required. For sites in western Oregon, it may be desirable to test for annual mineralized soil nitrogen in the fall after crop harvest and prior to winter rainfall so adjustment to the next year's nitrogen application rate can be made.

If a soil improvement or reclamation site has previously been amended with biosolids at a single high rate application, documentation of background soil nitrate-N (NO_3-N) shall be submitted to the department for approval before additional application of biosolids to the site [OAR 340-050-0080(4)(a)].

It is difficult to establish a single interpretation for soil nitrate-N (NO_3-N) across all cropping systems. Post-harvest soil nitrate test interpretations guidance may be found in *Biosolids Management Guidelines for Washington State* (Chapter 9 - Site Monitoring), Revised 2000, WA Dept. of Ecology Publication #93-80. Other references are available that include interpretation guidance, but some of the information presented does not represent residual nitrate-N that would be protective of groundwater quality, and some studies were based on dairy manure management.

Table 5-2: Example of When Soil Testing for Carry-over Nitrate-N Required

Year	Biosolids applied?	Soil testing required?
2000	Yes	No
2001	Yes	Yes (fall of 2001)
2002	Yes	No
2003	No	No
2004	No	No
2005	Yes	No
2006	Yes	Yes (fall of 2006)
2007	Yes	No if not land applying in 2008

Soil testing references

Soil samples must be based on representative samples collected and tested according to protocols published by Oregon State University (OSU) and the American Society of Agronomy [OAR 340-050-0080(4)(b) and (5)(b)]. The following references provide an informative understanding of protocols and test interpretation:

- *Monitoring Soil Nutrients Using a Management Unit Approach*, October 2003, Pacific Northwest Extension publication PNW 570-E.
  Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/PNW570-E.pdf
- *Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascades - second section on detailed suggestions for soil sampling and planning*, May 2003, OSU Extension Service publication EM 8832-E.
  Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/EM8832-E.pdf
- *Soil Sampling*, August 1997 (reprint), University of Idaho Cooperative Extension System Bulletin 704 (revised).
  Link to on-line version: http://info.ag.uidaho.edu/resources/PDFs/EXT0704.pdf
- *Soil Sampling for Home Gardens and Small Acreages*, Reprinted April 2003, OSU Extension Service publication EC 628.
  Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/ec628.pdf
- *Soil Test Interpretation Guide*, Reprinted August 1999, OSU Extension Service publication EC 1478.
  Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/EC1478.pdf

Considerations for reclamation and soil improvement

Biosolids applications exceeding normal crop nitrogen requirements (agronomic rates) may be approved by the department on a case-by-case basis for reclamation or soil improvement [OAR 340-050-0080(4)]. A soil improvement or reclamation site is a land application site authorized by the department to accept greater than agronomic rates to achieve a specific purpose, such as restoring organic matter to disturbed soils. The addition of nutrients and improved soil structure will support vegetative growth thus preventing erosion or allowing for better cultivation. Sites that may benefit from such applications include landfill cover soils, mine tailings piles, spill sites, fill sites, and degraded agricultural soils.

Calculating reclamation application rates

On a case-by-case basis at reclamation sites, a high rate application which is sufficient to supply enough organic matter to establish a vegetative cover may be allowed by the department; application rates at these sites may exceed the short-term agronomic loading rate of the vegetation established [OAR 340-050-0025(4)]. Justification for a proposed single high rate application must be provided to the department in advance of biosolids application. The quantity of biosolids, the nutrients in the biosolids, the type of vegetation to be established, and the amount of topsoil are factors that will determine what an appropriate reclamation and non-agricultural rate should be. For sites with little or no topsoil, rates should be established to increase soil organic matter levels to a background concentration equal to or the same as the undisturbed area soils.

Nitrogen management is important when determining an increased application rate. If there is concern with nitrate leaching, the department's groundwater staff should be consulted and the department may require an evaluation for potential groundwater quality impacts in the proposed site area [OAR 340-050-0026(6)].

Calculation methods for reclamation application rates can be found in *Managing Nitrogen from Biosolids* (Chapter 8 - Overview of the Balanced Soil Amendment Approach for Mixtures of Biosolids and Carbon-Rich Residuals), 1999, WA Dept. of Ecology Publication #99-508. This publication and others provide information on reclamation application rates that are based on organic matter loading instead of rates solely based on nitrogen demands of a crop. Furthermore, application methods exist to account for balancing the carbon to nitrogen ratio in a soil amended with biosolids, thus helping to curtail nitrogen losses below the rooting zone of a reclamation site.

Calculations for Agronomic Rate Determination

How to calculate application rates

Biosolids application rates on a dry weight basis can be calculated based on the biosolids nitrogen concentration, the total pounds of available nitrogen, and site and crop nitrogen requirement. The data needed to make this calculation includes laboratory biosolids analyses and land application information (e.g., biosolids processing method, method of application, etc.).

The following example shows how a biosolids application rate can be determined. The primary reference used for biosolids agronomic rate calculations is the *Worksheet for Calculating Biosolids Application Rates in Agriculture*, 1999, WSU, OSU, and Univ. of Idaho extension agencies, and USDA Publication PNW 511. The worksheet provides detailed explanation of each step used in a calculation. With continuing research of biosolids treatment and land application processes, it is anticipated that in 2006 the calculation method will be revised somewhat based on estimated data used in the calculation. The revised method determined by the extension agencies should be followed at such time it is available. The on-line version of the worksheet may be found at: http://www.puyallup.wsu.edu/soilmgmt/Biosolids.htm.

Biosolids nitrogen concentrations

Biosolids nitrogen concentrations of the various nitrogen forms must be known from a sample analysis in order to calculate the available nitrogen. The following example shows dry weight values of nitrogen forms in biosolids that have been anaerobically digested. These values are used in the calculation example below.

Nitrogen Form	Dry Weight Value
TKN (Total Kjeldahl Nitrogen)	55,000 mg/kg (5.5%)*
NH_4-N (Ammonium Nitrogen)	15,000 mg/kg (1.5%)*
NO_3-N (Nitrate Nitrogen)	5 mg/kg (0.0005%)*
*If analysis is in percent, multiply by 10,000 to convert to mg/kg. To convert a dry weight value in mg/kg to pounds per dry ton, multiply by 0.002.	

Example for calculating available nitrogen (N)

To calculate the **percent organic N**, the ammonium nitrogen dry weight percent value is subtracted from the total Kjeldahl nitrogen dry weight percent value: %TKN - $\%NH_4$-N

- Example:
  5.5% - 1.5% =
  4.0% organic N

To determine the **ammonium nitrogen retained** after biosolids application, obtain an estimate value from Table 2 of the *Worksheet for Calculating Biosolids Application Rates in Agriculture*, USDA Publication PNW 511. Information needed to determine a value includes the type of biosolids stabilization process, the land application method, and the number of days to soil incorporation. For surface application of dewatered biosolids west of the Cascades, a value of 50 percent of ammonium nitrogen retained will be used.

To calculate the **percent inorganic N** retained, the ammonium nitrogen and nitrate nitrogen dry weight percent values, and the ammonium nitrogen retained value are used in the following formula: ($\%NH_4$-N)(50 percent) + ($\%NO_3$-N)

- Example:
  (1.5%)(.50) + (0.0005%) = (0.75%) + (0.0005%) =
  0.75% inorganic N

To calculate the **pounds inorganic N/dry ton biosolids**, the following formula is used: (% inorganic N/100)(2000 lbs./dry ton)

- Example:
  (0.75/100)(2000) = (0.0075)(2000) =
  15 lbs. inorganic N/dry ton biosolids

To calculate the **pounds mineralized organic N/dry ton biosolids** (organic N equals TKN-inorganic N), a 30 percent mineralization rate for anaerobic digestion is used in the following formula: (% organic N/100)(30 percent)(2000 lbs./dry ton)

- Example:
  (4.0/100)(.30)(2000) =
  24 lbs. mineralized organic N/dry ton biosolids

To calculate the **total pounds available N/dry ton biosolids**, the following formula is used: lbs. mineralized organic N/dry ton biosolids + lbs. inorganic N/dry ton biosolids

- Example:
  24 + 15 =
  39 lbs. available N/dry ton biosolids

Determining a biosolids application rate

An annual crop agronomic loading rate is based on regional climatic factors and agricultural practices. Estimates of crop nitrogen requirements can be obtained from OSU, WSU, and University of Idaho fertilizer guides and other agricultural and regulatory agency literature references. Estimates of forest nitrogen requirements can be obtained from *Managing Nitrogen from Biosolids* (Chapter 6 - Using the Nitrogen Balance Approach for Forest Systems), 1999, WA Dept. of Ecology Publication #99-508. All agronomic rates are estimates, which should be confirmed through site monitoring of soils and crops. Once the total pounds available nitrogen/dry ton biosolids is calculated, then the biosolids application rate can be determined.

To calculate the **dry tons biosolids/acre**, a value of 150 lbs. N/acre (based on a known yield) for an irrigated pasture grass/hay crop nitrogen requirement is used in the following formula: (150 lbs. N/acre) / (lbs. available N/dry ton biosolids)

- Example:
  150 lbs. N/acre / 41 lbs. available N/dry ton biosolids =
  3.66 dry tons biosolids/acre

To convert dry tons to **wet tons biosolids/acre**, the following formula is used: dry tons biosolids / percent solids (from lab analysis) x 100

- Example:
  3.66 dry tons / 5% solids x 100 =
  73.2 wet tons biosolids/acre

To convert dry tons to **gallons/acre**, the following formula is used: dry tons biosolids / percent solids (from lab analysis) x 24,000

- Example:
  3.66 dry tons / 5% solids x 24,000 =
  17,568 gallons/acre

Useful references

The following references are useful for understanding biosolids agronomic application rates, and reclamation and forest application rates:

- Cogger, C.G. and D.M. Sullivan. 1999. *Worksheet for Calculating Biosolids Application Rates in Agriculture*, PNW 511 (WSU, OSU, and Univ. of Idaho extension agencies, and USDA).
  Link to on-line: http://www.puyallup.wsu.edu/soilmgmt/Biosolids.htm
- Henry, C., D. Sullivan, R. Rynk, K. Dorsey, and C. Cogger. 1999. *Managing Nitrogen from Biosolids* (Chapter 6, Using the Nitrogen Balance Approach for Forest Systems, and Chapter 8, Overview of the Balanced Soil Amendment Approach for Mixtures of Biosolids and Carbon-Rich Residuals), WA Department of Ecology Publication #99-508 (WA Dept. of Ecology and the Northwest Biosolids Management Association).
  Link to on-line version: http://www.ecy.wa.gov/pubs/99508.pdf
- Sullivan, D.M. 1998. *Fertilizing with Biosolids*, PNW 508 (Oregon State University, Corvallis, OR).
- Sullivan, D.M., D.M. Granatstein, C.G. Cogger, C.L. Henry, and K.P. Dorsey. Revised 2000. *Biosolids Management Guidelines for Washington State* (Chapter 7, Forest Site Design and Management, and Chapter 9, Site Monitoring), WA Department of Ecology Publication #93-80 (Olympia, WA).
  Link to on-line version: http://www.ecy.wa.gov/../biblio/9380.html

6. Cumulative Pollutant Loading

Overview

Under OAR 340-050-0026, the department adopted the federal pollutant (metals and metalloids) loading rates in 40 CFR §503.13 based on these rates being supported by valid scientific research and comprehensive, multimedia risk assessment modeling. Almost all Oregon wastewater treatment facilities generate biosolids that are considered low in trace inorganic pollutants. Representative values of biosolids analyses from a wide range of facilities are consistently well below the pollutant concentrations in 40 CFR §503.13(b)(3), Table 3. The department regulates cumulative site loading of pollutants only for biosolids that exceed the Table 3 values, however many facilities voluntarily track pollutant loading on land application sites. This section describes:

- What is required if pollutant concentration limits are exceeded thus triggering mandatory pollutant tracking,
- Considerations for soil sampling including base line soil monitoring, and
- Calculation method for tracking pollutant loading.

Exceeding Table 3 limits

OAR 340-050-0035(4) states that if biosolids analyses indicate one or more trace pollutants where the annual average pollutant concentration exceeds 40 CFR §503.13(b)(3), Table 3 concentration limits (see Table 6-1 below), then bulk biosolids that are land applied are subject to 40 CFR §503.13(b)(2), Table 2 cumulative pollutant loading rates (see Table 6-1 below). If an exceedance is noted in the analyses, it is recommended that resampling occur to consider outliers and sample or lab error. Once a facility exceeds a Table 3 concentration value for any trace pollutant, but meets the ceiling concentration limits in 40 CFR §503.1 3(b)(1), Table 1, and has land applied those biosolids on a site, it is required to track cumulative pollutant loading for that site during the remaining time the site is used. If any or all of the ceiling concentration limits in 40 CFR §503.1 3(b)(1), Table 1, are exceeded, the biosolids cannot be land applied.

Table 6-1: 40 CFR §503.13(b)(2) and (3), Tables 2 and 3

Pollutant	Table 2 Cumulative Pollutant Loading Rates (kilograms per hectare, dry weight)	Table 3 Pollutant Concentrations Monthly Average (milligrams per kilogram, dry weight)
Arsenic	41	41
Cadmium	39	39
Copper	1500	1500
Lead	300	300
Mercury	17	17
Molybdenum	-	-
Nickel	420	420
Selenium	100	100
Zinc	2800	2800

Continuous tracking of pollutants

Once base line levels of pollutants have been established for the soil at a site (not a regulatory requirement), continuous tracking of biosolids pollutant additions is required when inorganic pollutant levels are between Table 1 ceiling concentration and Table 3 pollutant concentration limits. Pollutant additions should be calculated by multiplying the number of metric tons (dry weight) of biosolids land applied after base line soil concentrations have been determined, by the concentration of each pollutant. This approach measures the actual and accumulated quantity of each pollutant present at a particular site. It takes into account not only the pollutants introduced via the land application of biosolids, but considers any naturally occurring pollutant levels as well as any pollutants already introduced to the site as a result of human activity. This is the most conservative approach to determine pollutant loading since it accounts for naturally occurring pollutant levels, including pollutants introduced through the land application of biosolids.

The department may provide technical assistance to small facilities with limited staff in tracking biosolids pollutant accumulations. Facilities must report sufficient information to establish biosolids quantity and quality where biosolids have been applied to a particular site. From this data, pollutant accumulations can then be calculated.

Base line soil monitoring

Base line soil monitoring for the regulated trace pollutants is not required at sites where biosolids are to be land applied, but monitoring is strongly recommended to establish a historical record of pre-existing site conditions. Monitoring is especially important if there is an exceedance of a 40 CFR §503.13(b)(3), Table 3 concentration limit and it may also help to address inquiries from the public and the media that question crop, soil, air and water quality impacts from biosolids application. Base line soil monitoring depends on good soil sample collection and analysis. The site owner, solids generating facility or crop consultant collecting a soil sample need to follow sampling procedures adequate to represent areas where biosolids are to be land applied.

Soil sampling procedures

Soil sampling should follow protocols published by Oregon State University (OSU) or other department approved sampling protocol. OSU Extension publications provide information on soil testing and a listing of suitable soil analytical laboratories. The publications are available from OSU's web site: http://cropandsoil.oregonstate.edu/extensio/Soils/publications.html

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Site monitoring and budget considerations

To decrease the expense associated with soil monitoring and still provide a representational analysis, a certain percentage of a facility's actively used land application sites might be monitored each year throughout the term of the NPDES or WPCF water quality permit. Using this approach, sites assessed could be based on:

- Sites which have received biosolids over the greatest period of time,
- Sites with the highest annual biosolids loading rate,
- Sites receiving the largest quantity of biosolids, or
- Sites where there is documented community concern.

Setting monitoring priorities in subsequent years could be done in a similar manner.

Calculating a cumulative pollutant loading rate

Based on the *Worksheet for Calculating Biosolids Application Rates in Agriculture*, 1999, WSU, OSU, and Univ. of Idaho extension agencies, and USDA Publication PNW 511, the following example shows how to calculate a cumulative pollutant loading rate. The on-line version of the worksheet may be found at: http://www.puyallup.wsu.edu/soilmgmt/Biosolids.htm.

Obtain average representative results of **biosolids pollutant analyses**, and determine from facility records the **amount of biosolids land applied** to a site during the year in dry tons per acre.

- Example:
  A facility is required to monitor trace pollutants quarterly. The results of the four analyses for mercury are 1.5 mg/kg, 2.0 mg/kg, 2.5 mg/kg, and 2.0 mg/kg. The average concentration result is 2.0 mg/kg dry weight value.

  Records state that 4 dry tons of biosolids were land applied per acre on site A.

Calculate the **pounds of mercury per dry ton of biosolids** by using the following formula: (mg/kg dry weight value of pollutant)(0.002 lbs./ton)

- Example:
  (2.0)(0.002) = 0.004 lbs. mercury/dry ton biosolids

Calculate the **pounds of mercury applied per acre** by using the following formula: (lbs. pollutant/dry ton biosolids)(dry tons biosolids land applied/acre)

- Example:
  (0.004)(4) = 0.016 lbs. mercury/acre

Compare **cumulative pounds of mercury applied per acre** with the **cumulative loading rate limit** in 40 CFR §503.13 (b)(2), Table 2.

- Example:

Pounds of mercury applied/acre	Loading rate for mercury in pounds/acre*
0.016	15
*40 CFR §503.13 (b)(2), Table 2 cumulative loading rates are expressed in kilograms/hectare. The Table 2 value for mercury of 17 kilograms/hectare was multiplied by a conversion factor of 0.892, resulting in 15 pounds/acre.	

If 0.016 pounds of mercury/acre were applied at this loading rate every year, the site life based on mercury would be 938 years (15÷0.016).

7. Biosolids Monitoring and Reporting

Overview

Minimum biosolids monitoring, recordkeeping, and reporting requirements under 40 CFR Part 503 and OAR Chapter 340, Division 50 must be stated in a wastewater treatment facility's NPDES or WPCF permit. They also may be included in a facility's biosolids management plan. The permittee is required to submit certain biosolids data and land application information as part of the facility's wastewater Discharge Monitoring Report (DMR) and biosolids annual report. The data and information in DMRs and annual reports are used by the department to help determine if a facility's biosolids program is in compliance and is also used as a source of information for annual reporting requirements to the EPA under 40 CFR §501.21. This section outlines what monitoring and reporting requirements need to be considered and included in a facility's permit and annual report.

Permit Considerations

Monitoring frequency

The frequency of monitoring is based on 40 CFR §503.16, Table 1 and depends on the quantity of biosolids generated, prepared, or land applied by a wastewater treatment facility or land applier [OAR 340-050-0035(2)(c)]. The pollutants, pathogens, and vector attraction reduction parameters that a treatment facility must monitor vary depending on the type of biosolids treatment and utilization method selected. The minimum monitoring frequency that should be stated in a facility's permit under the Minimum Monitoring and Reporting Requirements, Schedule B, is based on Table 7-1 below.

Table 7-1: Monitoring Frequency

Amount of Biosolids Generated and Used		Monitoring Frequency
Dry weight - metric tons/year	Tons/year	
> zero but < 290	> zero but < 319	Annually
≥ 290 but <1,500	≥ 319 but < 1,650	Quarterly
≥ 1,500 but <15,000	≥ 1,650 but < 16,500	Bimonthly
≥ 15,000	≥ 16,500	Monthly

What analyses are required

Parameters required to be monitored are stated under Schedule B of a facility's permit, as well as minimum monitoring frequencies and reporting requirements. Monitoring and reporting conditions in a permit should not conflict with what is outlined in the permittee's biosolids management plan.

Biosolids analyses are required for certain parameters, including all pollutants listed in 40 CFR §503.13(b)(3), but analyses are not limited to these parameters [OAR 340-050-0035(2)(a)]. Federal pollutant monitoring requirements for biosolids that are land applied include the following parameters (in mg/kg dry weight): arsenic,

cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. The department may require sampling of silver and chromium where permitted facilities have pretreatment programs. Other parameters that must be monitored include pH (standard unit) and the following (in percent dry weight): total kjeldahl nitrogen (TKN), nitrate nitrogen (NO_3-N), ammonium nitrogen (NH_4-N), total phosphorus (P), potassium (K), total solids, and volatile solids.

The permit should include appropriate parameter(s) that are required to show compliance with pathogen reduction alternatives and vector attraction reduction (VAR) options that a facility has indicated it will meet. Operating parameters must be appropriate for the pathogen reduction alternative and VAR option. For example, if a facility is to demonstrate compliance with VAR option 1 as stated in 40 CFR §503.33, then the permit should include a monitoring requirement parameter for percent volatile solids reduction that is accomplished through solids treatment.

Sampling and analytical methods

References to be used for biosolids sampling and analytical procedures are specified in 40 CFR §503.8 [OAR 340-050-0035(2)(b)]:

Inorganic pollutants (metals)
"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846, Second Edition (1982) with Updates I (April 1984) and II (April 1985) and Third Edition (November 1986) with Revision I (December 1987). Second Edition and Updates I and II are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161 (PB-87-120-291). Third Edition and Revision I are available from Superintendent of Documents, Government Printing Office, 941 North Capitol Street, NE, Washington, DC 20002 (Document Number 955-001-00000-1).

Fecal coliform (Part 9221 E. or Part 9222 D.), Salmonella sp. bacteria (Part 9260 D.), and additional inorganic parameters (e.g., TKN, NO_3-N, NH_4-N, total P, K, pH, total and volatile solids)
"Standard Methods for the Examination of Water and Wastewater", 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005.

EPA guidance documents that may be referenced for sample collection include:

- "Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge," EPA Office of Research and Development, Revised 2003 (EPA/625/R-92/013), and
- "Sampling Procedures and Protocols for the National Sewage Sludge Survey," EPA Office of Water Regulations and Standards, 1989b.

Note: EPA has proposed to revise test methods for fecal coliform and Salmonella in 40 CFR §136.3, Table IA. The intent of including the acceptable methods in the federal regulations is to make them available for monitoring purposes.

Submittal of data

In most cases, the submittal of data with a permittee's biosolids annual report will suffice unless there is a justified need for data submittal on a more frequent basis with the DMR (e.g., concern with variability in pollutant concentration data). Data submitted with the annual report will streamline requirements for the permittee and will reduce monthly and annual reporting redundancies. Annual data submittal will also allow the department to efficiently enter the data into the biosolids database and to comprehensively review the data in the annual report. The permittee still may need to include certain process or operational data on the DMR. The NPDES or WPCF permit should clearly state when the required monitoring information is to be reported.

Recordkeeping requirements

OAR 340-050-0035(3) states that recordkeeping requirements shall conform to 40 CFR §503.17. The federal regulations for recordkeeping outline:

- Who shall develop and retain the specified information,
- Length of time that records are to be retained (5 years),
- Description of how pathogen and vector attraction reduction requirements are met, and
- Required certification statements. Certification statements are posted on the department's web site at http://www.deq.state.or.us/wq/Biosolids/BioCerts.htm.

The permittee is also required to maintain site logs that indicate the quantity, quality, and location of biosolids applied to authorized land application sites. The site logs must be available for department review during the life of the application site [OAR 340-050-0035(1)].

Annual Report

Who needs to submit an annual report and when?

All NPDES and WPCF permittees in Oregon that land applied bulk biosolids or domestic septage, or that sold or gave away biosolids derived products (e.g., biosolids compost) for distribution and marketing are required to submit an annual report to the department by February 19; the report must provide a detailed accounting of solids handling activities from the previous calendar year [OAR 340-050-0035(6)]. This annual reporting requirement is a condition under Schedule B in NPDES and WPCF permits. As permits are renewed, a condition will be included in Schedule B that requires the annual report data to be submitted in a department approved format.

A copy of the annual report should be submitted to the regional DEQ biosolids staff contact and to the DEQ biosolids program coordinator. Under 40 CFR §503.18(a), Class I facilities (those classified as major facilities) must also submit an annual report to the Environmental Protection Agency (EPA) Region 10 by February 19 for the previous calendar year. The same annual report submitted to DEQ meets the requirements for the EPA. The annual report form is posted on the department's web site at http://www.deq.state.or.us/wq/Biosolids/BiosolidsHome.htm.

Required information

The annual report describes the quality and quantity of biosolids or domestic septage produced and land applied, as well as the specific land application activities practiced. The report should provide a summary of activities at each site to adequately demonstrate that biosolids were applied within agronomic loading rates and that other required site management practices were followed. The statewide Biosolids Annual Report form developed by the department should be used by all facilities required to submit annual reports in accordance with OAR 340-050-0035(6). The annual report must include the following:

- Description of how biosolids or septage were produced, stabilized, and tested;
- The amount of biosolids or septage produced;
- Information characterizing the quality of the biosolids or septage;
- Description of how pathogen reduction and vector attraction reduction requirements were met;
- Description of how and where the biosolids or septage were managed;
- Necessary signed certifications for pathogen reduction, vector attraction reduction, and site management practices (see section on available documents);
- Description of any major modifications to solids handling or land application site management practices; and
- Description of any violation of state or federal rules pertaining to biosolids or septage and remedial actions taken.

In addition to the above information, if biosolids or septage are land applied, the following is needed on the beneficial use sites:

- Site names and locations;
- Crops grown, and for septage the nitrogen requirements for each site;
- Amount of acreage amended;
- Amount of biosolids (dry tons/acre) or septage (gallons/acre) applied, including date and location;
- Amount of available nitrogen supplied by the biosolids or septage;
- Specific types of septage treated and applied; and
- Soil test(s) if required by a site authorization letter.

Database

The annual report information will be entered into the department's biosolids database at headquarters for tracking purposes of biosolids generation and land application activities throughout the state. Regional biosolids specialists and water quality managers will have access to data reports and run queries.

The development of the database will also focus on how permittees will eventually be able to satisfy reporting requirements by submitting data electronically through the use of the annual report outline.

8. Storage

Overview

The objectives of a facility's wastewater solids treatment system and biosolids land application program must be understood so storage needs can be adequately addressed either through the wastewater facility planning process or during permit renewal. These objectives must also be integrated into the facility's biosolids management plan. The design and review of constructed storage facilities (e.g., lagoons and tanks), which are usually located at the wastewater treatment facility, typically occurs during wastewater facility improvements. Proposed field staging or storage of biosolids is reviewed during the land application site authorization process. There are many factors to consider in planning for when, how much, and what type of storage is needed. This section discusses operational storage considerations at a wastewater treatment facility, and field storage of biosolids. EPA's *Guide to Field Storage of Biosolids*, 2000 (EPA/823-B-00-007), Chapter 5, is also a very useful reference relevant to field storage management practices.

What does staging and storage mean?

Liquid biosolids (less than 10 percent solids concentration) is typically stored at a wastewater treatment facility, then transported and directly applied to the land application site. Dewatered (10 to 50 percent solids) and dried (greater than 50 percent solids) biosolids are typically unloaded at a land application site in a staging area, and then loaded into spreading equipment for application. Field storage may occur on a short-term or long-term basis, and depends on site location, seasonal and climatic conditions, and agricultural management considerations.

Storage at a Wastewater Treatment Facility

The storage of wastewater solids at a wastewater treatment facility may occur within the wastewater treatment process (e.g., aeration basin, facultative lagoon) or the solids treatment process (e.g., digester or drying beds) but should not adversely impact treatment efficiency. Storage must be integrated with the operational design of the wastewater treatment process and the intended beneficial use of the biosolids. If treatment efficiency is affected, then dedicated storage facilities must be planned to optimize wastewater and solids treatment.

Staging

Staging dewatered or dried biosolids at a land application site may occur on a limited time basis so enough volume of biosolids can accumulate that will facilitate land application for certain agricultural operations. The staging area may be used on a permanent basis but biosolids from the area must be removed and land applied within a limited time, usually 7 days in western Oregon and 14 to 21 days in eastern Oregon. Staging requirements will be outlined in a site authorization letter.

Field Storage

Field storage of biosolids may occur at a land application site if a permittee demonstrates the need based on their biosolids management activities and the agricultural activities of the land application site. Field storage may be short-term or long-term to avoid land application during adverse weather conditions or during

times when soil moisture content would make normal operation of farming implements impractical due to soil compaction or limited trafficability. Field storage is generally suitable in the drier regions of the state (e.g., east of the Cascades). A permittee must submit specific information about the site and the management of activities where storage will occur. If field storage is approved, requirements will be outlined in a site authorization letter and the biosolids management plan may need to be modified.

Storage Considerations at a Wastewater Treatment Facility

Determining a wastewater treatment facility's storage needs

If a facility land applies biosolids, a wastewater treatment facility's storage needs are somewhat determined by the number and characteristics of sites available for land application and the agronomic biosolids application rate for those sites. Actual storage needs and requirements are based on a case-by-case evaluation of each wastewater treatment facility. The minimum amount of storage capacity will vary with each facility, but three to six months storage capacity is recommended for facilities located in western Oregon.

Biosolids storage needs for a wastewater treatment facility must be considered during the facility planning process for proposed treatment works upgrades or during permit renewal. The department may require plans and specifications for biosolids or domestic septage structures proposed for storage as part of an upgrade or as a condition of the permit or biosolids management plan approval [OAR 340-050-0032(1)]. Facilities that treat domestic wastewater are required to plan for sufficient storage capacity based on the expected quantity of solids that will be generated during a 20-year design life of the wastewater treatment facility. Any change to biosolids treatment or storage facilities at the treatment works, including construction of temporary biosolids storage facilities, is considered a modification to the wastewater treatment system and requires submittal of plans and specifications for department review and approval under OAR 340-052-0015.

Why storage during wet weather must be considered

The land application of biosolids is prohibited on flooded, frozen, or snow covered sites under conditions when there is the potential for biosolids to run off the site and enter wetlands or other waters of the United States (i.e., surface waters) [40 CFR §503.14(b)]. Land application must also consider crop nitrogen requirements and agricultural practices, soil conditions such as soil moisture content, and precipitation that may result in run-off to surface water or rapid infiltration to groundwater.

Adequate biosolids storage capacity at a wastewater treatment facility is needed during the wet weather season (i.e., approximately late fall to early spring) generally in western Oregon when prolonged inclement weather may cause unfavorable conditions for land application. The department recommends minimizing land application of biosolids in areas of western Oregon that experience the greatest potential for high levels of precipitation during the wet weather season. A facility in western Oregon with wet weather storage alternatives (e.g., aeration basin or lagoon)

is expected to use the alternatives to store solids during the non-growing wet weather season. A facility requesting to land apply during the wet weather season would only be authorized to use an acceptable site based on soil type and landform that could be considered during those times when weather, well drained soils, depth to groundwater, and site factors allow.

Contingency storage

Wastewater treatment facilities need to have contingency storage options in place for solids and liquids. Adequate storage capacity is necessary in the event of wastewater treatment or land application equipment breakdown, treatment facility process upset, unavailable land application sites, or unusual weather conditions creating operational or land application constraints. Adequate storage for unexpected conditions will enable operators to optimize wastewater or solids treatment, while protecting water quality.

Constructed storage facility plan requirements

A detailed description of the wastewater treatment processes and design data shall accompany plans and specifications for a proposed storage facility. Some design considerations that must be addressed for liquid and dewatered and dried biosolids storage facilities are listed below. EPA's *Process Design Manual for Sludge Treatment and Disposal*, 1979 (EPA 625/1-79-011) should be used for a comprehensive review of plans and design of solids treatment and storage facilities. Biosolids storage facilities shall also be designed and operated to maintain compliance with the groundwater quality standards as outlined in OAR Chapter 340, Division 40.

Liquid Storage Facilities

- Storage lagoons shall be designed and constructed following best engineering practices. The department's, "*A Review of Available Literature: Design and Construction of Liners for Wastewater Impoundments, 1996*" should be used when considering lagoon liners.
- Maximum lagoon depth shall be 6 meters (20 feet). Depth may be increased by the department on a case-by-case basis.
- Storage facilities shall be designed to facilitate easy addition and removal of solids without causing damage to the integrity of the facility.
- Storage tanks shall be designed, installed and maintained to prevent leaks due to corrosion or structural failure.
- If a biosolids storage facility is temporary, the department shall be notified of the initial placement of the facility. The department shall also be notified in writing prior to abandonment and the abandonment plan must be approved in writing by the department. The plan must address how abandonment will be accomplished and when the facility is abandoned, it shall be done in a manner which prevents the occurrence of safety, environmental and aesthetic problems.

Dewatered and Dried Biosolids Storage Facilities

- Dewatered or dried biosolids storage facilities shall be designed to minimize odors.
- Facilities shall be constructed with an impervious surface (unless otherwise approved in writing by the department) to protect surface waters, groundwater and soil.

- Management measures to divert precipitation, and surface run-off and run-on from the storage location shall be identified.
- Dewatered or dried biosolids storage facilities designed as bunkers shall provide a method for collection and containment of precipitation.

Field Storage

Meeting pathogen and vector attraction reduction requirements

The EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge*, 2003 (EPA/625/R-92/013), page 23, states that pathogen reduction requirements for Class B biosolids can be met at any point, therefore those biosolids meeting Class B and that are stored at the land application site do not require retesting if the quality of the biosolids has not changed. Management practices should be outlined in the biosolids management plan indicating how the potential movement of pathogens from the stored biosolids will be controlled.

Class A and Exceptional Quality (EQ) biosolids must be tested prior to use or distribution, so sampling must occur at the end of the storage phase. If composting is used to achieve Class A biosolids, sampling may occur after the curing phase if a preparer oversees the active composting and curing phases prior to distribution of the product to another person. If storage were also to occur under the same preparer prior to distribution of the product, then sampling would occur just prior to distribution. For further information on composting requirements, refer to the section on Composting of Biosolids.

Resampling for pathogens

In some cases and depending on the classification of biosolids, resampling may be required if biosolids have been stored prior to use or distribution and remain under the control of the preparer. If Class B, Class A or EQ biosolids are mixed with other materials or the quality is altered, it must be shown that the resulting product meets the pathogen reduction and vector attraction reduction requirements. Prolonged storage of biosolids may require resampling, based on factors resulting in a change of the product quality.

Considerations for field storage

Federal regulations define storage as the placement of biosolids on land on which the biosolids remain for two years or less [40 CFR §503.9(y)]. When biosolids will not be immediately used for land application and short-term or long-term storage is being considered at a land application site, the department requires that supporting documentation for the storage activity be submitted with the site authorization request. In addition to the information required in the department's site submittal checklist for land application authorization, sites being proposed for biosolids land application using field storage must address the following:

- Agricultural information
- Site specific information
- Field management plan

If a structure is proposed to be constructed, plans and specifications must be submitted and approved by the department, and a Land Use Compatibility statement (LUCS) may also be required.

After the information is reviewed, the department will determine if field storage should be authorized through the site authorization letter. A modification to the biosolids management plan and public notice may also be needed if storage will occur on a permanent basis.

Agricultural information

The need for field storage must be demonstrated by submitting information on the agricultural activity that identifies:

- Why there is a need for storage in relation to agricultural practices and biosolids land application activities (e.g., summer fallow requiring winter storage, and perennial forage requiring summer storage while crops are in production).
- Field/crop requirements that support the concept of using storage (e.g., planting and harvesting cycles of a particular crop).

Site specific information

The following information is needed to characterize each land application site storage area:

- Months of intended use.
- A detailed and to-scale topographic map (including legible contour intervals appropriate to the size of the site) that depicts the:
    - Exact location of the proposed storage area(s),
    - Distance from storage area(s) to domestic water sources or wells, buildings or structures, and roadways, and
    - Location of access roadways.
- The size, in acres or square feet, of each area, and what the percent slope is.
- The amount of biosolids to be stored at each area.
- Soil characteristics at each area (e.g., effective rooting depth, texture and structure).
- Distance to groundwater and surface water.
- Biosolids characteristics for the specific field storage area (e.g., percent solids, lime stabilized, anaerobically digested biosolids, etc.).
- Post-application monitoring plan for each area that addresses soil nitrate sampling to qualify what is occurring due to the storage of biosolids (e.g., the plan could outline that some monitoring up-front will occur and then if data shows no impacts then reduced monitoring could be requested from the department). The objective of the plan is to ensure that residual soil nitrate nitrogen will not be concentrated to a point that groundwater or site productivity will be adversely impacted.
- Climatic and seasonal conditions, including precipitation data and prevailing wind direction, and how this will affect storage.
- Site location in relation to sensitive areas (e.g., residential housing, groundwater management area, wildlife habitat).
- Post storage "closure" plan (e.g., deep subsoiling, reseeding schedule).

Field management plan

Overall proper management of a site will help to ensure that a storage area does not adversely impact the environment or public health. A field management plan should:

- Identify potential paths of run-off and run-on. Any necessary controls (e.g., earthen berm, drainage collection system) that will be implemented should be based on the following factors: percent solids of biosolids; location of storage area to neighbors, surface waters, roads, and wells; percent slope of the site; volume of biosolids stored; and length of storage.
- Identify locations, if any, of potential public access and exposure if run-off was to occur.
- Outline how the unloading of biosolids at a land application site will occur so the stockpiles will be properly shaped to prevent slumping or movement off the designated storage facility area.
- Outline cleanup or follow-up procedures if run-off of biosolids or leachate were to occur from a storage area.
- Outline notification procedures to the department if climatic conditions create potential public nuisance conditions due to a biosolids storage area (e.g., run-off, odors).
- Outline odor mitigation measures if off site odors occur due to a biosolids storage area.
- Other storage areas that might be used if areas are to be rotated within a site.

9. Biosolids Composting

Overview

Biosolids composting is considered a Process to Further Reduce Pathogens (PFRP) in 40 CFR Part 503, Appendix B. Certain operating conditions for time and temperature, and microbiological reduction requirements must be met to achieve Class A biosolids. Biosolids composting, including composting with feedstocks other than yard debris or wood waste, is not a common practice in Oregon because of the current viability of land application and Class B alternatives are more economically feasible. However, there is an increased interest in biosolids composting as a potential option for generating a Class A marketable product.

To ensure that a facility's biosolids composting process is operating in accordance with state and federal water quality and solid waste regulations, this section will clarify certain aspects of composting with regards to: Class A operational process requirements; monitoring, sampling and analysis; and permitting requirements when biosolids are mixed with solid waste.

Composting methods

The three most common composting methods are windrow, static aerated pile, and within-vessel. Before active composting occurs in each method, biosolids are mixed with a bulking agent (e.g., wood chips, sawdust) that supplies needed carbon and increases porosity of the mixture.

Windrow

Biosolids mixture is stacked into a long pile or row which is regularly turned or mixed with a machine such as a front-end loader.

Static aerated pile

Biosolids mixture is placed in a pile on top of either a fixed underlying forced aeration system or a system of perforated piping laid on the ground surface.

Within-vessel

Composting process takes place in an enclosed reactor vessel (e.g., silo, tunnel, or vessel) designed for several operational phases where operating conditions can be carefully controlled. Aeration and mechanical mixing occur in the vessel, and product movement through the vessel is by mechanical means.

Composting phases

Mixing

Initial commingling of feedstock and biosolids to attain a homogeneous material is critical for the composting process. The bulking agent, carbon/nitrogen ratio, and moisture content are factors that will affect active composting.

Active composting

After biosolids are mixed with a bulking agent, decomposition occurs and temperatures elevate in the mixture as microorganisms break down organic matter. Carbon and nitrogen must be present in the proper balance for microbial growth, and a sufficient amount of oxygen is needed through aeration and/or mixing.

Curing
During the curing phase, further reduction of organic matter occurs, volatile solids continue to decompose, the potential for odor decreases, and temperatures continue to decrease. The mixture may or may not be screened to remove the bulking agent that has not decomposed. The result of this phase is a product that has stabilized and is ready for use.

Storage
Storage of the cured product may be necessary when a product is not going to be used immediately. Depending on the end user and the market for the product, storage needs should be considered.

Class A Requirements

Pathogens

Class A pathogen reduction must be met before or at the same time as vector attraction reduction [40 CFR §503.32(a)(2)]. Class A composted biosolids must be monitored for either fecal coliform or *Salmonella* sp. and meet one of the following requirements [40 CFR §503.32(a)(7)(i) - Alternative 5]:

- Fecal coliform - Density must be less than 1,000 Most Probable Number (MPN) per gram of total solids (dry weight basis).
- *Salmonella* sp. - Density must be less than three MPN per four grams of total solids (dry weight basis).

The density of fecal coliform or *Salmonella* sp. must be determined for each discrete sample, and each sample must meet the Class A requirement for compliance purposes. Sample results may not be averaged and the geometric mean may not be used as the basis for meeting the pathogen density requirement.

Alternative 5 states that microbiological requirements must be met either:

- At the time when the biosolids are used or disposed, or
- At the time the biosolids are prepared for sale or given away in a bag or other container for land application, or
- At the time the biosolids are prepared to meet the requirements for "exceptional quality" in 40 CFR §503.10(b), (c), (e) or (f).

Process to Further Reduce Pathogens (PFRP)

To be considered a PFRP under 40 CFR §503.32(a)(7)(ii), Appendix B, the temperature requirements for the following composting methods must be met:

- Static aerated pile or within-vessel - Temperature must be maintained at 55 degrees Celsius (131 degrees Fahrenheit) or higher for 3 consecutive days. The entire mass of the static aerated pile must attain the required temperature.
- Windrow - Temperature must be maintained at 55 degrees Celsius (131 degrees Fahrenheit) or higher for 15 consecutive days or longer; during this period when the temperature is maintained, a minimum of five turnings of the windrow is required.

Vector Attraction Reduction (VAR)

For composted biosolids, the most appropriate VAR requirement is aerobic treatment for at least 14 days at over 40 degrees Celsius (104 degrees Fahrenheit) with an average temperature of over 45 degrees Celsius (113 degrees Fahrenheit) [40 CFR §503.33(b)(5)]. VAR must be met at the time or after the pathogen reduction alternative is met [40 CFR §503.32(a)(2)]. The department does not consider the VAR requirement to be met prior to the composting phase. For example, if using a static aerated pile method, temperatures at each monitoring point should meet PFRP requirements for 3 consecutive days, followed by a minimum of 11 more consecutive days where temperatures of the pile meet VAR requirements.

Monitoring

Process performance

Process performance (e.g., pathogen reduction) for outdoor composting may be more variable during certain times of the year due to seasonal variations in temperature, sunshine, and precipitation that will affect microbial activity. It is critical that composting process performance be monitored during the time of the year when poorest performance is expected. If the cured compost produced by a facility is sampled at least once per quarter, this should account for seasonal variations. Samples collected should be representative of changes in biological, chemical and physical characteristics.

Pathogen monitoring

Bacteria re-growth may occur during or after the curing phase of composting. It is important to make the determination that the compost has finished curing and has entered a storage phase where re-growth is unlikely to occur. It is at this time that microbiological testing should happen. To meet the pathogen reduction requirement, the timing at which monitoring should occur is the "last practical monitoring point before the biosolids are applied to the land or placed on a surface disposal site" [EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge*, 2003 (EPA/625/R-92/013), page 27].

Biosolids that meet the requirements under 40 CFR §503.10(b), (c), (e), or (f) are considered "Exceptional Quality" and not subject to further control; thus the microbiological requirements should be met in most cases when the biosolids are under the control of the biosolids preparer for the last time. For example, if a preparer oversees the active composting and curing phases prior to distribution of the product to another person, sampling should occur just prior to distribution. If storage were also to occur under the same preparer prior to distribution of the product, then sampling would occur just prior to distribution. In both cases, sampling is to occur when the product is last managed by the preparer.

Temperature monitoring

The EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge*, 2003 (EPA/625/R-92/013), page 51, states that "the temperature profiles from every monitoring point, not just the averages of the points, should reflect PFRP conditions." The guidance document further states on page 33 that "for all PFRP processes, the goal of temperature monitoring should be to represent all areas of a batch or pile and to ensure that temperature profiles from multiple points in the process all meet mandated temperatures."

Monitoring of multiple points at varying depths in a batch or pile will determine if "cool" or "hot" spots exist, and if the active phase of composting is occurring throughout the entire batch or pile. If temperatures vary and are not meeting PFRP requirements, process operations and characteristics of the biosolids mixture (e.g., ratio of biosolids to bulking agent) should be evaluated to determine why temperature variation exists.

Moisture level monitoring

Without moisture level data, it is difficult to determine if the biological process occurs during composting. Moisture level monitoring should be addressed in a monitoring and sampling plan. Insufficient moisture inhibits the growth of microorganisms and "the cessation of microbial activity results in lowered pile temperatures which can easily be mistaken for the end-point of composting" [EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge,* 2003 (EPA/625/R-92/013), page 52]. Too much moisture can cause the composting process to turn anaerobic.

Moisture levels should be maintained at 45-60% to ensure that composting is occurring; it may be necessary for a composting facility to add water if moisture is too low, or increase aeration or mixing if moisture levels are too high. The final product should have a moisture content of about 35-40%. To determine moisture content, the "squeeze test" is a non-quantitative, subjective method for estimating moisture. A handful of material may be squeezed in the fist and if water only drips out and does not crumble apart when the fist is opened, the moisture content should be about right. A more accurate means for determining moisture content is using the "gravimetric" procedure of weighing samples before and after the water is removed. The frequency of sampling and number of samples should be based on the quantity of compost and the variability of conditions within a composting pile from one location to another.

Sampling and Analysis

Monitoring and sampling plan

Sampling procedures and monitoring data must substantiate if a PFRP is met. It is very important that a monitoring and sampling plan be developed and followed so a facility can determine how effective all phases of the composting process are. The plan will also help to determine compliance with 40 CFR Part 503 and will be referenced in the facility's Biosolids Management Plan.

Collecting a representative sample

Where and when samples are taken in a composting batch are the most important factors in determining if the biosolids meet the 40 CFR Part 503 requirements. It is critical that monitoring of pathogens and temperature be conducted at locations in the compost batch or pile and during times that include where there may be variability in the characteristics due to the composting process. To assure fecal coliform and *Salmonella* sp. densities adequately reflect actual microbial populations present at the time of sampling, samples should be collected over a period not to exceed one hour.

For example, in a static aerated pile, microbial growth may vary due to temperature differences between the interior of the pile and the pile surface. Compost piles may not fully decompose if they are excessively aerated or contain material that is too dry. Samples from a large pile should be taken at various depths along its length that will be representative of the final product. When there is a large temperature gradient in the pile, it is important to include a sample of the composted product from the cooler section of the pile where the chance of pathogen occurrence is greatest.

The edges and interior of heterogeneous piles should be weighted as part of the sample collection procedure, and a sampling grid that prevents bias should be used [EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge,* 2003 (EPA/625/R-92/013), page 70]. Statistically recognized sampling strategies for piles and sampling plan development are described in Chapter 9, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846, Third Edition.

Sampling techniques

The heterogeneous nature of some composted biosolids may cause sampling problems. For example, a composted product may be a large pile comprised of biosolids and wood chips. It is important that wood chips or other materials used as bulking agents are included in the sample collection. Most augers and sampling tools will not be effective for obtaining a representative sample from the interior of a large pile. There may be no substitute for digging with a shovel, silage auger, or backhoe to get to the desired location.

Containers and tools used for sampling should be sterilized and dedicated only to sampling if the product is to meet the Class A pathogen requirements [EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge,* 2003 (EPA/625/R-92/013), page 66]. A clean shovel can be used to get close to a desired sampling location within the compost pile, but a sterilized trowel should then be used for the actual sample collection. Sterilization of tools should be done with steam or a sterilizing solution such as sodium hypochlorite. If a sterilizing solution is used, the tools must be thoroughly rinsed to prevent any effect the residual may have on the microbial population of the sample. Inexpensive, single use, pre-sterilized plastic trowels are also commercially available.

Dry solids samples can generally be mixed adequately by shaking. If the particles are large and a number of sub-samples must be combined for a composite sample, it may be necessary to reduce the particle size before the samples are composited. This

can be done in a sterile covered chopper, blender, or grinder. The individual sub-samples should then be combined and mixed by shaking, rotating, and tumbling. A representative composite sample can be obtained by taking a number of grabs from all parts of the combined sample. Some sampling methods to reduce particle size, such as "coning and quartering" (ASTM 1992), cannot be used for pathogens since it is difficult to avoid contaminating the sample when using these procedures [EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge,* 2003 (EPA/625/R-92/013), page 72].

Sampling frequency

Testing one batch of composted biosolids on an annual basis at the minimum monitoring frequency required of a small facility (less than 290 metric tons per 365 days under 40 CFR §503.16) is inadequate to reasonably demonstrate compliance and product consistency. A permittee should test for inorganic pollutants and pathogens from a representative pile of cured compost on a quarterly basis at a minimum. Variations in inorganic pollutants and pathogens may occur over time and the impact of seasonal variation must be assessed. If compost is processed, cured and distributed or marketed to the public in less than 90 days, the department will require more frequent testing that will be considered on a case-by-case basis.

Required number of samples

The minimum number of samples needed to demonstrate compliance with the pathogen requirements is seven (7) discrete samples. The sampling event should extend beyond two weeks [EPA guidance document, *Control of Pathogens and Vector Attraction in Sewage Sludge,* 2003 (EPA/625/R-92/013), page 139]. A single sample for pathogens in a compost product is inadequate due to:

- Inherent variations in biosolids compost microbiological quality,
- Heterogeneous nature (i.e., uniformity and feedstock characteristics) of the compost, and
- Variability in sampling or laboratory analysis.

For organic pollutants, sampling may be from a composite sample.

Approved analytical methods

Approved analytical methods are listed in 40 CFR §503.8. Sample preparation and testing for fecal coliform and *Salmonella* sp. should follow protocols listed in EPA's Manual, *Control of Pathogens and Vector Attraction in Sewage Sludge* (EPA/625/R-92/013, revised July 2003), in Appendices F and G, pages 137-140 and 141-149 respectively (or as updated).

Mixing Sewage Sludge, Domestic Septage, or Biosolids with Solid Waste

Definitions

Sewage sludge/biosolids

Domestic sewage sludge is generated during the treatment and processing of domestic wastewater at a wastewater treatment facility. Biosolids is the resulting

product after raw solids have been sufficiently treated to meet state and federal requirements, including but not limited to pollutant limits, pathogen reduction and volatile solids reduction, or solids chemically stabilized to the extent that vectors are not attracted.

Domestic Septage
Domestic septage is liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, holding tanks, or similar treatment works that receive only domestic wastewater.

Solid waste (as used in this IMD)
Any feedstock, as defined in OAR Chapter 340, Division 93 (Solid Waste: General Provisions) used to produce compost is considered solid waste. Biosolids compost as a finished product is not considered solid waste.

What type of permit is needed?

When any amount of sewage sludge or domestic septage is composted with solid waste, the processing and product are subject to the 40 CFR Part 503 regulations. The site or facility must operate under a NPDES or WPCF water quality permit issued pursuant to ORS 468B.050, and is thus specifically exempt from needing to obtain a solid waste disposal site permit [OAR 340-093-0050(3)]. The permit must include substantive requirements that adequately address solid waste regulations, and the operation must comply with OAR Chapter 340, Divisions 93 through 97 and other applicable laws, rules, and regulations regarding solid waste disposal [OAR 340-096-0030(1)(b)].

Substantive requirements

The NPDES or WPCF water quality permit and biosolids or septage management plan must reflect applicable solid waste program regulations. The biosolids management plan must address how certain aspects of the composting operation are managed. The following substantive requirements will be included in the permit and the plan.

Permit requirements
- Monitoring and Reporting - Actual type and amount of solid waste used as feedstock on an annual basis.
- Operational Management Practices - Manage biosolids and feedstocks in accordance with a biosolids management plan approved by the department.

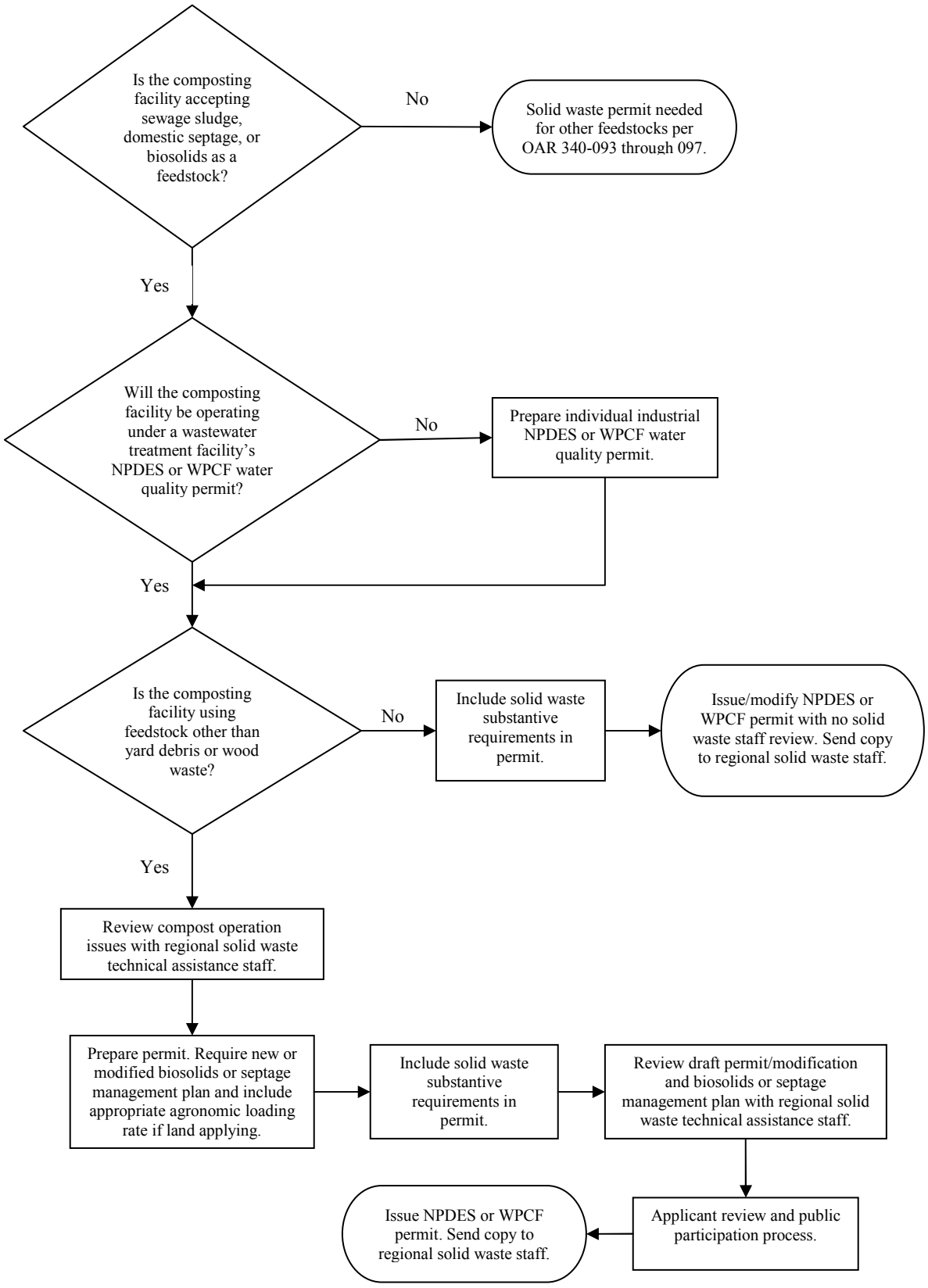
Biosolids Management Plan requirements
- Source(s), type(s), and amounts of solid waste to be used as feedstock per batch of compost.
- How contaminants (i.e., solid waste not used in the composting process) from the feedstock will be managed and disposed of.
- Odor minimization plan per OAR 340-096-0028(3)(b).

Permitting process under water quality rules

The "decision tree" on the following page depicts the permitting process under water quality rules for a composting facility when sewage sludge, domestic septage, or biosolids are used. Two determining factors in the process are what kind of feedstock will be used, and will the composting facility be operating under a wastewater treatment facility's water quality permit.

This process clarifies how regional solid waste technical assistance staff is involved in the water quality permitting process as the permit and biosolids or septage management plan are developed. If the composting facility will be using feedstock other than yard debris or wood waste, operational issues must be discussed between the water quality and solid waste regional staff prior to developing the draft permit. This discussion should result in a clear understanding of what the permit and biosolids or septage management plan should address. After the draft permit and draft biosolids or septage management plan are developed, the regional solid waste technical assistance staff will review the documents prior to applicant review and public notice. If a permit or plan needs to be modified as a result of the public participation process, regional solid waste staff should be notified. Permit compliance activities will be the responsibility of water quality staff.

Figure 9-1: Permitting a Composting Facility under Water Quality Rules (excluding storm water)



Appendix A

Biosolids Management Plan Template

Overview

The biosolids management plan template was designed to streamline the process of plan development and review, and to ensure all necessary elements required by state and federal regulations are addressed in a plan. The format of the management plan template will assist Department of Environmental Quality (department) staff review process and be useful to wastewater treatment facilities as they develop a complete and comprehensive management plan. Required information that is not addressed will delay the process for obtaining plan approval. Each facility should tailor their management plan to the specifics of their wastewater treatment facility operations, and their biosolids management and land application program. All draft management plans must be reviewed by the department. Prior to department approval, the biosolids management plan and land application plan must go through the public notice process.

Instructions for using the template

- Placeholders needing information are indicated in **<bold>**. A placeholder defines what specific information is needed, or in some cases a selection may be made from what is written and indicated by **<bold/bold>**. Bulleted items under Liquids Processing, Solids Processing, and Septage Processing are not in bold, but do require the information as stated.
- "**Notes*" are marked with an asterisk and are italicized. Notes are inserted to give clear direction to the biosolids management plan writer about a particular topic or section.
- Check boxes are included under the Pathogen Reduction and Vector Attraction Reduction sections. The appropriate alternative(s), and process(es) if necessary, must be checked for pathogen reduction requirements. The appropriate option(s) must be checked for vector attraction reduction.
- Attention should be given to information that should be stated either in the permit or the site authorization letter (see Appendix C). Approved management plan provisions are considered to be permit conditions and should not conflict or be repetitious with conditions that are included in a permit or those to be included in a site authorization letter.
- The draft management plan must be submitted for review to the appropriate department regional office.
- After the management plan has gone through the public notice process and is considered to be approved by the department, the regional office will mail a letter to the permittee indicating action that was taken on the management plan.

Biosolids Management Plan
for
<Permittee Name>
<NPDES/WPCF> Permit No. <number>
File No. <number>
<Permittee contact name>
<Permittee contact phone number>

INTRODUCTION

The **<permittee>** (facility) owns and operates a municipal wastewater collection and treatment system, and manages a biosolids land application program. Wastewater processed by the treatment works is primarily of domestic origin, **<and no/but a>** formal pretreatment program is required to be implemented under our **<NPDES/WPCF>** permit. **<The facility also receives and processes septage>**. This biosolids management plan, as required by the **<NPDES/WPCF>** permit, outlines the liquids and solids processes at the facility, how biosolids are managed to meet federal and state requirements, and how the biosolids land application program is operated. The **<permittee's>** biosolids management plan was originally approved by the Oregon Department of Environmental Quality (Department) on **<date>** and is being updated at this time to address **<state changes>**.

WASTEWATER TREATMENT FACILITY

Liquids Processing

<Permittee> operates **<type of facility>** located at **<street address>** in **<name>** county. Treated effluent is discharged **<year-round/state months>** to **<receiving stream name>** at river mile **<number>**. The designed average dry weather flow is **<number>** million gallons per day (MGD). Actual flows during the **<year>** dry season averaged **<number>** MGD and during the wet season averaged **<number>** MGD. The peak flow design capacity is **<number>** MGD. The origin of the wastewater processed is **<number>** percent domestic, **<number>** percent commercial, and **<number>** percent industrial.

**Note: This section should describe the wastewater treatment facility liquid process flow schematic step-by-step and address the following. A diagram should also be included.*

- <Liquids processing components, including the number of components and the volume of each unit, and the current operating capacity (e.g., one headworks screenings and grit drop box - 5,000 gallon; two oxidation ditches - 1.6 MGD each).
- Upgrades or modifications made to the process since the facility's previously approved biosolids management plan (e.g., in 2001 a new 20,000 gallon concrete chlorine contact basin was constructed which provides approximately 2 hours detention time).
- Fluctuations in flow (e.g., inflow and infiltration; septage received; impact of tourism or vacation home use).
- Changes in mode of operation during seasonal conditions or fluctuations in flow (e.g., reclaimed water use, bypassing under what conditions).
- Process flow used for solids processing.
- Process monitoring units (e.g., effluent flows through a 6-inch concrete Parshall flume which is equipped with an ultrasonic flow meter).>

Solids Processing

**Note: This section should describe the wastewater treatment facility solids process flow schematic and address the following. A diagram should also be included.*

- <Primary, secondary, and tertiary solids processing components, including the number of components and the volume of each unit, and the current operating capacity (e.g., two sludge holding tanks - 155,000 gallons each, one asphalt drying pad - 180,000 square feet).
- Operational information of component (e.g., time that solids remain in digester, drying bed, or compost pile; operating temperature of each digester; type and quantity of polymer used in solids thickening process).
- Operational controls for odor minimization (e.g., the solids dewatering process takes place in an enclosed solids handling facility).
- End product and volume resulting from process (e.g., an annual average of 360 dry tons of dried biosolids are collected from the storage area and land applied).
- Upgrades or modifications made to the process (e.g., in 1999, a 175,000 gallon sludge storage tank was constructed to accommodate storage of digested sludge during the winter months).
- Solids processing operational changes during seasonal conditions or fluctuations in flow (e.g., during the months when field access is limited for application, biosolids are air dried on the drying pad or stored in the sludge storage tank which serves as a secondary digester).
- Solids process monitoring (e.g., temperature readings are taken daily from the anaerobic primary digester to attain the necessary requirement for Class B pathogen reduction).>

Septage Processing

**Note: If the wastewater treatment facility receives and processes septage, this section must be included and address the following.*

- <Type of septage received (e.g., septic tank, holding tank, chemical toilet).
- Average number of gallons received each year.
- Receiving facility screening practices.
- Receiving and processing components, including the volume of each component.
- Septage processing operational changes during seasonal conditions or fluctuations in flow.
- Septage process monitoring (e.g., flow measurement, screening, pH readings).>

Pretreatment Program

The **<permittee>** **<is/is not>** required at this time to implement an industrial wastewater pretreatment program as **<state reason>**. Pollutant monitoring requirements as stated in the permit will ensure land application of biosolids occurs within federal and state limitations.

BIOSOLIDS TREATMENT PROCESSES

Under 40 CFR Part 503 and Oregon Administrative Rules Chapter 340, Division 50, pathogen reduction and vector attraction reduction for biosolids must be met prior to land application. Vector attraction reduction requirements can also be met at the time of land application if biosolids are injected below the surface of the land or incorporated into the soil within 6 hours after application to the land. Biosolids are categorized as Class A or Class B depending on the method used to determine pathogen reduction. Biosolids may also be classified as exceptional quality (EQ) if the product meets: pollutant concentration limits in 40 CFR Part 503, one of the Class A pathogen reduction alternatives in 40 CFR §503.32(a), and one of the vector attraction reduction options in 40 CFR §503.33(b)(1) through (8). To meet regulatory

requirements, pathogen reduction must be met before or at the same time that vector attraction reduction is achieved.

The **<permittee>** will certify in writing that Class **<A/B>** pathogen requirements and vector attraction reduction requirements are met. The **<permittee>** will also notify the Department in writing and obtain written approval prior to any process change that would use a pathogen reduction or vector attraction reduction method other than what is specified in this biosolids management plan.

Pathogen Reduction

Pathogen reduction requirements of 40 CFR Part 503 and OAR 340-050 are met through **<state class(es) of biosolids, state which alternative(s) is met, how and when the treatment process achieves the alternative(s), and include supporting data within the biosolids management plan or as an appendix>**.

Class B Pathogen Requirements

**Note: Must meet one of the following alternatives. Check applicable alternative.*

☐ Alternative 1: The geometric mean of the density of fecal coliform of seven representative samples shall be less than either 2 million Most Probable Number (MPN) or 2 million Colony Forming Units (CFU) per gram of total solids (dry weight basis).
☐ Alternative 2: Biosolids shall be treated in one of the Processes to Significantly Reduce Pathogens (PSRP) described in the table below.
☐ Alternative 3: Biosolids shall be treated in a process that is equivalent to a PSRP, as determined by the permitting authority.

Processes to Significantly Reduce Pathogens (PSRP) Listed in Appendix B of 40 CFR Part 503

**Note: Check applicable PSRP*

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☐	Aerobic Digestion	Sewage sludge is agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time (i.e., solids retention time) at a specific temperature. Values for the mean cell residence time and temperature shall be between 40 days at 20ºC (68ºF) and 60 days at 15ºC (59ºF).
☐	Air Drying	Sewage sludge is dried on sand beds or on paved or unpaved basins. The sewage sludge dries for a minimum of 3 months. During 2 of the 3 months, the ambient average daily temperature is above 0ºC (23ºF).
☐	Anaerobic Digestion	Sewage sludge is treated in the absence of air for a specific mean cell residence time (i.e., solids retention time) at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35ºC to 55ºC (131ºF) and 60 days at 20ºC (68ºF).
☐	Composting	Using either the within-vessel, static aerated pile, or windrow composting methods, the temperature of the sewage sludge is raised to 40ºC (104ºF) or higher and remains at 40ºC (104ºF) or higher for 5 days. For 4 hours during the 5-day period, the temperature in the compost pile exceeds 55ºC (131º).
☐	Lime Stabilization	Sufficient lime is added to the sewage sludge to raise the pH of the sewage sludge to 12 for ≥2 hours of contact.

Class A Pathogen Requirements

**Note: Must meet the requirement for fecal coliform or Salmonella sp. <u>and</u> one of the alternatives. Check applicable alternative.*

Either the density of fecal coliform in the biosolids must be less than 1,000 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). Sampling must consists of at least seven (7) discrete samples taken over a two week period, unless otherwise specified in the permit.

☐ Alternative 1: Thermally treated biosolids must meet one of four time-temperature regimes as outlined in 40 CFR §503.32(a)(3)(ii).
☐ Alternative 2: Biosolids must meet specific high pH-high temperature, and air-drying requirements as outlined in 40 CFR §503.32(a)(4)(ii).
☐ Alternative 3: Demonstrate that biosolids treated in other processes (that don't meet Alternatives 1 and 2) can reduce enteric viruses and viable helminth ova, and maintain operating conditions used to demonstrate pathogen reduction as outlined in 40 CFR §503.32(a)(5)(ii) and (iii).
☐ Alternative 4: Biosolids treated in unknown processes 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 as outlined in 40 CFR §503.32(a)(6)(i),(ii) and (iii).
☐ Alternative 5: Biosolids shall be treated in one of the Processes to Further Reduce Pathogens (PFRP) described in the table below.
☐ Alternative 6: Biosolids shall be treated in a process that is equivalent to a PFRP, as determined by the permitting authority.

Processes to Further Reduce Pathogens (PFRP) Listed in Appendix B of 40 CFR Part 503
**Note: Check applicable PFRP.*

☐	Composting	Using either the within-vessel composting method or the static aerated pile composting method, the temperature of sewage sludge is maintained at 55ºC (131ºF) or higher for 3 consecutive days. Using the windrow composting method, the temperature of the sewage sludge is maintained at 55ºC (131ºF) or higher for 15 consecutive days or longer. During the period when the compost is maintained at 55ºC (131ºF) or higher, there shall be a minimum of five turnings of the windrow.
☐	Heat Drying	Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content of the sewage sludge to 10% or lower. Either the temperature of the sewage sludge particles exceeds 80ºC (176ºF) or the wet bulb temperature of the gas in contact with the sewage sludge as the sewage sludge leaves the dryer exceeds 80ºC (176ºF).
☐	Heat Treatment	Liquid sewage sludge is heated to a temperature of 180ºC (356ºF) or higher for 30 minutes.
☐	Thermophilic Aerobic Digestion	Liquid sewage sludge is agitated with air or oxygen to maintain aerobic conditions and the mean cell residence time (i.e., the solids retention time) of the sewage sludge is 10 days at 55ºC (131ºF) to 60ºC (140ºF).
☐	Beta Ray Irradiation	Sewage sludge is irradiated with beta rays from an electron accelerator at dosages of at least 1.0 megarad at room temperature (ca. 20ºC [68ºF]).
☐	Gamma Ray Irradiation	Sewage sludge is irradiated with gamma rays from certain isotopes, such as Cobalt 60 and Cesium 137, at dosages of at least 1.0 megarad at room temperature (ca. 20ºC [68ºF]).
☐	Pasteurization	The temperature of the sewage sludge is maintained at 70ºC (158ºF) or higher for 30 minutes or longer.

Vector Attraction Reduction

Vector attraction reduction requirements of 40 CFR Part 503 are met through **<state option(s) from table below, how the treatment process achieves the option(s), and include supporting data within the biosolids management plan or as an appendix>**.

Vector Attraction Reduction Options

**Note: Must meet one of the following options. Check applicable option(s).*

40 CFR Part 503 Requirement		What is Required?	Most Appropriate For:
☐	Option 1 503.33(b)(1)	At least 38% reduction in volatile solids during sewage sludge treatment	Sewage sludge processed by: Anaerobic biological treatment Aerobic biological treatment
☐	Option 2 503.33(b)(2)	Less than 17% additional volatile solids loss during bench-scale anaerobic batch digestion of the sewage sludge for 40 additional days at 30ºC to 37ºC (86ºF to 99ºF)	Only for anaerobically digested sewage sludge that cannot meet the requirements of Option 1
☐	Option 3 503.33(b)(3)	Less than 15% additional volatile solids reduction during bench-scale aerobic batch digestion for 30 additional days at 20ºC (68ºF)	Only for aerobically digested liquid sewage sludge with 2% or less solids that cannot meet the requirements of Option 1 – e.g., sewage sludges treated in extended aeration plants. Sludges with 2% or greater solids must be diluted
☐	Option 4 503.33(b)(4)	SOUR at 20ºC (68ºF) is ≤ 1.5 mg oxygen/hr/g total sewage sludge solids	Liquid sewage sludges (2% or less solids) from aerobic processes run at temperatures between 10 to 30ºC (should not be used for composted sewage sludges)
☐	Option 5 503.33(b)(5)	Aerobic treatment of the sewage sludge for at least 14 days at over 40ºC (104ºF) with an average temperature of over 45ºC (113ºF)	Composted sewage sludge (For sewage sludges from other aerobic processes, it will likely be easier to meet option 3 or 4)
☐	Option 6 503.33(b)(6)	Addition of sufficient alkali to raise the pH to at least 12 at 25ºC (77ºF) and maintain a pH ≥ 12 for 2 hours and a pH ≥ 11.5 for 22 more hours	Alkali-treated sewage sludge (alkaline materials include lime, fly ash, kiln dust, and wood ash)
☐	Option 7 503.33(b)(7)	Percent solids ≥ 75% prior to mixing with other materials	Sewage sludges treated by an aerobic or anaerobic process (i.e., sewage sludges that do not contain unstabilized solids generated in primary wastewater treatment)
☐	Option 8 503.33(b)(8)	Percent solids ≥ 90% prior to mixing with other materials	Sewage sludges that contain unstabilized solids generated in primary wastewater treatment (e.g., heat-dried sewage sludges)
☐	Option 9 503.33(b)(9)	Sewage sludge is injected into soil so that no significant amount of sewage sludge is present on the land surface 1 hour after injection, except Class A sewage sludge which must be injected within 8 hours after the pathogen reduction process	Sewage sludge applied to the land or placed on a surface disposal site. Domestic septage applied to agricultural land, a forest, or a reclamation site, or placed on a surface disposal site
☐	Option 10 503.33(b)(10)	Sewage sludge is incorporated into the soil within 6 hours after application to land or placement on a surface disposal site, except Class A sewage sludge which must be applied to or placed on the land surface within 8 hours after the pathogen reduction process	Sewage sludge applied to the land or placed on a surface disposal site. Domestic septage applied to agricultural land, forest, or a reclamation site, or placed on a surface disposal site

<Batch Processing/Alkaline Stabilization/Thermal Drying/Composting>

**Note: This section should describe any specific solids process (i.e., batch processing, alkaline stabilization, thermal drying, or composting) that is used at the wastewater treatment facility to achieve pathogen reduction and vector attraction reduction. The process should be described in detail and explain how operational conditions will ensure achievement of pathogen reduction and vector attraction reduction.*

BIOSOLIDS STORAGE

Treatment Facility

From the **<processing unit at treatment facility>** **<type of biosolids (i.e., liquid, dewatered)>** can be **<pumped/transferred>** into a truck for land application, or **<pumped/transported>** to **<describe storage facility (e.g., drying beds, lagoons)>**. The **<storage facility (or unit)>** is designed with a total **<area/ volume>** to accommodate for **<number of days or months>** of storage during **<state months>** until land application can commence. This is based on **<year>** production rates**. <Further pathogen reduction is achieved through <storage unit> prior to the biosolids being land applied.>**

Staging

The unloading and placement of biosolids in one area at a land application site may occur on a limited time basis. If staging of biosolids occurs, the requirements outlined in the site authorization letters for each site will be followed.

Field Storage

Field storage **<is/is not>** authorized by the Department at this time.
**Note: If field storage is authorized, include the following sentence:* Biosolids may be stored as required by the site specific authorization letter.
**Note: If field storage is authorized, the following must be submitted and will be included with the site specific authorization letter or this biosolids management plan: agricultural information, site specific information, and a field management plan. Refer to "Implementing Oregon's Biosolids Program Internal Management Directive", December 2005, for specific information that must be submitted.*

TRANSPORTATION

The **<permittee>** **<owns type of vehicle/contracts out>** to transport biosolids from the wastewater treatment facility to authorized land application sites. The **<type(s) of vehicle>** are operated by **<permittee's employees/contract employees>**. The **<permittee>** is able to handle the volume of biosolids produced through these transportation practices.

<Type of biosolids (e.g., liquid, dewatered, dried)> are loaded from **<processing unit at treatment facility>** into **<type of vehicle>** for land application. **<Discuss how biosolids are transferred to the vehicle, how the vehicle loading process occurs, and what measures are in place at the facility in case of a spill (e.g., impoundments, drains).>**

REMEDIAL PROCEDURES

All spills into waters of the state or spills on the ground surface that are likely to enter waters of the state will be reported immediately to Oregon Emergency Response System (OERS) at 1-800-452-0311 and the

Department's regional biosolids specialist at **<phone number>**. All spills of **<number>** gallons or more on the ground surface will be reported to the Department's regional biosolids specialist within **<number>** hour(s) of the spill incident.

Spill During Transportation of Biosolids

The **<permittee>** is responsible for cleanup of any biosolids spills that occur while transporting to land application sites. If a spill occurs during the transport of biosolids between the wastewater treatment facility and the land application site, the **<permittee>** will:

- Contain the spill.
- Post the area and set up temporary fencing if there is a potential for public exposure.
- Remove spilled biosolids with a front end loader or shovel.
- Cover the area with dry lime if needed **<specify when according to quantity and location>**.
- Apply absorbent (e.g., sand) if needed **<specify when according to quantity and location>**.
- Transport spilled product to a Department authorized biosolids land application or disposal site.

Solids Treatment Process Failure or Modification

If a mechanical problem occurs with **<treatment component>** and replacement parts are not in stock at the treatment facility, an emergency parts order will be placed. During this period, **<discuss options to treatment processes to accommodate failure (e.g., divert waste activated sludge to another wastewater treatment facility, divert all sludge to a holding tank)>**.

If maintenance is needed on a treatment process component that will affect compliance with pathogen reduction or vector attraction reduction requirements, the **<permittee>** will notify the Department and get approval prior to the maintenance activity.

MONITORING AND REPORTING

Monitoring and Sampling Program

The **<permittee>** **<will develop/has developed>** and **<implement/implements>** a biosolids monitoring and sampling plan. Samples collected and analyzed will be representative of the biosolids to be land applied. Quality control measures and procedures will be implemented for microbiological tests to verify precision and accuracy. Sampling location(s) stated will demonstrate how vector attraction reduction option(s) **<option number>** **<is/are>** met. The plan includes:

- The sampling location (must be representative),
- How samples will be collected, preserved and transported, and
- The analytical method for each analysis.

All monitoring and reporting will be conducted in accordance with the **<permittee's>** **<NPDES/WPCF>** permit. The monitoring frequency is based on the amount of biosolids generated that is land applied, or marketed to be sold or given away. Based on 40 CFR §503.16, Table 1 and the amount of biosolids generated and used during **<year>**, the **<permittee>** is required to sample biosolids **<monthly/bimonthly/quarterly/annually>**.

Recordkeeping and Reporting Procedures

The **<permittee>** as the preparer and land applier of biosolids is required to maintain records to demonstrate that federal and state biosolids requirements are met. Records will be kept on file by the **<permittee>**, and will be available upon request by the Department. Monitoring and sampling records

will be retained for a period no less than 5 years, unless otherwise required by the **<NPDES/WPCF>** permit or a site authorization letter. The minimum required records include the following information:

- Pollutant concentrations of each parameter stated in the permit,
- Pathogen requirements as stated in the permit for Class **<A/B>**,
- Description of how one of the vector attraction reduction requirements in 40 CFR §503.33(b)(1) through (8) are met,
- Description of how the management practices in 40 CFR §503.14 and site restrictions in 40 CFR §503.32(b)(5) are met for each biosolids land application site (*note: this is for Class B bulk biosolids*), and
- Certification that the information submitted is accurate to determine compliance with pathogen and vector attraction reduction requirements, and site restriction/management requirements.

Annual Reporting

A biosolids annual report is required to be submitted to the Department each year by February 19th or as required by the permit if bulk biosolids have been land applied, or biosolids derived products were sold or given away the previous year. The report will include information on biosolids handling activities and data (i.e., monitoring results, nutrient loading rates) from the previous calendar year. Some of the information required with the annual report includes:

- Daily site logs or records, including date, time, and quantity (gallon, pounds) of nitrogen/acre land applied.
- Map, including scale, showing the site and the land application location that coincides with the daily site application method (e.g., truck spreader bar, irrigation cannon).
- Signed copy of the certification statement (see next section on Certification Statement).

Certification Statement

The **<permittee>** is capable of meeting Class **<A/ B>** pathogen reduction and vector attraction reduction requirements. As required under 40 CFR §503.17, the **<permittee>** must retain a certification statement indicating whether compliance with pathogen reduction, vector attraction reduction, and certain site restrictions have been met. The certification statement must be retained for a period of five years, and must be submitted with the annual report that is due February 19th or as required by the permit. The **<permittee>** will retain the following certification statement and it will be signed by a principal executive officer or ranking elected official (**note: for a municipality, State, Federal, or other public agency)* or their duly authorized representative (e.g., individual or position having responsibility for the overall operation of the system, such as the position of plant manager, supervisor, superintendent or equivalent responsibility).

> **Note: The following certification is for the most common situation when Class B bulk biosolids meet Table 3 metals values and VAR is achieved at the wastewater treatment works, and is prepared and land applied by the permittee. For other situations including Class A biosolids, domestic septage, or when Table 2 Cumulative Pollutant Loading Rates are met, a different certification statement must be signed and retained. These statements are posted on the Department's web site at http://www.deq.state.or.us/wq/Biosolids/BioCerts.htm.*

> "I certify, under penalty of law, that the information that will be used to determine compliance with the Class B pathogen requirements in 40 CFR §503.32(b)**<insert either (2),(3), or (4)>**, the vector attraction reduction requirement in 40 CFR §503.33(b)**<insert appropriate option (1) through (8)>**, and the site restrictions in 40 CFR §503.32(b)(5) for each site on which Class B sewage sludge was applied, was prepared under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate this information. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

Signature_____Date_____

<Permittee> is also required as the land applier to certify that the management practices in 40 CFR §503.14 are being met. This certification includes that biosolids are being land applied at approved agronomic loading rates as specified in department issued site authorization letters.

> "I certify, under penalty of law that the management practices in 40 CFR §503.14 have been met for each site on which bulk biosolids is applied. 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 have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

Signature_____Date_____

BIOSOLIDS CHARACTERISTICS

Pollutant Characteristics

The following table is a representative biosolids analysis for pollutant characteristics. This data and all previous data indicate that pollutant concentrations for all regulated pollutants have been met.
**Note: If a facility is required to monitor more than once a year, all data for the year should be provided in this section.*

Parameter	Biosolids Analytical Result (mg/kg)	Sample Date	40 CFR §503.13(b)(3) Pollutant Concentration Limits (mg/kg)
Arsenic (As)			41
Cadmium (Cd)			39
Chromium (Cr)			-
Copper (Cu)			1500
Lead (Pb)			300
Mercury (Hg)			17
Molybdenum (Mo)			-
Nickel (Ni)			420
Selenium (Se)			100
Zinc (Zn)			2800

Nutrient Characteristics and Other Parameters

The following table is a representative biosolids analysis for nutrient characteristics and other parameters. **Note: If a facility is required to monitor more than once a year, all data for the year should be provided in this section.*

Parameter/measurement unit	Biosolids Analytical Result	Sample Date
Total solids, percent		
Volatile solids, percent		
TKN, percent		
NO_3-N, percent		
NH_4-N, percent		
Phosphorus (P), percent		
Potassium (K), percent		
pH, standard unit		

BIOSOLIDS UTILIZATION PROGRAM

<Percentage> of biosolids generated by **<permittee>** is beneficially used **<through land application/as a composted product>**. The following biosolids land application plan outlines agronomic application rate and site crops, where biosolids are land applied, site selection criteria for a new site, and site and crop management practices.

BIOSOLIDS LAND APPLICATION PLAN

Agronomic Application Rate and Site Crops

Class B biosolids are required to be land applied to a site at a rate that is equal to or less than the agronomic rate for the site. An agronomic rate is the whole biosolids application rate (dry weight basis) designed to provide the annual total amount of nitrogen needed by a crop and to minimize the amount of nitrogen passing below the root zone of the crop or vegetation to groundwater.

Biosolids application rates for the **<permittee>** sites were developed based on Oregon State University (OSU) Extension Service Fertilizer Guide: **<name of guide>**. The annual application rate for **<type of crop>** is **<number of pounds>** available nitrogen (N) per acre, unless the application site demonstrates additional nitrogen is required to match crop uptake rates. (**Note: If more than one type of crop is used at the same site, then state each type of crop and the application rate.*) The land application sites authorized for use can assimilate the total plant available nitrogen the biosolids provide on an annual basis. Specific site agronomic loading rates are stated in the Department issued site authorization letters.

Site Inventory of Existing and Potential Sites

The **<permittee>** currently land applies Class **<A/B>** biosolids to the Department authorized sites listed in the **<table below/Appendix letter>**. Surface application of biosolids is performed using **<describe equipment/vehicle>**. Site maps with the general location and size of existing authorized sites are included as Appendix **<state letter>** of this biosolids management plan. The **<permittee>** currently has **<total number>** acres that are authorized for land application. This is an adequate land base for current **<and future>** operations, based on current biosolids generation rates.

Biosolids Land Application Site Inventory
**Note: May be included as an Appendix*

Site Name/Identifier	Type of Crop/Acreage	lb. N/acre	lb. N/site	Time of year applied (month)	Harvest Cycle	Department Authorized?

Site Selection Criteria for a New Site

If necessary, the **<permittee>** will locate additional sites for land applying biosolids. Prior to using any site for land application, the **<permittee>** is required to receive a written site authorization letter from the Department. The following site conditions will be considered when determining the suitability of a site for land application:

- All sites will be located on **<agricultural/forest/reclamation>** land in **<name of county or more defined area>**.
- A site should be on a stable geologic formation not subject to flooding or excessive run-off from adjacent land.
- Minimum depth to permanent groundwater should be four feet **<and the minimum depth to temporary groundwater should be one foot at the time when application of liquid biosolids occurs>**.
- Topography should be suitable for normal agricultural operations. **<Liquid biosolids should not be land applied on bare soils when the slope exceeds 12 percent. / Dewatered or dried biosolids may be land applied on well vegetated slopes up to 30 percent>**.
- Soil should have a minimum rooting depth of 24 inches.

Public Notification

The **<permittee>** is required to notify the public of the proposed land application activity. Each year prior to land application of biosolids, the **<permittee>** should verify for those sites to be used for the year that the property owners who received prior notification have not changed. If a property owner has changed, notification of the land application activity should be made to the new property owner and documented.

Site Management Practices

Site access restrictions and setbacks will be followed as outlined in the Department's site authorization letters. The **<permittee>** will ensure that access is restricted by appropriate means as necessary, such as fencing or posting of signs at the land application site. Biosolids land application will not occur in those areas designated as buffer strips and will be achieved through accurate measurement of the buffer area prior to commencing land application.

Crop Management Practices

As listed in the Biosolids Land Application Site Inventory table on page **<number>**, biosolids are applied to **<type of crop(s)>**. Timing of application and the harvest cycle of the crop are also listed. Soil conditions must be favorable for application such that runoff, leaching, or soil compaction does not occur. The timing of land application will take into consideration tilling and irrigation practices that may occur on an authorized site.
**Note: If tilling or irrigation occurs, describe those practices.*

The overall management of nutrients at the land application sites takes into account the amount of biosolids land applied, the amount of commercial fertilizers used and the amount of residual nutrients in the soil. When additional sources of nitrogen (e.g., commercial fertilizer) are applied to a site, then the application of biosolids should be reduced to compensate for the additional nitrogen loading.

**Note: If soil sampling occurs, the following paragraph should be included.*
Prior to the initiation of biosolids application to a site, a representative soil sample is collected across the entire site, and analyzed by an independent commercial laboratory. Existing nitrogen levels in the soil profile are subtracted from the OSU Extension Service recommended nitrogen application rates for the crop and the biosolids application rate is adjusted. Soil testing is conducted at **<site locations>** on a **<state frequency>** basis. In the event of annual biosolids application to the same field for 3 consecutive years, annual sampling and testing of application site soils for nitrate and ammonia nitrogen will be conducted prior to biosolids application. Application rates must be adjusted to account for available nitrogen carried over from previous applications. If crop removal of nitrogen exceeds the calculated agronomic rate, additional nitrogen may be required to sustain crop production.

Appendix B

Site Authorization Documentation Checklist for the Land Application of Biosolids

SITE INFORMATION

☐ Vicinity map (e.g., tax lot or county assessor map) indicating location of proposed land application site and acreage, including gross and net (any area or buffer areas not available for biosolids application) acreage.

☐ Site location including street address (if not available, then state directions to site), tax reference number, section, township, range, and county.

☐ Site owner name, address, and phone number. Site renter name if applicable.

☐ Detailed map showing property boundaries, and setbacks from roadways, occupied buildings, other manmade features, surface waters, and domestic water source or wells.

☐ Distance (in feet) from biosolids land application site boundary to nearest residence(s), other publicly occupied building(s) (e.g., retail store, school, apartment building), and public use areas such as parks or hiking trails.

☐ Site management agreement between the biosolids generating source and the site owner(s) of record and/or authorized representative operator.

SOIL INFORMATION

☐ USDA Natural Resources Conservation Service (NRCS) soil survey map.

☐ Copy of the soil survey map description for each soil series indicated on a NRCS map at the proposed land application site.

☐ *Not required but if available*, the most recent soil analysis (of parameters listed below for biosolids).

AGRICULTURAL AND CROP MANAGEMENT INFORMATION

☐ Crop to be grown at the site and intended market (e.g., barley for seed, feed, brewing, food or commodity sale).

☐ Crop assimilative capacity (nitrogen).

☐ Crop sequences and the time(s) of year biosolids will be land applied to the crop site.

☐ Crop harvest method (e.g., silage vs. pasture) and tilling practices.

☐ Irrigation practices and fertilizer use.

BIOSOLIDS AND LAND APPLICATION INFORMATION

☐ Biosolids characteristics from the most recent biosolids analyses, including data on:

- Total kjeldahl nitrogen, nitrate nitrogen, ammonium nitrogen, total phosphorus, potassium, total solids, volatile solids (expressed as percent dry weight), pH; and
- Arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, and if required, silver and chromium (expressed as mg/kg dry weight).

☐ Forecast of biosolids application rate (gallons or dry tons/acre/year).

☐ Nutrient and metal loadings based on biosolids analyses and total acreage land applied for the year.

☐ Calculations used for forecasting annual biosolids application rate.

☐ Site life calculations (if applicable).

☐ Field staging and/or storage practices (if applicable).

Appendix C

What to Include in a Water Quality Permit, Biosolids Management Plan, and Site Authorization Letter

WHAT TO INCLUDE IN A WATER QUALITY PERMIT, BIOSOLIDS MANAGEMENT PLAN, AND SITE AUTHORIZATION LETTER

WATER QUALITY PERMIT	BIOSOLIDS MANAGEMENT PLAN	SITE AUTHORIZATION LETTER
Wastewater Treatment Facility		
• Design flow stated for determining mass load limits • If septage is received, monitoring required for quantity	• Wastewater treatment process and unit processes • Treatment facility design flow and actual flows • Origin (sources) of wastewater flow and flow schematics through treatment facility • Septage receiving facilities • Quantity and type of septage received • Pretreatment program (if applicable)	
Solids Treatment Processes		
	• Description of how primary, secondary, and tertiary solids are removed, thickened, digested, dewatered and how treatment process is used to achieve adequate storage • Time (days) that solids remain in each digester, solids storage pond, compost pile, or drying bed • Operating temperature of digester(s) • Volatile solids reduction achieved through digestion • Quantities of raw and stabilized solids generated annually (gallons and dry tons) • Means used to attain pathogen reduction and supporting data • Method(s) for determining vector attraction reduction (degree of solids stability) and supporting data	• Process and handling to comply with Oregon Administrative Rules, 40 CFR Part 503, and other applicable statutes, rules, and regulations.

WATER QUALITY PERMIT	BIOSOLIDS MANAGEMENT PLAN	SITE AUTHORIZATION LETTER
Solids Storage (Wastewater Treatment Facility, Staging, and Field Storage)		
	• Operating capacity and number of all digesters, solids storage tanks, drying beds, lagoons, and stockpile areas • Months of storage the structures provide • Projected use of structures • Additional treatment that may occur during storage • Description of equipment used for staging and field storage management Field storage (refer to IMD chapter on Storage): • Agricultural information • Site specific information • Field management plan	• Site specific information for staging and/or field storage
Transportation and Land Application Equipment		
	• Description of method and equipment used to remove and transport biosolids from facility • Description of land application method and equipment • Ownership of transportation and application equipment and operator of equipment	• Cleanup requirements for land application equipment
Remedial Procedures		
	• Solids treatment process failure • Solids spill at treatment facility • Spill during transport	• Spill cleanup requirements • Notification requirements – to whom and when • Odor complaint follow-up
Monitoring and Reporting		
• Sampling frequency • Type of sample • Sampling location • Analytical procedures referenced • Monitoring frequency • Annual report requirement	• Monitoring and sampling program at treatment facility and land application site • Recordkeeping procedures • Reporting procedures • Annual reporting requirement • Certification statements	• Maintain a site application log indicating quantity, quality, and location of biosolids land applied. • Site application log must be available for department review during the life of the application site.

WATER QUALITY PERMIT	BIOSOLIDS MANAGEMENT PLAN	SITE AUTHORIZATION LETTER
Biosolids Characteristics		
• Biosolids analysis for pollutants (inorganics), nutrients, pH, total solids, and volatile solids • Appropriate parameter(s) to reflect the vector attraction reduction option to be met • Appropriate parameter(s) to reflect the pathogen reduction alternative to be met	• Pollutant, pathogen, and nutrient characteristics and analyses • Vector attraction reduction option(s) to be met • Pathogen reduction alternative(s) to be met	
Biosolids Utilization Program		
• Biosolids management in accordance with approved plan and site authorization letters	• Land application • Composting • Distributed to public or other entities • Transported to other facility for processing	
Biosolids Land Application		
• Record locations where land application has occurred and date • Quantity land applied • New application sites must meet site selection criteria and location identified	*(Land Application Plan)* • Identification of all department authorized land application sites • Potential sites to be used within term of the permit • Geographic location of new sites not specifically listed when permit application submitted • Land application site selection criteria for new sites • Site management practices to be implemented at all new sites (i.e., staging, site access restrictions, how setbacks are achieved) • Crop management practices • Site crops and crop assimilative capacity	• Identification, description, and specific location of site • Site application restrictions including: o Seasonal application, o Ponding and run-off, o Frozen or snow covered ground, o Topographic considerations, o Buffer strips (setbacks), and o Use of an easement property • Grazing and harvesting restrictions • Controlled public access restrictions • Application rate for crop identified • Adjustment to application rate if utilizing other sources of nitrogen • Site management practices/conditions, including notification to Department of changing crop types • Soil testing (if required)

WATER QUALITY PERMIT	BIOSOLIDS MANAGEMENT PLAN	SITE AUTHORIZATION LETTER
Biosolids Composting		
• Monitoring and reporting of actual type and amount of solid waste used as feedstock on an annual basis • Management of biosolids and feedstocks in accordance with a biosolids management plan	• Source(s), type(s), and amounts of solid waste to be used as feedstock per batch of compost • How contaminants from the feedstock will be managed and disposed of • Odor minimization plan per OAR 340-096-0028(3)(b)	