Toward Quality Biosolids Management

A Trainer's Manual

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Version 1.0

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Sponsored by

NORTHWEST BIOSOLIDS MANAGEMENT ASSOCIATION

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Contents

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Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. (Revised edition available in 1999.)

A plain English guide to the EPA Part 503 biosolids rule. EPA Publ. 832-R-93-003.

Guide to soil suitability and site selection for beneficial use of domestic wastewater biosolids. Manual 8, Oregon State University Extension Service, Corvallis, OR.

Key "training methods" publications for manual preparation

North Carolina Division of Environmental Management and North Carolina Water Pollution Control Association. 1995 (revised annually). Needs to Know. In: Land application of residuals operators training manual. North Carolina Water Pollution Control System Operators Certification Commission. Raleigh, NC. Phone: 919-733-0026.

Seiter, Stefan. 1998. Soil quality card design manual: A guide to develop locally adapted conservation tools. Version 1.0. Soil Quality Institute, Natural Resources Conservation Service, United States Dept. of Agriculture. Available from Soil Quality Institute's product catalog at: http://www.statlab.iastate.edu

Preface

This manual was produced under a cooperative agreement with the United States Environmental Protection Agency (EPA) and the Northwest Biosolids Management Association (NBMA). It is part of a larger project, "Cooperative Agreement for Implementation of the Regional Biosolids Stakeholder Vision" (Agreement CX824832-01-2). The manual serves as a resource for those who oversee and conduct biosolids training programs and is based on two pilot workshops presented by Oregon Association of Clean Water Agencies (ACWA) at a wastewater operator short school in 1997 and 1998.

The manual also provides a broad framework for long-term development of training programs across the U.S. We look toward the development of training programs initiated by local biosolids management associations. Quality training programs for biosolids professionals will enhance the public's overall acceptance of beneficial use of biosolids, enable biosolids management agencies to self-regulate, and reduce the potential for negative environmental impacts.

This manual provides a broad framework for development of training programs across the U.S.

The open structural format of this training manual is designed for adaptation and innovation. New training resources can be added as they are produced by organizations, states, or regions. The advent of the World Wide Web as an information dissemination tool provides exciting possibilities for sharing training materials in the future.

We'd like to hear about ways that you have adapted this manual to fit regional/local needs. Please contact:

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About this Manual

This manual is an effort to implement the NBMA Code of Good Practice.

What is the purpose of this manual?

This manual is designed to serve as a resource for those who organize and conduct training programs in biosolids management. It describes the process of organizing and conducting effective training sessions as well as the technical topics that should be covered. This manual was produced in an effort to begin implementation of the "Code of Good Practice" developed by the Northwest Biosolids Management Association (see "Code of Good Practice," page 10).

What is in this manual?

This training manual contains the following major sections:

- Getting Started
- Training Modules
- Innovative Presentation Methods
- Training Resources
- Appendix: State and National Biosolids Training Programs

"Getting Started" targets training program organizers and presenters. Tips and suggestions are provided for organizing successful workshops and for presentation methods that actively involve participants in the learning process.

"Training Modules" are written for the presenters at a training workshop. We expect presenters to adapt the initial training ideas presented here. A training module covers one aspect of biosolids management. The major curriculum topics—Regulatory Compliance, Biosolids Quality, Public Information, Transportation to Land Application, Land Application: Nutrient Management, and Land Application: Site Management—correspond approximately with the NBMA Code of Good Practice. For each module, the manual provides an overview, specific items that training participants should be able to master (Need-to-knows), and training suggestions and resources.

"Innovative Presentation Methods" gives a detailed description of training methods that involve the participants in creative thinking and hands-on learning. Included are a Biosolids Jeopardy game, case studies, and a take-home test.

"Training Resources" lists existing guidance publications that are useful resources for presenters in preparing for a training workshop. This section also lists contact information for biosolids regulatory agencies and biosolids industry associations. Included are World Wide Web addresses for these organizations, so that presenters can take advantage of educational materials on the Web.

"Appendix: State and National Biosolids Training Programs" describes the lessons learned from the Oregon pilot training workshops, and the outlook for a coordinated national biosolids training program within the next 5 years.

This manual gives suggestions for organizing and conducting a training event.

How do you use this manual?

This manual is focused on how to organize and prepare for a training event and does *not* provide technical specifications for biosolids management. Organizers of and presenters at biosolids training events are the major audience for this manual. The manual also may be of interest to biosolids managers and their employees, authors of guidance documents, and developers of a national training program. The list below identifies the major users of this manual and describes potential applications.

Workshop organizer or education coordinator: Select topics for an effective workshop. Use "Training Modules" to communicate with workshop presenters. Use Need-to-knows to prepare a test for workshop participants.

Presenter of a session at a biosolids training workshop: Use "Presenting at a Training Program," "Training Modules," "Innovative Presentation Methods," and "Training Resources" to prepare workshop presentations and hand-

outs. Review "Training Modules" of other presenters to avoid overlap with your presentation.

State or regional biosolids management organization: Determine the structure and topics to be included in a voluntary certification/accreditation program.

Biosolids manager (wastewater treatment facility or private business): Use "Training Modules" to conduct in-house training for employees.

Biosolids managers/employees: Conduct self-directed training using existing guidance documents in conjunction with Need-to-knows in the "Training Modules."

Preparers of biosolids guidance documents: Organize guidance information to be compatible with the modular organization of the "Training Modules."

Developers of national program for biosolids training: Use "Training Modules" as a first draft of an outline for a national curriculum. Add/combine/delete modules to reach consensus on minimum national standards. Revise suggested structure for national training in "Outlook for a Coordinated National Training Program" to meet training goals.

What is not in this manual?

This manual does not ensure the quality of training provided. It gives a general outline for training, but relies on the workshop organizers and presenters to deliver timely and appropriate information. The manual does not provide ready-to-use handout materials for workshop participants. This task is left to organizers and presenters of biosolids training events.

This manual, although useful for a national audience, is focused on biosolids management in the Pacific Northwest. For example, soil testing at biosolids application sites is required by some states in the Pacific Northwest. There-

fore, this topic is covered in a training module. Soil testing is not required by EPA regulations. Organizers and presenters in other regions will need to customize the training modules to fit local conditions.

In training modules on land application of biosolids, the manual focuses on agricultural site management. Biosolids can promote vegetation establishment and increase the productivity of many kinds of nonagricultural sites, including forests, Christmas tree farms, poplar plantations, rangelands, and drastically disturbed sites (e.g., urban sites and mining sites). Additional modules for management of specific kinds of application sites could be added when there is a demand for training in these areas.

Land application training modules focus on agricultural sites.

This manual aims to provide broad coverage of topics important to biosolids management. It highlights key topics, but does not provide all the details. The use of this training manual is not a substitute for a thorough knowledge of federal and state rules pertaining to biosolids management. The manual is also incomplete in its coverage of topics that may be important to biosolids management. Wastewater treatment processes, biosolids storage, and other topics may have a place in a biosolids training program. Future revisions to enhance the training concepts outlined here are encouraged and applauded.

Code of Good Practice

Northwest Biosolids Management Association (NBMA)

The *Code of Good Practice*, prepared by the Northwest Biosolids Management Association (NBMA) in 1998, summarizes goals and objectives for environmentally responsible biosolids management programs. The *Code* was developed by a cooperative process involving biosolids generators, regulatory agencies, and other interested parties. It is formatted for participants to sign after completion of a training workshop, indicating the participant's commitment to work toward responsible environmental management. The *Code* is expected to undergo continued refinement in the coming years as it is adapted for nationwide use.

Regulatory Compliance

Maintain compliance with all applicable federal, state, and local regulations.

Biosolids Product Quality

Provide valuable products for beneficial use that adhere to regulatory quality standards for metals, pathogen reduction, and vector attraction reduction. Recognizing that each generating facility operates individually, each facility should consider other product quality parameters such as aesthetics, usability, and consistency as biosolids are provided to the public or placed in the environment.

Public Information

Provide meaningful public information and opportunities for public involvement, including a communication plan addressing the public, users, and interested others.

Safe Transportation

Prevent nuisance conditions and spills during transportation. An Incident Response Plan specific to the biosolids and the geographic area in which they are transported should be carried in each vehicle, and drivers should be trained in its utilization.

Application Site Management

Ensure appropriate and practical application site practices, including nutrient application planning (i.e., agronomic rates), recognized best management practices, maintenance of buffer zones, and site selection criteria.

Good Housekeeping

Require good housekeeping practices to prevent odor, traffic, dust, noise, etc. from impacting biosolids project neighbors and the general public.

Contingency Planning

Require programmatic contingency or emergency plans for unexpected but predictable events (e.g., inclement weather, spills, injuries).

Continual Improvement

Ensure continual improvement for biosolids programs and personnel by participating in training and educational opportunities, voluntary periodic self-auditing, and management reviews, and by encouraging third-party verification.

Statement of Support

I have successfully completed the NBMA biosolids training program and agree to uphold the principles of this *Code of Good Practice* to the best of my abilities.

Signature_____ Date_____

Affiliation_____

This *Code of Good Practice* for biosolids recycling was developed through a Cooperative Agreement between the U.S. Environmental Protection Agency and the Northwest Biosolids Management Association.

Preparing for a training workshop

Effective workshop organizer(s) are one of the keys to a successful workshop. More than one person is often needed to organize a training program. A team approach to prepare, conduct, and evaluate the workshop is highly recommended.

A team approach to prepare, conduct, and evaluate the workshop is highly recommended.

The tasks involved in preparing for a workshop, and suggestions to perform these tasks efficiently, are outlined below:

1. **Define the target audience for the training—basic or advanced.** Start with basic training to reach the largest number of biosolids managers.
2. **Decide on the length of the training workshop—1 or 2 days.** A 1-day workshop might not give you enough time to cover all aspects of basic biosolids management. It is usually restricted to a lecture format. A 2-day workshop allows much more opportunity for thorough coverage of the wide-ranging subject matter. It also allows for "hands-on" participatory activities or tours.
3. **Choose a time/location for training.** Think about conducting the training in conjunction with an existing wastewater operator's short school, annual biosolids management association meeting, or other existing event. Partnering with existing events reduces cost for participants, provides free publicity for the workshop, and usually ensures a good turnout.
4. **Make arrangements for meeting facilities.** Make sure that the facility can accommodate the participatory group activities that supplement the lectures and presentations.
5. **Determine which training modules will be covered.**

   Shown in the table below are training modules that can be reasonably covered in a 1- or 2-day program (approximately 6 hours of instruction per day). It is helpful, but not critical, to present the modules in the order listed in the matrix table. Try to alternate data-intensive lecture presentations with group participation activities. An

advanced workshop on any of the training modules could be offered as a half-day program in conjunction with a wastewater short school or annual biosolids management association meeting.

Training module	1-day workshop	2-day workshop
1. Regulatory Compliance	X	X
2. Biosolids Quality		
2.1 EPA Part 503 Requirements	X	X
2.2 Sampling and Testing Biosolids		X
3. Public Information	X	X
4. Transportation to Land Application	X	X
5. Land Application: Nutrient Management		
5.1 Introduction		X
5.2 Calculation of Agronomic Rates	X	X
5.3 Soil Testing		X
6. Land Application: Site Management		
6.1 Site Suitability		X
6.2 Biosolids Application	X	X

6. **Select presenters/trainers**. Choose individuals with complementary expertise. For a 1-day workshop, a team including a regulator, a biosolids manager, a consulting engineer, and a crop/soil scientist is desirable.
7. **Decide whether participants will receive a notebook.** Assembling a notebook of speaker handout materials usually is greatly appreciated by participants. The notebook provides a reference for future use and ensures that every participant gets all the handout materials. It also can be used as an information source for a take-home test. Assembling the notebook is a major task. If you choose to provide a notebook, make sure you identify a person to supervise notebook construction and add the cost of the notebook to your budget.
8. **Set a workshop cost/price.** Try to keep costs low enough to make the training affordable for small wastewater treatment facility operators. Consulting firms or

regulatory agencies may be willing to pick up part of the workshop cost. More participants from smaller wastewater treatment facilities will attend if you can provide continuing education credits (CEUs) for wastewater operator certification.

9. **Determine the need for a workshop education coordinator.** Often workshop presenters may not have much training and instruction experience. In this case, you need a workshop education coordinator. A coordinator can ask questions of the presenter or make summary comments after a presentation that help to clarify key concepts. The coordinator also can facilitate a discussion between the participants and the presenter. A good coordinator will make the workshop a successful learning experience. If you feel comfortable with the topics covered and have facilitation experience, you may serve as education coordinator yourself. Alternatively, invite a specialist or consultant (see "Working with an education coordinator," below).

Working with an education coordinator

An education coordinator is a person selected by the workshop organizer who has primary responsibility for the educational value of the training program. The coordinator should be familiar with all of the topics included in the training, attend all training sessions at the workshop, and be available to assist presenters in making smooth transitions between training sessions. The coordinator plays a key role in helping to ensure a consistent training experience when presenters are not familiar with the total program.

Other roles the education coordinator could fill:

Before the workshop

- Work with the training organizer to select presenters.
- Resolve any problems with presentations that may overlap.

- Contact presenters and discuss how their presentation fits into the overall program.
- Assemble a notebook of presenter handout materials.

At the workshop

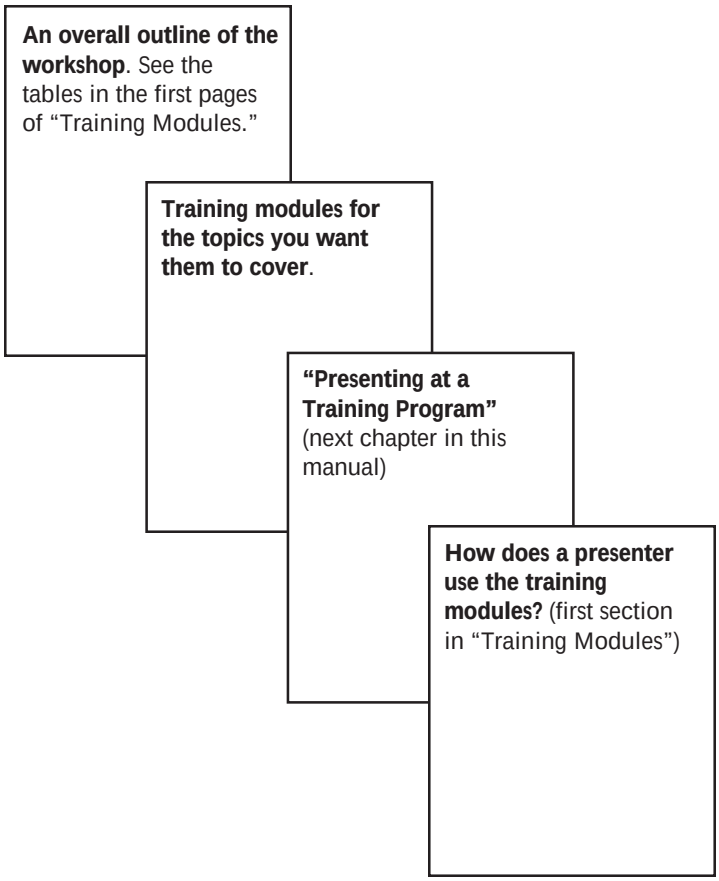
- Clarify for presenters what earlier presenters actually covered (if different from the planned program).
- Introduce presenters, and tell how the presentation fits in the context of the total training workshop.
- Conduct review session(s) with participants to summarize, review, and link the concepts covered by presenters.
- Solicit written and oral participant evaluations of the workshop.

After the workshop

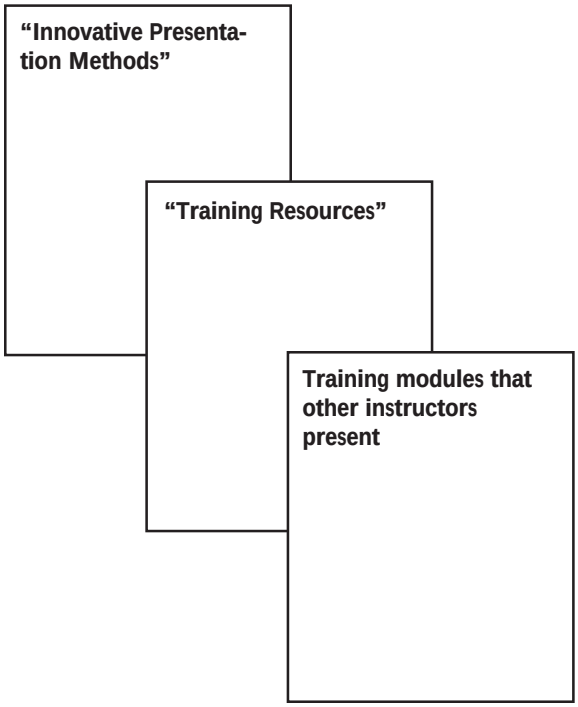
- Summarize the workshop evaluations for the training organizer(s).
- Make suggestions for improvements in the next workshop.

Providing presenters with appropriate information

Quality presentations are a key component of the training effort. The workshop organizer must provide presenters with adequate preparatory materials and information. At a minimum, provide presenters with the following documents:



To improve the overall quality of the workshop and avoid overlap among the various presentations, you may also provide the presenters with:



Lessons learned about working with presenters

During 2 years of pilot workshops in Oregon, we learned the following:

- Volunteers are willing to serve as presenters, but generally don't want to make their presentations fit into a narrow, rigidly defined curriculum.
- The personal touch and creativity of different presenters makes training more interesting and relevant.
- Presenters need detailed information on the total workshop to make their sessions fit into the curriculum.
- Clearly defining individual topics for each presenter helps reduce confusion and excessive overlap between presentations.
- Working with as many presenters as possible makes the training program sustainable on a long-term basis.
- Presenters avoid burnout if they don't have to do the same program every year. Increasing the pool of presenters makes training possible at more locations. Participants in training workshops may attend in successive years if presenters are rotated.

Promote the personal touch and creativity of different presenters to make training more interesting and relevant.

Evaluating the workshop

A written evaluation, completed by participants, is an integral part of a training workshop. A thorough evaluation makes planning and executing the next workshop easier, since you have data on the things that worked well and those that can be improved. Consider offering participants a tangible reward for completing a workshop evaluation. In Oregon, we included the evaluation questions in multiple-choice format on the take-home test, and awarded credit for any response. Other rewards could include T-shirts, coffee mugs, key chains, etc. If rewards are not offered, only 10 to 20 percent of participants may complete the evaluations.

This section is directed toward presenters recruited to make a presentation at a biosolids training program. It highlights ways that presenters can work with the workshop organizer, an education coordinator, and workshop participants to make the training experience more valuable. It also describes a number of presentation formats that involve the participants in creative thinking and hands-on learning.

The role of presenters

Think of your presentation as a part of a competency-building process. Your role in the training workshop is similar to that filled by a subcontractor on a large construction project. If, for instance, you were in charge of framing a building, you would do this only after the building plan was approved and the foundation was in place. Similarly, in the workshop, you need to coordinate your presentation with other presenters to create a useful learning experience for the training participants.

The training workshop is a competency-building process.

Other players on the workshop team

Let's review who else is on the team. Commonly, the other players on the team include workshop organizer(s), other presenters, and an education coordinator.

Workshop organizer(s) are responsible for making physical arrangements for the workshop (room size and type, audio-visual capabilities, time, date, place, etc.). They prepare the training program outline, recruit presenters, arrange for publicity, and handle workshop registration. Ask the workshop organizer for the description of any training modules that are directly related to the one you will present. You also may want to contact some of other presenters directly to make sure your presentations aren't overly repetitive.

The education coordinator is responsible for the quality of instruction provided by the workshop. The coordinator is familiar with all of the topics included in the training, and should attend all training sessions to assist presenters. Prior to the training event, if you're not sure about the level of

detail to include in your presentation, solicit the input of the coordinator.

Don't forget to consider the abilities and needs of workshop participants. If you're still unfamiliar with the audience ability level after visiting with the coordinator, consider sitting in on one of the early introductory sessions in the training workshop.

Don't forget to consider the abilities and needs of workshop participants.

Identifying your role in the overall training program

You will want to get a copy of an overall training outline from the workshop organizer or education coordinator. This will help you identify the subject areas covered by other presenters, and help you to fit your presentation into the overall program.

In the overall training outline, look for:

- The major goals of the training event
- Modules covered prior to your presentation that provide participants with a foundation or introduction to your module
- Modules that have some overlap with your presentation

For a comprehensive outline for a training event, see "Overall Training Outline" in the first pages of "Training Modules." For an example of a training outline for a specific event, see "Pilot Biosolids Training Programs in Oregon 1997–98" in the Appendix of this manual.

Choosing the "key concepts" to emphasize in your presentation

The overall training outline, shown in the first pages of "Training Modules," lists "key concepts," the major questions that should be addressed by the training. For some of the modules, you may not have time to cover all of the key concepts. Choose key concepts for your presentation that will meet the most important needs of workshop participants.

Choosing a presentation method

A biosolids training workshop should be more than just an information delivery event. Adults learn best when they are actively involved in a learning activity. Because of the nature of some topics, a standard lecture format may be the only workable option. However, opportunities do exist for breaking out of the lecture routine. "Innovative Presentation Methods," a later chapter in this training manual, describes three methods to get participants actively involved in the learning process: Biosolids Jeopardy, case-study problems, and a take-home test. Other methods for increasing participation in the learning process include:

Adults learn best when they are actively involved in a learning activity.

Pretest

Give a short, written pretest on what you plan to cover. Then answer the test questions in your presentation. This would be a good technique for a data-intensive topic such as EPA 503 regulations.

Games

Design a game to fit your topic. An example: a Nitrogen Cycle Game was used successfully at a Northwest Biosolids Management Association training on nitrogen management. Briefly, here's an outline for the game: Mark off a "gameboard" on the floor that represents the nitrogen cycle (layout similar to board games such as "Monopoly®" or "Careers®"). Locations on the board are places where nitrogen is found (air, plants, soil organic matter, soil solution, groundwater). People are "units of nitrogen." They move around the board in response to cards drawn from a pile (similar to "Chance" cards in Monopoly or "Opportunity" cards in Careers). For example, if a card reads, "Crop growing conditions favorable. Move 10 units of nitrogen from soil solution to crop," then 10 people move from the "soil solution" location to the "crop" location.

Probe questions

This technique is really a variation of a question-and-answer session, or a post-test. The difference is that you, the presenter, prepare questions to "probe" how well participants understood your message. You can use the Need-to-knows listed in each training module as a source of

Asking participants to respond to your presentation reinforces your message.

probe questions. For example, after a presentation about transportation of biosolids, you might ask participants the following questions:

- What are three major parts of a spill response plan?
- How should a small spill of biosolids be cleaned up?
- What information should the driver provide to the first responder after a large biosolids spill?

The participants, individually or as small groups, then give their answers. You, the presenter, can then explain anything that the participants overlooked in their responses. Asking participants to respond to your presentation reinforces your message.

Panel discussion

This technique often is misused, but it can be very powerful if you plan carefully. Make sure you select a diverse panel that discusses a particular topic from different perspectives. For example, a panel could be composed of a biosolids manager, a regulator, and a farmer discussing best management practices. The panel needs a quality moderator that will guide the panel discussion. A quality moderator is familiar with biosolids issues, capable of steering discussion toward relevant issues, and able to control unruly panelists and participants. A panel discussion also requires good questions. Make sure the moderator has some general questions in mind before the discussion period ends. A structured approach to obtaining questions often is helpful to panel discussions. One way to get a good supply of questions is to provide 5 minutes for participants to write their questions on note cards prior to the panel discussion. The note cards are then passed to the moderator, who reads/sorts/combines questions before the panel discussion begins.

References for effective presentation methods

These two books provide helpful hints and ideas on how to structure a presentation and how to use different media such as slides and overhead transparencies. Both books are available in most public libraries.

Mandel, Steve. 1993. Effective presentation skills. Crips Publications, Menlo Park, CA.

Raab, Margaret Y. 1990. The presentation design book. Veneta Press, Chapel Hill, NC.

Also available in public libraries is a book that describes icebreakers and fun activities that make people think outside of their box:

van Oech, Roger. 1990. A whack on the side of your head. Warner Books, Inc., New York, NY.

What's inside Training Modules?

How does a presenter use the training modules?

This manual includes 10 modules, arranged into six competency areas. Each training module is a self-contained training package. It covers one aspect of biosolids management. A training event may cover one, several, or all of the modules (see "Organizing a Training Program"). Each module follows the same outline:

Module overview describes the major topics and concepts that will be covered by the trainer.

Training suggestions discusses how this module fits within the total curriculum and provides suggestions for an effective training.

Need-to-knows lists specific items that training participants are expected to master. Trainers should use the listed need-to-knows as a starting point. Need-to-knows should be customized to the geographic region of the training participants and the time allocated to the training session.

Need-to-knows should be customized.

Within a module, the need-to-knows are grouped by "key concepts," major questions that should be addressed by the training. For most workshops, you will need to choose among the "key concepts" listed in the training modules.

Topics and activities for extended training describes ways of creating in-depth workshops in individual topic areas.

Use the detailed outlines on the following pages to design a training event.

Oregon Short School Example describes how the training module was covered at pilot workshops in Oregon.

Training resources lists available resources that could supplement a speaker's presentation. In many cases, participants also may use the training resources for self-instruction. Resources listed include publications and other media such as Web pages and videos.

Overall training outline

The six tables on the following pages provide a detailed overview of the training modules in this manual. Use the detailed outlines as the starting point for creating a coordinated training event. Key concepts marked with an "X" should be emphasized in a 1-day basic training workshop.

Training Module 1: Regulatory Compliance

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Applicable regulations	What federal, state and local regulations apply to biosolids preparers and appliers?	X
Meeting regulatory requirements	What process should be followed to obtain approval for a land application site?	X
	What are the components of a long-range plan for biosolids management?	X
	What reports must be submitted to regulatory agencies?	X

Training Modules 2.1 and 2.2: Biosolids Quality

Module 2.1: EPA Part 503 Requirements

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Introduction to biosolids quality	What are biosolids?	X
	What are the components of biosolids quality?	X
	What are the impacts of biosolids quality on land application options?	X
Pathogen reduction	How are pathogens reduced by biosolids stabilization processes?	X
	How is pathogen reduction addressed by EPA Part 503 rules?	X
	How is pathogen reduction documented?	X
Vector attraction reduction	What is vector attraction reduction, and why is it important?	X
	What options for vector attraction reduction are given in EPA Part 503 rules?	X
	How is vector attraction reduction documented?	X
Pollutant concentration (trace element) limits	What about pollutants (trace elements) in biosolids?	X
	How did EPA determine concentration limits and cumulative loading limits for trace elements?	
	How do trace element concentrations affect land application options?	X
	What are cumulative loading limits for trace elements, and when are they important?	X

Module 2.2: Sampling and Testing Biosolids

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Biosolids sampling	What are key considerations in developing a sampling plan?	X
	For different kinds of testing, what specific materials and procedures are required for sample collection and preservation?	
Biosolids analyses	What laboratory analytical procedures should be used?	
	How are laboratory results interpreted?	

Training Module 3: Public Information

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Working with application site neighbors	What are appropriate methods for notification of application site neighbors?	X
	What are appropriate methods for dealing with complaints?	X
Communicating with the general public	What resources are available for public information on biosolids management?	X
	What written information is needed for rapid response to public concerns?	X
	What preparations are needed for media response?	
	What proactive approaches to public information are helpful?	

Training Module 4: Transportation to Land Application

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Highway regulations and driver performance	What are the rules of the road?	X
	What performance standards are appropriate for truck drivers?	X
Spill response	What actions should be taken to prepare for a biosolids spill?	X

Training Modules 5.1, 5.2, and 5.3: Land Application: Nutrient Management

Module 5.1: Introduction

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Nitrogen in the environment	What forms of nitrogen are found in biosolids, soils, and the environment?	
	What nitrogen transformations are important for biosolids management?	
	What are the objectives of biosolids nitrogen management?	
Other nutrients	What plant-available nutrients are supplied by biosolids?	
	What is the fertilizer replacement value of biosolids?	
	How do biosolids affect soil quality?	

Module 5.2: Calculation of Agronomic Rates

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Calculation principles	What is an agronomic rate?	X
	What data is needed to estimate an agronomic rate?	X
	What other sources of nitrogen besides biosolids should be included in the calculation?	
Making calculations	How is the amount of plant-available N per unit of biosolids calculated?	X
	How is the agronomic rate calculated?	X

Module 5.3: Soil Testing

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Test selection and sample collection	Why monitor nutrient availability via soil testing?	X
	How are soil samples collected?	X
	How are soil samples handled and preserved?	
Soil testing methods	What soil analyses should the laboratory perform?	
	What factors should be considered in choosing a laboratory?	

Training Modules 6.1 and 6.2: Land Application: Site Management

Module 6.1: Site Suitability

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Soil survey information	How are soils described in a soil survey?	X
	How are soil maps interpreted?	X
Evaluating site suitability	How is site suitability for biosolids application evaluated?	

Module 6.2: Biosolids Application

Subtopics in Need-to-knows	Key concepts	Emphasis in 1-day workshop
Site management goals	What site management practices maintain soil quality and reduce erosion?	
	What waiting periods are required by EPA between biosolids application and crop harvest?	X
Site management procedures	What procedures should be used in working with landowners and land managers?	X
	How are maps used in conjunction with biosolids application?	X
	How are buffer zones delineated?	X
	How is biosolids application equipment calibrated?	X
	What records should be kept during biosolids application activities?	X

Module overview

Because of public health and natural resource concerns, federal, state, and local agencies may regulate biosolids management activities. The goal of this module is to familiarize training participants with the regulations that apply to biosolids management in their particular state or region, and the process for obtaining approval for biosolids application sites. Requirements for long-range management plans and annual reports also are discussed.

Training suggestions

During this session, focus on general regulatory processes and requirements. Specific regulations applicable to biosolids quality, public information, and land application will be discussed in depth in other training modules. Regulations are difficult for most people to fully grasp in one session, so repetition of regulatory concepts in later sessions is helpful to participants.

Coordinate this training session with other trainers so that regulatory terms are consistent throughout the training. Consider providing other speakers with a list of regulatory terms with your definitions to assist them in word choices.

Use consistent regulatory terminology throughout a training event.

Need-to-knows—Applicable regulations

What federal, state, and local regulations apply to biosolids preparers and appliers?

- List the agency or agencies responsible for biosolids regulation in your state.
- Describe the additional reporting requirements for your state or local government (any requirements in addition to federal requirements).
- List the kind of permit (e.g., wastewater discharge permit: NPDES) your state uses to regulate biosolids production/processing facilities.

Need-to-knows—Meeting regulatory requirements

What process should be followed to obtain approval for a land application site?

- Tell what agencies are involved in the site approval process.
- Tell when site approvals are required for biosolids application.
- Identify the kinds of data you need to collect about the application site for site approval.

What are the components of a long-range plan for biosolids management?

- List the agency that oversees long-range plans for biosolids management.
- Describe briefly the major components of a long-range plan for biosolids management.
- Tell how often the long-range plan must be updated.

What reports must be submitted to regulatory agencies?

- Identify the annual due date for your facility's report.
- List the agencies that must receive a copy of your facility's report.
- Describe three of the major components of the annual report required by your state biosolids regulatory agency.
- Describe the kinds of information that must be reported annually for individual biosolids application sites.

Topics and activities for extended training

Biosolids management plans and annual reports

Regulations in most states require two documents that provide an outline of information for a biosolids management program: (1) a long-range biosolids management plan, and (2) an annual report. Use these documents as the basis for an in-depth workshop.

During the workshop, ask progressive biosolids managers to highlight the components of their management plans and annual reports. Sharing actual experience usually is much more valuable than just listing the requirements for the management plan and the report. You also could ask your permitting authority (e.g., state regulatory agency) to share generic examples of "do's and don'ts" for plans and reports.

Share actual experiences in meeting regulatory requirements.

Consider actively involving workshop participants. A series of lectures on reporting can strain the attention capacity of the most dedicated participants.

Third-party verification of regulatory compliance
Third-party verification is a process in which a non-regulatory person (usually a consultant with considerable biosolids management experience) "audits" a biosolids management program. For an extended program, ask a qualified consultant to review the third-party verification process, highlighting in generic terms some of the problems observed in regulatory compliance. A "Biosolids Program Checklist," developed by the Northwest Biosolids Management Association, could be used as the basis for a workshop on third-party verification. See "Training resources" at the end of this module.

Oregon Short School Example

Activity description
Lecture (50 minutes)

Speaker description
Representative of Oregon Dept. of Environmental Quality

Handout materials

- General description of Oregon system for biosolids regulation (notes from slide presentation)
- Oregon template for a biosolids management plan
- Oregon template for a annual report

Presentation materials

Slides: Highlights of Oregon biosolids management program

Training resources

Publications

Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. (Revised edition available in 1999.) Kyle Dorsey, Biosolids Coordinator, 360-407-6107. E-mail: kdor461@ecy.wa.gov

Biosolids program checklist. Northwest Biosolids Management Association, Seattle, WA.

Policies for biosolids land application. Oregon Dept. of Environmental Quality, Water Quality Division. Douglas Peters, Biosolids Coordinator, 503-229-6442. E-mail: peters.douglas@deq.state.or.us

Manual of good practice for agricultural land application of biosolids. California Water Environment Association. Phone: 510-382-7800.

World Wide Web

Washington State Dept. of Ecology
Publications Distribution
P.O. Box 47600
Olympia, WA 98504-7600
http://www.wa.gov/ecology/

Oregon Dept. of Environmental Quality
811 SW Sixth Ave.
Portland, OR 97204
503-229-5696
1-800-452-4011 (toll-free in Oregon)
http://www.deq.state.or.us/

USEPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
http://www.epa.gov/r10earth/index.htm

Module overview

Biosolids quality is defined by the degree of pathogen reduction prior to land application, steps taken to reduce vector attraction, and the content of inorganic pollutants. The United States Environmental Protection Agency (EPA) has set requirements for each of these parameters. This module discusses biosolids quality and describes the general options for meeting EPA requirements.

Training suggestions

This module requires that participants have a basic understanding of wastewater treatment and biosolids production. If your audience includes many participants who are not treatment facility personnel (e.g., application site managers), you may want to provide an introduction to wastewater treatment. Consider a tour of a treatment plant or an educational video to give participants an overview of wastewater treatment facilities and processes.

Preparation for this module: Participants should have a basic understanding of wastewater treatment and biosolids production.

Because of time constraints during a basic training, you will be unable to include details on all the options for meeting EPA pathogen reduction and vector attraction reduction requirements. To focus your presentation, select the treatment options most likely to be used by smaller wastewater treatment facilities.

This session covers biosolids quality only as it relates to EPA regulatory requirements. Biosolids nutrient content is addressed in "Land Application: Nutrient Management." The need-to-knows for this module do not address biosolids product quality from a marketing standpoint. Biosolids characteristics that make a product more desirable for various markets could be discussed along with the EPA regulatory requirements.

To maintain clarity in presentations in this and other modules, consider adopting consistent terminology for the nine elements listed in Tables 1 and 3 of the EPA Part 503 rule. The 503 rule uses the term "pollutant" for the nine elements.

Other names for the nine elements include "trace elements" and "EPA Table 3 elements."

Need-to-knows—Introduction to biosolids quality

What are biosolids?

- Define "biosolids."
- Identify what sources of wastewater are included under EPA's biosolids rule (Part 503).
- Identify other wastewater treatment plant by-products that do not meet the definition of "biosolids."
- Describe the difference between raw wastewater solids and biosolids.

What are the components of biosolids quality?

- Identify whether your state regulations for biosolids quality are the same as EPA regulations.
- Define in simple terms how the EPA terms "pathogen reduction," "vector attraction reduction," and "pollutant concentrations" relate to biosolids quality.

What are the impacts of biosolids quality on land application options?

- Identify what is required for biosolids to be marketed or distributed to the general public.
- List the options in your state for wastewater solids that don't meet EPA biosolids quality standards.

Need-to-knows—Pathogen reduction

How are pathogens reduced by biosolids stabilization processes?

- List the major classes of human pathogens found in raw solids.
- List the major processes responsible for pathogen reduction/elimination (e.g., high pH, desiccation) during wastewater solids treatment.

How is pathogen reduction addressed by EPA Part 503 rules?

- Identify the difference between Class A and B biosolids.
- Describe the relationship between PSRP processes and Class B biosolids.
- Describe the relationship between PFRP processes and Class A biosolids.

How is pathogen reduction documented?

- List the four kinds of indicator organisms that can be used to assess pathogen reduction.
- List three EPA-approved alternatives to meet Class B pathogen reduction requirements.
- List three EPA-approved alternatives to meet Class A pathogen reduction requirements.
- Identify alternatives for dealing with treatment plant process upsets (treatment process does not meet Class A or B pathogen requirements).

Need-to-knows—Vector attraction reduction requirements

What is vector attraction reduction, and why is it important?

- Define "vector attraction reduction" and how it relates to biosolids stability.
- Tell why biosolids that meet vector attraction reduction standards are more desirable for land application.
- Identify which EPA-approved vector attraction reduction options also reduce odors.

What options for vector attraction reduction are given in EPA Part 503 rules?

- List three alternatives for meeting vector attraction reduction standards applicable to small wastewater treatment facilities.
- Identify vector attraction reduction options that can be met to produce Class A biosolids.

- Identify vector attraction reduction options that can be used to produce Class B biosolids.
- Identify EPA-approved processes for pathogen reduction (PSRP or PRFP processes) that also should meet vector attraction reduction requirements.

How is vector attraction reduction documented?

- Calculate percent volatile solids reduction given data from an aerobic or anaerobic digestion process.
- Briefly describe the SOUR test and how it can be used to satisfy vector attraction reduction requirements.

Need-to-knows—Pollutant concentration (trace element) limits

What about pollutants (trace elements) in biosolids?

- Identify which trace elements are regulated in biosolids.
- List the sources of trace elements in biosolids (where do trace elements come from?).
- Identify factors that have reduced the concentrations of trace elements in most big-city biosolids over the past 20 years.
- Explain what happens to trace element concentrations in biosolids as volatile solids content is reduced.
- Identify acceptable alternatives for reducing trace element concentrations in biosolids.

How did EPA determine concentration limits and cumulative loading limits for trace elements?

- List some of the organisms protected by EPA's biosolids risk assessment for transfer of trace elements.
- List some of the risk assessment pathways included in EPA's biosolids risk assessment.

How do trace element concentrations affect land application options?

- Describe the wastewater solids management alternatives when one or more elements exceed the Ceiling Limit.

- Describe biosolids management alternatives when trace elements are below Pollutant Concentration (PC) limits.
- Describe biosolids management alternatives when one or more elements have concentrations that fall between the Ceiling limit and the Pollutant Concentration limits.

What are cumulative loading limits for trace elements, and when are they important?

- Define cumulative loading limit for trace elements.
- Identify the situations where tracking of cumulative trace element loading is required.
- Calculate cumulative loading of trace elements for a site given a biosolids analysis and a biosolids application rate.

Topics and activities for extended training

Case studies

Use the case study described in "Innovative Presentation Methods: Case Study Problem" to actively involve group participants during an extended training.

Biosolids stabilization options for small treatment facilities

You may know of some smaller treatment facilities that do an excellent job of meeting EPA requirements using a specific biosolids stabilization/processing method. You could include a tour of such a facility in extended training, or have the treatment plant operator or supervisor explain how their facility meets EPA requirements. Alternatively, a consultant specializing in design/operation of biosolids stabilization processes for small treatment plants could share examples of a variety of stabilization options.

Oregon Short School Example (Extended Workshop)

Activity description

Three lecture sessions (each session 50 minutes)

One group activity (50 minutes)

Sessions 1 and 2: Technology options to meet Part 503 requirements for pathogen reduction and vector attraction reduction. Calculating volatile solids reduction. Case studies demonstrating how small treatment plants are meeting Part 503 requirements.

Session 3: Record keeping and reporting to meet 503 requirements

Session 4: Case study. A detailed account of this case study is given in "Innovative Presentation Methods: Case Study Problem." Briefly, to conduct the case study, participants are given data on a city's effort to comply with Part 503 regulations. They are asked to evaluate the city's compliance in small groups of five to eight people. After 20 to 30 minutes to prepare an assessment, each group presents its findings to the whole group. Facilitator asks lots of questions of group spokespersons, and assists in summarizing group findings. At conclusion, facilitator discusses the items that the small groups failed to consider.

Speaker description

Sessions 1 and 2: Private consultant, wastewater treatment/ biosolids processing

Session 3: Biosolids manager with prior experience at state regulatory agency

Session 4: Facilitator with background in biosolids management

Handout materials

Sessions 1 and 2: Notes developed by the consultant. The notes were identical to the slides presented in the training.

Session 3: Notes developed by the biosolids manager, relying heavily on "A plain English guide to the EPA Part 503 biosolids rule."

Session 4: Case study invented by the facilitator, incorporating a number of questionable practices for meeting

Part 503 requirements. Participants are asked to critique the case study presented by the facilitator.

Presentation materials

Sessions 1 and 2: Text slides with EPA Part 503 requirements. Slides illustrating case studies of small treatment plants that are using appropriate technology to meet Part 503 requirements.

Session 3: Text slides with EPA Part 503 requirements. Slides illustrating biosolids data collection techniques at the wastewater treatment facility.

Session 4: One-page case study describing an imaginary city's biosolids quality. The handout for the case study can be found in "Innovative Presentation Methods: Case Study Problem."

Training resources

Publications

Land application of biosolids; Pathogen and vector attraction reduction requirements. Chapters 2 and 5 in: A plain English guide to the EPA Part 503 biosolids rule. EPA 832-R-93-003.

Environmental regulations and technology—Control of pathogens and vector attraction in sewage sludge. EPA-626-R-95-013.

Overview of the Part 503 regulatory requirements for land application of sewage sludge; Characteristics of sewage sludge. Chapters 3 and 4 in: Process design manual, land application of sewage sludge and domestic septage, EPA-625-R-95-001.

Biosolids quality. Chapter 3 in: Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. (Revised edition available in 1999.)

Compost testing requirements for pathogen regrowth; Biosolids trace pollutant forecasting; Vector attraction reduction—Volatile solids reduction. Chapters 2, 7, and

10 in: Policies for biosolids land application, Oregon Dept. of Environmental Quality, Water Quality Division.

World Wide Web

Washington State Dept. of Ecology
Publications Distribution
P.O. Box 47600
Olympia, WA 98504-7600
http://www.wa.gov/ecology/

Oregon Dept of Environmental Quality
811 SW Sixth Ave.
Portland, OR 97204
503-229-5696
1-800-452-4011 (toll-free in Oregon)
http://www.deq.state.or.us/

USEPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
http://www.epa.gov/r10earth/index.htm

Module overview

For regulatory compliance, wastewater treatment facility managers and biosolids applicators need accurate data on trace elements, pathogens, and vector attraction characteristics of biosolids. In this module, participants will be introduced to appropriate protocols for sampling and testing biosolids. This module describes the development of a biosolids sampling plan, sampling methods, laboratory analytical procedures, and how laboratory data is evaluated with respect to EPA regulations.

Training suggestions

Emphasize practical "how-to's" and general principles of sampling and testing during this training session. At the same time, explain how participants can get information applicable to their specific needs.

Emphasize practical "how-to's" and general principles of sampling and testing.

Make sure participants understand the basics of biosolids quality under the EPA Part 503 Rule prior to this session. See Training Module 2.1, "Biosolids Quality: EPA Part 503 Requirements."

Need-to-knows—Biosolids sampling

What are key considerations in developing a sampling plan?

- Identify the minimum number of subsamples that should make up a composite biosolids sample submitted to a laboratory.
- Given data on annual biosolids production, identify the proper frequency for monitoring pathogens, vector attraction reduction, trace elements under EPA regulations.
- List additional analyses (beyond federal requirements) required by your local permitting authority.
- Tell what chain of custody documentation is.
- Tell why it is important to describe and document the routine procedures used to collect, preserve, and transmit biosolids samples to the analytical laboratory.

For different kinds of testing, what specific materials and procedures are required for sample collection and preservation?

- Identify acceptable and unacceptable sample container materials for samples collected for pathogen and trace element analyses.
- Identify the proper location(s) for sampling biosolids in a given biosolids management system.
- Describe a sterile sample collection technique for pathogen testing for Class A biosolids.
- Identify the minimum number of samples that need to be taken at one sampling date to evaluate fecal coliform density.

Need-to-knows—Biosolids analyses

What laboratory analytical procedures should be used?

- List a person at the state or regional level who can be contacted for guidance in choosing appropriate analytical procedures.
- List publications that give detailed information on appropriate sample-holding times and approved analytical methods.
- For nutrient and trace element analyses, identify the quantity of dry biosolids the laboratory should digest.

How are laboratory results interpreted?

- Convert lab analyses determined on a wet weight or "as-is" basis to a dry weight basis.
- Identify for what sample constituents you need to calculate arithmetic or geometric means.
- Describe the procedure for calculating mean pathogen density from laboratory analytical data for fecal coliform and salmonellae.
- Evaluate compliance status with respect to EPA regulations for trace elements, using a calculated confidence interval.

- Describe alternatives for dealing with analytical data that indicates noncompliance with regulatory standards.

Topics and activities for extended training

Case study exercise

Give participants laboratory data and ask them to determine whether analyses demonstrate compliance with EPA Part 503 regulations. An example of the case study problem technique is described in "Innovative Presentation Methods: Case Study Problem."

Oregon Short School Example

Activity description:

Lecture (50 minutes)

Speaker description

Private consultant or representative of large wastewater treatment plant that specializes in biosolids sampling and testing.

Handout materials

Simplified guidance for sampling and testing (two pages)

Contacts/publications for additional information on sampling and testing of biosolids

Example of a sampling/analysis plan for a large biosolids production facility

Presentation materials

Slides/overheads illustrating sampling procedures

Training resources

Publications

Sampling and analysis. Chapter 6 in: A plain English guide to the EPA Part 503 biosolids rule. EPA Publ. 832-R-93-003.

Sampling procedures and analytical methods. Chapter 8 in: Environmental regulations and technology—Control of pathogens and vector attraction in sewage sludge, EPA, Office of Research and Development, Washington, D.C. 20460, EPA-626-R-95-013.

Biosolids quality. Chapter 3 in: Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. (Revised edition available in 1999.)

Module overview

Because the public has concerns about health, natural resource protection, and potential nuisances associated with biosolids applications, communication with the public is an important part of every biosolids program. In this module, participants will learn appropriate methods for notifying application site neighbors and responding to complaints from the public. Other topics include public information resources, strategies for working with the media, and proactive approaches to public information.

Training suggestions

You can approach the issue of public information from many different perspectives. Work with one or several of the following presenters to introduce training participants to a diversity of viewpoints:

Discuss the need for public information from many different perspectives.

A representative of your local biosolids permitting authority can discuss required procedures such as neighbor notification and signage at application sites.

A biosolids manager can give examples of everyday public information needs, make suggestions for managing truck drivers and applicators, explain routine procedures to minimize nuisances to the public (dust, noise, etc.), describe how to work with application site neighbors, and tell how to respond to complaints.

A public information specialist can share the challenges of working with television, radio, and print media.

A facilitator can suggest the best ways to involve the public in the planning process for your biosolids program, and provide examples of collaborative versus top-down planning.

A representative of your state/regional biosolids organization can discuss the resources available for telling the public about beneficial use of biosolids.

Need-to-knows—Working with application site neighbors

What are appropriate methods for notification of application site neighbors?

- Describe the procedure required or suggested by your local permitting authority for notification of neighbors to a biosolids land application site.
- Describe the specifications of your permitting authority for signage at a biosolids application site.
- Describe what you should tell the neighbors about routine testing that takes place in conjunction with biosolids application (e.g., well water testing, soil testing, biosolids testing).

What are appropriate methods for dealing with complaints?

- Describe a procedure for responding to complaints about odors, dust, or noise associated with biosolids application.
- Describe a procedure for responding to property damage complaints from a landowner adjacent to a biosolids application site.

Need-to-knows—Communicating with the general public

What resources are available for public information on biosolids management?

- Identify three World Wide Web sites the public can go to for information on biosolids safety.
- Identify three publications that provide information about biosolids regulations and biosolids safety which are readable by a general public audience.
- List local suggested media contacts for your region (growers, Extension agents, landowners with "on-the-ground" biosolids experience).

What written information is needed for rapid response to public concerns?

- List the name and contact information for your local biosolids regulatory official/office.
- List the public information the driver should have in the truck carrying biosolids to the field.
- Describe the kinds of information to be included in a one-page summary of your facility's biosolids application and management practices.

What preparations are needed for media response?

- List the media contact person(s) that represent your city or business
- Identify the message about your biosolids management program you want to communicate to media representatives and the general public.
- Identify two key differences between print media and broadcast media (radio or television), and describe how these differences affect your response options.
- Describe what to do if a reporter asks you a question that is beyond your current knowledge base (you honestly don't know the answer to the question).
- Describe in a few short sentences why land application of biosolids is "beneficial technology for a better environment."

What proactive approaches to public information are helpful?

- List other groups besides regulators and application site neighbors that may play a key role in the acceptance of your biosolids program.
- List biosolids industry organizations in your region that can assist you in developing a proactive plan for public information.
- Identify non-confrontational public settings where you can explain the benefits of biosolids recycling (e.g., speaking at meetings sponsored by civic and environmental organizations)

Topics and activities for extended training

Group participation activity: Mock public meeting

A mock public meeting provides participants with practice in responding to questions in a formal setting.

Holding a mock public meeting will provide participants with practice in responding to questions in a formal setting. Briefly construct a context for a mock meeting conducted by biosolids managers with the general public, such as: "A land application site proposed near the City of Cornucopia has gained notoriety through a local newspaper. You, the biosolids managers, schedule a public meeting to explain your project to the public." Then, select participants to act as "biosolids managers" responding to questions from the public (the rest of the participants) such as: "What are biosolids? Are biosolids safe? How will local water resources be protected from contamination? Who regulates biosolids, and what assurances are there that the regulators do an adequate job?"

You may want to appoint a few participants to act as observers. The observers watch the meeting from an audience's perspective, noting effective and ineffective responses from the biosolids managers. The observers share their findings with the whole group after the mock meeting is concluded.

You can keep this activity going for a long time by supplying new situations and allowing participants to change roles.

Oregon Short School Example (Extended Workshop)

Activity description

Session 1: Examples of everyday public information needs. Suggestions for managing truck drivers and applicators. Routine procedures to minimize nuisances to the public (dust, noise, etc.). How to work with application site neighbors. Responding to complaints.

Session 2: How to work with television, radio, and print media.

Speaker description

Session 1: Biosolids manager

Session 2: Public information specialist for a wastewater treatment agency

Handout materials

Session 1: Public information materials used by the biosolids production facility

Session 2: Do's and don'ts for working with the media

Presentation materials

Session 1: No visual aids. Short formal presentation with extended question and answer session.

Session 2: No visual aids. Lecture covering major topics listed on the handout. Extended question-and-answer session.

Training resources

The publications and World Wide Web sites listed below provide examples of public information on biosolids. Many are too general or too region-specific for your needs. However, they provide key ideas for creating localized fact sheets for your biosolids program.

Publications

Public Participation. Chapter 12 in: Process Design Manual, Land Application of Sewage Sludge and Domestic Septage, EPA-625-R-95-001.

Biosolids recycling: Beneficial technology for a better environment. EPA Publ. 832-R-94-009.

Biosolids questions and answers. Northwest Biosolids Management Association, Seattle, WA.

Fact sheets: Wastewater treatment, forestry, land reclamation, agriculture, environmental effects. Northwest Biosolids Management Association. Seattle, WA.

Biosolids recycling in Oregon. EC 1471. OSU Extension Service, Corvallis, OR.

World Wide Web

Web addresses are listed in this format: organization name, Web address, and "pages" with biosolids public information topics. Complete contact information for each organization is provided in "Training resources."

Northwest Biosolids Management Association: http://www.nwbiosolids.org/
Biosolids questions and answers

Fact sheets accessible from "Biosolids questions and answers" include: wastewater treatment, forestry, land reclamation, agriculture, environmental effects

Oregon State University: www.orst.edu
Biosolids Recycling in Oregon

King County Washington, Department of Natural Resources, Wastewater Treatment Division: http://waterquality.metrokc.gov/
Biosolids Recycling Basics
Biosolids Management Program
Biosolids Recycling Projects

Water Environment Federation: http://www.wef.org/WEF/
U.S. EPA Biosolids Fact Sheet Project
Biosolids Recycling Facts
Biosolids Recycling: An Environmentally Sound Way to Put a Valuable Resource to Work for All of Us
Biosolids Recycling: Beneficial Technology for a Better Environment
Biosolids Recycling Public Awareness Program—Biosolids Information Kit

Videotape

Biosolids: The Growth of Recycling
Northwest Biosolids Management Association
821 2nd Ave. MS 81 Seattle, WA 98104-1598
Phone: 206-684-1145
Fax: 206-689-3485

Module overview

Because biosolids must be hauled from a biosolids production facility to an application site, transportation is an important part of biosolids management. In this module, participants will learn the rules of the road that govern biosolids hauling to a land application site, the actions that should be taken to prepare for a biosolids spill, and appropriate performance standards for truck drivers.

Training suggestions

State and local regulations are an important component of this training session. Proactive procedures, training, and plans to prevent transportation incidents should be stressed. This session should follow "Biosolids Quality, EPA Part 503 Requirements" and "Public Information." A basic knowledge of biosolids quality and how to interact with the public is essential to designing a spill response plan.

Emphasize proactive procedures to prevent transportation incidents.

Need-to-knows—Highway regulations and driver performance

What are the rules of the road?

- Name the state agency that licenses truck drivers.
- Name the state or local agency that designates vehicle weight, height, and width restrictions for highways
- Name the state or local agency that administers seasonal weight restrictions (e.g., restrictions that apply to unpaved roads during spring thaw in northern states).
- Describe the characteristics of acceptable/unacceptable routes for hauling biosolids from treatment plant to the application site.

What performance standards are appropriate for truck drivers?

- Describe appropriate cleanup procedures to be performed on biosolids application equipment before it leaves the application site for the public roads.
- Describe alternatives to reduce dust from truck traffic on rural roadways.

- Describe improper trucking practices that should result in a reprimand for city employees or contractors.
- List what should be included in a trucking contractor's standard operating plan.
- List a source of specifications for contracts with outside trucking companies (vendors).

Need-to-knows—Spill response

What actions should be taken to prepare for a biosolids spill?

- Identify what items must be included in a spill response plan, and where written copies of the plan should be kept.
- Tell when regulatory agency, law enforcement, and/or transportation department personnel must be notified of a biosolids spill.
- Describe appropriate response actions for a spill of a large or small quantity of biosolids.
- Describe the written information the driver should provide to the first responder in the case of a large spill.
- Tell why it is important that spill responders receive written information on biosolids stating that biosolids are not a hazardous waste.

Topics and activities for extended training

Group participation activities

Simulate a biosolids spill on a highway (virtual simulation only; do not spill a load of biosolids in the meeting room). Give participants a situation, and ask them to develop a quick response plan.

Hold a mock "transportation provider" meeting (a meeting with your trucking firm). Select participants to play the role of biosolids managers, explaining the proper spill response protocol to the truckers (other participants).

Oregon Short School Example

Activity description

Lecture: 50 minutes

Speaker description

Transportation coordinator for large wastewater treatment plant

Handout materials

Example: Trucking contractor's standard operating plan

Example: Spill response plan from a biosolids production facility

Example: One-page information sheet carried in all vehicles outlining spill response actions

Presentation materials

Slides of biosolids transport from a large wastewater treatment plant via contract haulers

Training resources

Publications

Transporter management practices. Chapter 3 in: Manual of good practice for agricultural land application of biosolids. California Water Environment Association.

General design considerations. Chapter 14 in: Process design manual, land application of sewage sludge and domestic septage, EPA-625-R-95-001.

State department of transportation handbook

Nutrient Management—Introduction

Module overview

Biosolids application rates usually are based on supplying adequate nitrogen for crop needs without excessive losses to the environment. In this module, participants will be introduced to the forms, transformations, and movement of nitrogen in the environment. The module also highlights the role of biosolids in supplying other nutrients for crop production. Biosolids effects on soil chemical, physical, and biological properties (soil quality) also are described here.

The nitrogen cycle describes the forms, transformations, and movement of nitrogen in the environment.

Training suggestions

The nitrogen cycle can be used as a springboard for discussion of nitrogen forms, transformations, and losses. The calculation of fertilizer replacement value of biosolids demonstrates the difference between "total" and "available" nutrient content of biosolids.

This session introduces the need for soil testing, which is covered in greater detail in Training Module 5.3, "Nutrient Management—Soil Testing."

Need-to-knows—Nitrogen in the environment

What forms of nitrogen are found in biosolids, soils, and the environment?

- List the forms of nitrogen commonly found in biosolids and in soils.
- List the forms of nitrogen taken up by plant roots.

What nitrogen transformations are important for biosolids management?

- Explain the process that transforms organic N to ammonium-N.
- Explain the process that transforms ammonium-N to nitrate-N.
- Identify and describe the processes that transform biosolids nitrogen to gaseous nitrogen.

What are the objectives of biosolids nitrogen management?

- Explain why nitrate in ground water is a public health concern.
- Describe how heavy winter precipitation or excess irrigation affects nitrate in the soil.
- Describe the causes of excess nitrate-N in ground water.

Need-to-knows—Other nutrients

What plant-available nutrients are supplied by biosolids?

- List three plant-essential macronutrients, and four plant-essential micronutrients supplied by biosolids.
- List two nutrients that accumulate in the soil when biosolids are applied at agronomic rates based on nitrogen.
- List a macronutrient that declines in the soil when biosolids are applied at agronomic rates and the crop is removed from the field via harvesting.

What is the fertilizer replacement value of biosolids?

- Describe the difference between total nutrient content and the plant-available nutrient content of biosolids.
- Identify the data needed to estimate the fertilizer replacement value of a biosolids application.

How do biosolids affect soil quality?

- Identify a method for monitoring changes in soil nutrient status at biosolids application sites.
- List three ways that a biosolids application can improve soil quality.
- Describe the expected change in soil pH after application of biosolids stabilized with alkaline materials. Will soil pH increase or decrease?
- Describe the impact of the decomposition of biosolids organic N and S compounds in the soil. Over time, will decomposition of these compounds increase or decrease pH?

Topics and activities for extended training

There are a number of soil/nutrient-related topics that might be of interest for an advanced workshop, such as: biosolids effects on soil health/quality, managing biosolids phosphorus to protect water quality, and the economic value of biosolids nutrients.

Other topics/methods for advanced workshops can be found in Training Module 5.2, "Calculation of Agronomic Rates" and Training Module 5.3, "Soil Testing" that follow this module in *Land Application: Nutrient Management.*

Oregon Short School Example

Activity description

Lecture (50 minutes)

Speaker description

Soil scientist (university or private)

Handout materials

Fertilizing with biosolids. Pacific Northwest Extension Publ. 508. Oregon State University Extension Service, Corvallis, OR.

Presentation materials

Overheads illustrating the nitrogen cycle, and selected tables from "Fertilizing with biosolids"

Training resources

Publications

Fertilizing with biosolids. Pacific Northwest Extension Publ. 508. Oregon State University Extension Service, Corvallis, OR.

Chapters 1–3 in: Managing nitrogen from biosolids. (In Press) Northwest Biosolids Mgmt. Assoc., Seattle, WA.

World Wide Web

Oregon State University Extension and Experiment Station Communications
eesc.orst.edu.
Fertilizing with biosolids (Adobe Acrobat PDF file)

Module overview

Accurately matching the biosolids application rate to site-specific nitrogen needs is important for producing high-yielding, high-quality crops, and it is critical for compliance with biosolids regulations. In this module, participants will learn how to calculate agronomic biosolids application rates. They will learn how information on biosolids processing/stabilization methods, biosolids nitrogen analyses, crop nitrogen requirements, biosolids application methods, and application site data are used to calculate an agronomic rate.

Training suggestions

This session should include both the "how-tos" and "whys" involved in an agronomic rate calculation. It is important to remind participants that the agronomic rate calculation is an estimate based on available data. The calculated agronomic rate should be regarded as only a rough estimate if there is little data on:

- Crop N requirements for the site and management practices planned
- N availability for a particular biosolids stabilization/processing method

The presentation should include an example demonstrating the calculation of agronomic rates. Participants need to know how to do the calculation with minimal assistance. If there is time available, ask participants to calculate an agronomic rate for given set of biosolids and site information.

Demonstrate the calculation of agronomic rates.

When it comes to conversion factors to get from a biosolids analysis to an agronomic rate in field application units (e.g., gallons per acre), there are many "paths through the woods." Providing agronomic rate problems with answers will help participants practice their calculation skills. Getting the correct result with good documentation should be stressed, rather than a rigid calculation scheme.

A discussion of the nitrogen cycle and nitrogen forms should precede discussion of agronomic rate. These subjects are addressed in Training Module 5.1, "Nutrient Management—Introduction." Participants should be aware that trace element concentrations should be considered prior to a calculation of an agronomic rate based on nitrogen. Trace element calculations are addressed in Training Module 2.1, "Biosolids Quality—EPA Part 503 Requirements."

Need-to-knows—Calculation principles

What is an agronomic rate?

- Define agronomic rate.
- Explain when agronomic rates are required for biosolids applications.
- List agencies in your region that can assist with agronomic rate calculations.

What data are needed to estimate an agronomic rate?

- Describe sources of information on crop nitrogen requirements, and their relative reliability.
- List the laboratory analyses needed in calculating a biosolids application rate based on nitrogen.

What other sources of nitrogen besides biosolids should be included in the calculation?

- List potential sources of plant-available nitrogen for a crop, in addition to fertilizer or biosolids.
- Explain what happens to nitrogen returned to the soil as crop residues.
- Explain how previous organic fertilizer applications (manure, biosolids, etc.) affect agronomic application rates.

Need-to-knows—Making calculations

How is the amount of plant-available N per unit of biosolids calculated?

- Describe the relationship between percent total solids and the moisture content of biosolids.
- From a laboratory analyses data sheet, determine whether nitrogen concentrations are reported on a dry-weight or wet-weight ("as-is") basis.
- From a biosolids analysis, calculate organic N content in units of lb/dry ton.
- Describe the effects of tillage after biosolids application on the amount of biosolids ammonium-N retained after application.
- Discuss how the biosolids stabilization/processing methods used at the treatment plant affect projected mineralization rates for biosolids organic-N.

How is the agronomic rate calculated?

- Given data for a particular site, calculate N supplied from sources other than biosolids.
- Given biosolids analytical data and site management information, calculate the quantity of plant-available nitrogen (PAN) per dry ton of biosolids.
- Given data on crop N requirement, N supplied by other sources, and plant-available N per dry ton of biosolids, calculate an agronomic rate.
- Describe how agronomic rates change over time when biosolids are applied annually to the same site.

Topics and activities for extended training

Practice calculations

You can construct more complicated calculation scenarios for agronomic rate calculations with site variables such as: nitrogen provided by irrigation water or starter fertilizer, credits for previous biosolids applications at the site, fall biosolids applications, application to very sandy soil, etc. You could also vary the kind of biosolids applied (liquid, solid, lime-stabilized, etc.).

Oregon Short School Example

Activity description
One lecture session (50 minutes)

Speaker description
Agronomist: private consultant or university

Handout materials

Worksheet for calculating biosolids application rates in agriculture. 1999. Pacific Northwest Extension Publication 511. Washington State University Cooperative Extension.

University fertilizer guide(s) for selected crops.

Presentation materials
Excel spreadsheet with the same format as the handout. Both spreadsheet and handout demonstrate step-by-step agronomic rate calculations

Training resources

Publications

Worksheet for calculating biosolids application rates in agriculture. 1999. Pacific Northwest Extension Publ. 511. Washington State University Cooperative Extension, Pullman, WA.

Process design for agricultural and application sites; Process design for forest land application sites. Chapters 7 and 8 in: Process design manual, land application of sewage sludge and domestic septage. EPA-625-R-95-001.

World Wide Web
Oregon State University Extension and Experiment Station Communications Web site
eesc.orst.edu
Worksheet for calculating biosolids application rates in agriculture. 1999. HTML version with on-line calculator and downloadable Excel spreadsheet (for IBM compatibles).

Module overview

Soil testing is a tool to assess the potential for crop response to applied nutrients, and to monitor changes in soil nutrient availability over time. Although soil testing is often not required by federal or state regulations, it can provide valuable information for site selection and for fine-tuning of agronomic biosolids application rates. In this module, participants will become familiar with appropriate protocols for collecting and handling soil samples, appropriate procedures for soil sample analyses, and factors to consider in choosing an analytical laboratory.

Soil testing provides information for site selection and for fine-tuning of biosolids application rates.

Training suggestions

Soil testing is not required by EPA regulations, and requirements vary from state to state. There currently is also much debate about appropriate soil testing methods, and the interpretation of soil test data. Therefore, to adapt the training program to your audience, consult your local permitting authority for local soil testing requirements.

A general discussion of nutrient management principles and the calculation of agronomic application rates should precede this session. In this training manual, these topics are addressed in Training Modules 5.1 and 5.2.

This topic can be presented in a "hands-on" format. Consider bringing in materials for your presentation such as sample collection and preservation tools, blocks of field soil (12 x 12 x 12-inch), soil test results and interpretations, or field sampling maps.

Need-to-knows—Test selection and sample collection

Why monitor nutrient availability via soil testing?

- List a local source for accurate information on soil testing requirements at biosolids application sites.
- Describe the goals of a voluntary soil testing program.

- Tell why pre-application soil testing is valuable, even if it is not required by the regulatory agency.
- List your state land-grant university and a soil scientist that can be contacted for information on soil testing.

How are soil samples collected?

- List the number of soil cores that should make up each composite soil sample.
- Identify acceptable tools for collecting soil samples for nutrient analyses.
- List the appropriate soil sampling depth for routine nutrient analyses like soil pH, and plant-available phosphorus and potassium.
- Describe the protocol for collecting soil samples from a large field with distinctly different soil types that occupy areas large enough to be fertilized separately.
- Describe the tools available for collecting deep soil samples (samples 2 to 6 feet in depth), and their advantages and disadvantages.

How are soil samples handled and preserved?

- Describe the expected changes in soil nitrate-N if a soil sample is stored under moist, warm conditions.
- Describe approved soil sample preservation techniques for samples to be analyzed for nitrate-N.

Need-to-knows—Soil testing methods

What soil analyses should the laboratory perform?

- List the soil analyses you should request prior to the first biosolids application at a site.
- Describe the difference between the total concentration of a nutrient in soil and the "plant-available" nutrient concentration.
- List a state or regional reference document that gives the details of appropriate sample extraction and analytical methods for soil testing.

What factors should be considered in choosing a laboratory?

- Discuss the differences between agricultural testing laboratories and environmental testing laboratories.
- Describe what "laboratory proficiency testing" or "laboratory sample exchange programs" are.

Topics and activities for extended training

A number of group activities can be developed to give participants a chance to use their skills with actual sites and/or data. If possible, take a short field trip to collect a representative soil sample. Alternatively, ask participants to design a sampling strategy for a site identified on a soil survey map. Specify fence lines, crop rotations, and important grower management practices (tillage, harvest, irrigation, etc.). For group involvement in data interpretation, ask participants to make nutrient management recommendations, given soil test results from a potential application site, and a university nutrient management guide.

Extended training idea: Take a short field trip to collect a representative soil sample.

Oregon Short School Example

Activity description

One lecture session (50 minutes). Includes demonstration of sampling tools and composite sampling technique.

Speaker description

Private consultant or university

Handout materials

How to take a soil sample...and why. EC 628. Oregon State University Extension Service. Corvallis, OR.

Site Monitoring. Chapter 9 in: Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. Olympia, WA. (Revised edition available in 1999.)

Presentation materials

Overheads prepared by private consultant

Training resources

Publications

How to take a soil sample...and why. EC 628. Oregon State University Extension Service. Corvallis, OR.

Site Monitoring. Chapter 9 in: Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. Olympia, WA. (Revised edition available in 1999.)

Agronomic application rates. Chapter 1 in: Policies for biosolids land application, Oregon Dept. of Environmental Quality, Water Quality Division.

A list of analytical laboratories serving Oregon. FG 74. Oregon State University Extension and Experiment Station Communications. Corvallis, OR.

Soil test interpretation guide. Pub. EC 1478. OSU Extension Service. Corvallis, OR.

Mahler, R. and T. Tindall. 1994. Soil sampling. Bulletin 704. University of Idaho Cooperative Extension. Moscow, ID. 8 pp.

Westermann, R. L. (ed). 1990. Soil testing and plant analysis. Soil Science Society of America. SSSA Book Series No. 3. Soil Science Society of America. Madison, WI.

World Wide Web

Oregon State University Extension and Experiment Station Communications
eesc.orst.edu
Adobe Acrobat PDF files:
A list of analytical laboratories serving Oregon. FG 74.
Soil test interpretation guide. EC 1478.

Module overview

Site characteristics described in a USDA-NRCS soil survey often are used by permitting authorities as part of the site approval process. In this module, training participants learn how to find site information in a soil survey, and how the survey can be used to assess site suitability for biosolids application. Participants will be introduced to soil descriptions, soil maps, and ways of integrating data found in different sections of a soil survey report.

Training suggestions

For basic training, participants should be able to locate a proposed site on a soil survey map, list the soil series present, and find the corresponding soil profile description. In a 1- or 2-day comprehensive training workshop, you probably will not have a full hour session on site suitability. You can show participants how to use a soil survey in the same session with other site-related items in Training Module 6.2, "Biosolids Application." Another alternative is to briefly discuss soil survey information in connection with Training Module 5.2, "Calculation of Agronomic Rates."

Basic training: Locate a site on a soil survey map and find the corresponding soil profile description.

An in-depth knowledge of soil science principles related to site suitability often is not needed by biosolids managers, because the local permitting authority assumes the responsibility for assessing site suitability.

Need-to-knows—Soil survey information

How are soils described in a soil survey?

- List the three size classes of particles found in soils.
- Recognize USDA soil textural classes, and be able to rank them in relative clay content.
- List the soil morphological characteristics that are important indicators of perched water tables.
- From a soil profile description, identify the series name, slope, horizons present, and the soil surface texture.

How are soil maps interpreted?

- Locate a specific site on a soil survey map using a legal description (range, township, and section number).
- From a soil survey map, identify the major soil mapping units present at the site.
- Describe the difference between a soil mapping unit and the actual soils present at a site.

Need-to-knows—Evaluating site suitability

How is site suitability for biosolids application evaluated?

- List available sources of information on soil suitability for land application and biosolids storage. Rank these sources in order of reliability.
- List site/soil factors that usually preclude land application of biosolids.
- Describe the limitations that soil/site characteristics place on land application and biosolids storage activities. List specific limitations imposed by shallow soil profiles, perched water tables, seasonal flooding, high percentages of coarse fragments, and steep slopes.

Consider extended training workshops for consultants, managers of larger land application programs, and regulatory officials.

Topics and activities for extended training

This topic can be expanded to a half- or full-day workshop for advanced training (a 3-hour workshop on this topic was received enthusiastically by participants at a Northwest Biosolids Management Association annual meeting). Other advanced workshops could be targeted towards consultants, managers of larger land application programs, and regulatory officials involved in the site approval process.

Oregon State University Manual 8 (full reference given below) is an excellent resource for an advanced workshop. It uses soil characteristics found in the soil survey to rank site suitability, and to identify major site limitations.

Visit field sites during advanced workshops to do a "hands-on" site assessment. If you are unable to go to actual field

sites, you could do a shorter "case study" workshop in the classroom, using data from a particular site, together with criteria presented in OSU Manual 8. Procedures for developing a case-study problem are described in "Innovative Presentation Methods: Case Study Problem."

Oregon Short School Example

Activity description

Session 1: Lecture (20 minutes) included with Training Module 5.2, "Calculation of Agronomic Rates." Basic soil science principles applicable to site suitability.

Session 2: Lecture (20 minutes) included with Training Module 6.2, "Biosolids Application." Example showing maps and soil information submitted to local permitting authority for site approval.

Speaker description

Session 1: Private consultant

Session 2: Biosolids manager

Handout materials

Session 1: Notes to accompany slide presentation

Session 2: Example soil data submitted for site approval

Presentation materials

Session 1: Slides

Session 2: Overheads

Training resources

Publications

Agricultural site design. Chapter 4 in: Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. Olympia, WA. (Revised edition available in 1999.)

Guide to soil suitability and site selection for beneficial use of domestic wastewater biosolids. Manual 8, Oregon State University Extension Service, Corvallis, OR.

Site evaluation and selection process; Phase II site evaluation. Chapters 5 and 6 in: Process design manual, land application of sewage sludge and domestic septage, EPA-625-R-95-001.

World Wide Web

Natural Resources Conservation Service
United States Dept. of Agriculture home page:
http://www.nrcs.usda.gov/

USDA-NRCS Soil Survey Division
http://www.statlab.iastate.edu/soils/osd/
Official soil series descriptions

Module overview

Professional site management practices are perhaps the most important aspect of a biosolids management program. Sloppy site management usually will lead to failure of a biosolids management program, even if biosolids are of excellent quality and public information activities are appropriate. In this module, participants will learn the key site features that should be considered in designing an application plan, and EPA rules that apply to site management. Participants will become familiar with map reading, buffer delineation, application equipment calibration, and record keeping.

Training suggestions

The topics covered in this module are of critical importance for biosolids managers. The other modules lay the foundation for this module, which gives practical guidance on the management of application sites. For basic training, do not cut back on this module. A minimum of 2 hours is needed for thorough coverage of the need-to-knows.

This session should give participants a step-by-step outline for managing an application site. Site management is a blend of regulatory requirements, common sense, and continuous tracking of actual vs. planned management activities. The ideal presentation would be a group presentation including the local permitting authority (EPA, state, or other), a biosolids manager with an excellent site-management program, and a land manager (e.g., a farmer) with extensive biosolids experience.

Give participants a step-by-step outline for managing an application site.

A general discussion of biosolids quality and soil/landscape characteristics that affect site suitability should precede this session. In this training manual, these topics are addressed earlier in Training Module 2.1, "Biosolids Quality—EPA Part 503 Requirements" and Module 6.1, "Site Suitability."

This training module focuses on agricultural site management practices. An advanced workshop could cover site

management practices for other kinds of application sites (e.g., forests or rangelands). See "Topics and activities for extended training" later in this module for workshop suggestions on nonagricultural site management.

Need-to-knows—Site management goals

What site management practices maintain soil quality and reduce soil erosion?

- Name the federal agency that develops and helps landowners implement best management practices to prevent soil erosion.
- Discuss why there is often a compromise between tillage to incorporate biosolids and Natural Resources Conservation Service (NRCS) best management practices designed to reduce soil erosion.
- Describe how furrow-irrigated sites should be managed to prevent runoff of biosolids-enriched soil with irrigation water.
- Describe site management procedures that will minimize soil compaction by biosolids application activities.

When is biosolids application feasible?

- List soil factors to consider in scheduling of biosolids applications during the fall and winter months.
- Describe the scheduling of biosolids applications for different kinds of crops: annual field crops, pastures, orchard crops, etc.
- Identify the minimum separation between a seasonal high water table and the soil surface that is required by your local permitting agency before biosolids application commences.
- Describe pasture/hayfield management practices that minimize the amount of biosolids adhering to the forage.

What waiting periods are required by EPA between biosolids application and crop harvest?

- Identify the minimum waiting period when Class B biosolids are applied to crops whose harvested parts *do not* touch the soil/biosolids mixture, such as wheat, oats, barley, sweet corn, apples, peaches, or hops.
- Identify the minimum waiting period between biosolids application and harvest when Class B biosolids are applied to grasslands harvested for hay or grazed by livestock
- Identify the minimum waiting period between Class B biosolids application and harvest of a root crop such as potatoes or carrots.
- Identify the required minimum waiting period when Class B biosolids are applied to crops whose harvested parts touch the soil/biosolids mixture, such as melons, strawberries, squash, tomatoes, cucumbers, cabbage, or lettuce.

Need-to-knows—Site management procedures

What procedures should be used in working with landowners and land managers?

- Describe the steps the biosolids preparer and applicator should follow to make sure the landowner understands and abides by the prescribed site management practices (grazing management, public access restriction, nitrogen fertilizer application, etc.).
- Describe the information that should be given to the landowner and land manager before, during, and after a biosolids application.
- Describe alternatives for dealing with land managers or landowners that do not follow the prescribed EPA site management practices after a biosolids application.

How are maps used in conjunction with biosolids application?

- Describe sources of maps for biosolids application fields and their suitability for use in developing detailed site plans.
- Given the legal description (township, range, section, etc.), locate a site on a map.
- Describe significant features and areas that should be clearly marked on your field maps prior to application
- Given a map of a field and the dimensions of buffer areas, calculate the net area available for biosolids application.

How are buffer zones delineated?

- Identify the minimum buffer width requirement (set-back) from surface waters specified by the EPA Part 503 rule, and by your local permitting agency.
- List the physical landscape features on or adjacent to a biosolids application site that may require a buffer area.
- Describe what activities usually are allowed in a designated buffer area.
- Describe an accurate method for measuring and marking buffer areas.

How is biosolids application equipment calibrated?

- Describe methods to calibrate liquid biosolids application equipment and solid biosolids application equipment.
- Calculate biosolids application rate in dry ton/acre, given data on weight of biosolids spread, area spread (square feet), and the percent total solids analysis of biosolids.
- For a given biosolids application rate (dry ton/acre), calculate equivalent amounts of biosolids in units of wet tons/acre, gallons/acre, and acre-inches.
- For biosolids spreader equipment with a known hopper/tank/spreader capacity that discharges biosolids over a

swath of constant width (ft), determine how long of a swath is needed (ft) for a given biosolids application rate (wet biosolids weight/acre).

What records should be kept during biosolids application activities?

- List the kinds of data that should be recorded daily while biosolids are being stored or applied at a site.
- Describe the kinds of information that should be kept on file after biosolids are applied to a site.
- Describe a system for a supervisor to verify the accuracy of application site data.

Topics and activities for extended training

High technology options for application site management. Precision agriculture technology offers new possibilities for site management. Precision agriculture tools include global positioning systems (GPS), geographic information systems (GIS), yield monitors, and site-specific weather data. Probably the most immediately applicable technology is the use of GPS to accurately determine acreage and delineate buffer areas. A precision agriculture workshop could be held at an educational institution or library where a "classroom" of computers is available.

Biosolids application at nonagricultural sites. Biosolids can promote vegetation establishment and increase the productivity of many kinds of nonagricultural sites, including forests, Christmas tree farms, poplar plantations, rangelands, and drastically disturbed sites (e.g., urban sites or mining sites). For an advanced workshop, a biosolids manager, a land manager, and a regulator could highlight important site selection, permitting, and management considerations for a specific kind of nonagricultural site.

Extended training: Highlight site selection, permitting, and management processes for nonagricultural sites.

Oregon Short School Example (Extended Workshop)

Activity description

Three lecture sessions (each 50 minutes):

Session 1: EPA requirements and site record keeping and reporting methods

Session 2: Maps, buffers, landowner agreements, calibration of liquid application equipment

Session 3: Farmer viewpoint. Case study of application site management at a large commercial farm over a 6-year period.

Speaker description

Sessions 1 and 2: Biosolids managers

Session 3: Land manager/farmer

Handout materials

Session 1: Selected components of an annual report for field sites submitted by a biosolids production facility to the local permitting authority. The annual report demonstrated compliance with EPA Part 503 regulations and state requirements.

Session 2: Information sheets, maps, calculation templates, and records kept by the city for a typical biosolids application site

Session 3: No handouts. Topics include the suitability of various biosolids application methods, how biosolids have provided a benefit to the farm, how biosolids application records for a site are recorded, and how livestock grazing is managed.

Presentation materials

Session 1: Slides with selected information from handout materials

Session 2: Overheads (same as handouts)

Session 3: Slides

Training resources

Examples

Example: Site authorization or site approval from your local permitting agency specifying required site management practices.

Example: Description of the procedure followed by a local biosolids production facility to obtain site approval from the local permitting authority. The description could include information given to landowner, example calculations, calibration data, site maps, and application records etc.

Publications

Process design for agricultural land application sites; Process design for forest land application sites. Chapters 7 and 8 in: Process design manual, Land application of sewage sludge and domestic septage, EPA-625-R-95-001.

Agricultural site management; Forest site design and management; Other beneficial uses of biosolids. Chapters 6, 7, and 8 in: Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. Olympia, WA. (Revised edition available in 1999.)

Applier management practices; Grower management practices. Chapters 4 and 5 in: Manual of good practice for agricultural land application of biosolids. California Water Environment Association.

Biosolids Jeopardy

Presentation method overview

This presentation method is best used at the start of a training session. Its purpose is to preview topics to be covered in the workshop, assess how much the workshop participants already know, introduce participants to the trainers, and wake up sleepy or sluggish participants.

Presentation method description

This activity is patterned after the popular television game show. Prior to the training, the trainers choose categories that fit the training modules (e.g., Biosolids Quality, Public Information) and prepare "answers" for the Jeopardy Game Board: $20, $40, $60, $80, $100.

Two trainers are needed to make the activity go smoothly. It can be done with one trainer, but the pace will be slower. Tasks for the trainer group are:

- Moderator. Reads the jeopardy "answer." Identifies which team will respond first. Judges whether responses are correct or incorrect.
- Scorekeeper. Crosses off "answers" from the Jeopardy game board after they are used in the game (e.g., Biosolids Quality for $20). Keeps track of score by each team.

At the training session, participants are told to divide up into two or three teams. Trainers may choose to balance the teams by spreading experienced biosolids management personnel among the teams. Teams are best with about 10 participants, but can have many more. Play begins with the moderator picking a team to provide the first response. Team members are allowed to confer briefly before responding. If the response is incorrect, the other team(s) has an opportunity to respond.

Play continues until time runs out (40 to 50 minutes at Oregon Short School). In a slower-paced game, it can take 40 minutes to do the first round of Jeopardy. With a rapid pace, two rounds of Jeopardy and "Final Jeopardy" can be included. A slower pace allows the moderator to provide additional explanatory information beyond the question to participants. This adds value for participants who may not understand why a particular response was "correct" or "incorrect."

Presentation method example—Jeopardy answers and questions

EPA Regulations

A: Impractical crops for class B biosolids application due to 38-month waiting period after application.
Q: What are root crops?

A: In Class A biosolids, these are below detectable levels.
Q: What are pathogens?

A: Agency that performed scientific risk assessment for land application of biosolids.
Q: What is the EPA?

A: Required waiting period for pasture grazing after application of Class B biosolids.
Q: What is 30 days?

A: Biosolids that meet pollutant concentration limits and pathogen reduction standards also must meet these standards to be land applied.
Q: What are vector attraction reduction standards?

Nutrients

A: Biosolids provides these nutrients.
Q: What are N, P, K, S, and micronutrients?

A: This nutrient usually controls biosolids application rates.
Q: What is nitrogen?

A: Biosolids usually supply an excess of this nutrient.
Q: What is phosphorus?

A: The term used to describe the rate of biosolids application that matches nitrogen requirements for a specific crop on an annual basis.
Q: What is the agronomic application rate?

Oregon regulations

A: According to definitions in Oregon Biosolids Rules (Chapter 340, Division 50), liquid biosolids contain less than this percentage of solids.
Q: What is 10 percent solids?

A: This agency regulates land application of biosolids in Oregon.
Q: What is the Oregon Department of Environmental Quality (DEQ)?

A: This DEQ-issued document establishes site management conditions for applying biosolids or septage to a specific land application site.
Q: What is a site authorization letter?

A: This document, prepared by a wastewater treatment plant, describes planned biosolids production, treatment, storage, and land application activities.
Q: What is a biosolids management plan?

A: Required setback or separation between land-applied biosolids and a water supply well.
Q: What is 200 feet?

A: These "solid" measures are required by DEQ.
Q: What are Total and Volatile Solids?

A: When soil nitrate-nitrogen testing is required at biosolids application sites.
Q: What is prior to the third successive annual application at the same site?

Wastewater treatment

A: Two main products of wastewater treatment.
Q: What are clean water and biosolids?

A: This process removes solids from wastewater via gravity.
Q: What is primary treatment?

A: This process removes solids and BOD from wastewater via microbial activity.
Q: What is secondary treatment?

A: One reason for reduced copper and zinc levels in modern biosolids.
Q: What is raising pH of water in industrial and residential water supply, or what are industrial pretreatment programs?

A: Low-tech, solar-powered, biosolids stabilization and dewatering method.
Q: What are drying beds?

Biosolids Jeopardy *continued*

Name game

A: The biosolids that made Milwaukee famous.
Q: What is Milorganite?

A: Untreated sewage solids.
Q: What is sludge?

A: Stabilized sewage sludge that meets EPA and Oregon standards for recycling via land application.
Q: What are biosolids?

A: Type of rock 'n' roll music, or transition elements from the periodic table.
Q: What are heavy metals?

A: EPA jargon for seagulls, flies, mosquitoes, and rats.
Q: What are vectors?

Bio-stuff

A: This material is used to increase the pH of biosolids to 12 for stabilization and pathogen reduction.
Q: What is lime?

A: This program regulates and/or prohibits wastewater pollutant discharges from industries.
Q: What is an industrial pretreatment program?

A: In windrow composting, temperature and oxygen concentration in the pile are controlled by doing this.
Q: What is mixing or turning?

A: More comprehensive than any previous federal rule-making effort, EPA used this new methodology to determine pollutant levels that are protective of public health and the environment.
Q: What is a comprehensive risk assessment?

Pathogens and vectors

A: Pathogens are defined as this.
Q: What are disease-causing organisms?

A: PFRP is an acronym for this biosolids treatment classification.
Q: What is a Process to Further Reduce Pathogens?

A: This is the minimum temperature required when composting to meet PFRP requirements.
Q: What is 55ºC (131ºF)?

A: These are the principal pathogens of concern that we monitor in biosolids to determine Class A criteria.
Q: What are enteric viruses, salmonella sp. bacteria, and viable helminth ova? (Fecal coliform is used as an indicator organism.)

A: One way to demonstrate that vector attraction reduction has been achieved is for the volatile solids to be reduced by this percentage during sludge treatment.
Q: What is 38 percent?

Sampling/monitoring

A: These are the two basic types of samples.
Q: What are grab and composite samples?

A: If using steel sampling equipment, make sure that the steel is not coated with this material, as it readily releases into the sample.
Q: What is zinc or galvanized?

A: One of the 10 original pollutants that required monitoring under Part 503, this pollutant recently was removed by EPA, leaving 9 pollutants that require monitoring.
Q: What is chromium?

A: This measurement determines the minimum frequency of monitoring required in 40 CFR Part 503.
Q: What is the quantity, in dry metric tons, of biosolids used or disposed of in a 365-day period?

A: According to the state and federal regulations, minimum required monitoring frequencies for biosolids testing generally fall into one of these four time frames.
Q: What is once per year, once per quarter (3 times per year), once per 60 days (6 times per year), or once per month (12 times per year)?

Biosolids Jeopardy *continued*

Site management practices

A: This is the time required for restricted public access to land with a high potential for exposure after a class B biosolids application.
Q: What is 1 year?

A: These are the cropping and use restrictions for Exceptional Quality biosolids, according to Part 503.
Q: What are none?

A: Bulk biosolids cannot be applied to the land if it is likely to adversely affect this group or classification of plants and animals.
Q: What are endangered species?

A: In general, liquid biosolids or septage should not be surface applied on bare soils where the ground topography exceeds this slope.
Q: What is 12 percent?

Record keeping/reporting

A: Annual biosolids reports for the previous year's activities are due to the regulatory agencies by this date.
Q: What is February 19?

A: When biosolids exceed Exceptional Quality limits for pollutants, the applier must maintain records documenting cumulative pollutant loading for each application site for this period of time.
Q: What is indefinitely?

A: Certification statements for documenting regulatory compliance with EPA rules must be kept and made readily available to inspection for at least this long.
Q: What is 5 years?

A: Reporting requirements under Part 503 apply to all municipalities that meet these criteria.
Q: What are Class 1 wastewater treatment facilities, or facilities with design flow greater than 1 mgd, or facilities with a service population greater than 1 million?

Case Study Problem

Presentation method overview

A case study problem is an example situation. Case studies can be relatively simple or detailed, depending on your objectives and the amount of time you have. Case studies are open-ended, allowing participants to synthesize solutions to a problem. There usually are many correct answers. Case studies allow participants to learn from each other. Case studies also provide trainers with an assessment of how well the participants have mastered the information presented.

Use open-ended case studies to give participants practice in solving complex problems.

Presentation method description

The case study is prepared using either fictional or actual data, or some combination of the fictional plus actual data. For example, for a biosolids application case study you could use a real site (so people can find it in on a map) together with fictional information about biosolids quality. A good approach for case studies is to use actual information whenever possible, but always change the name of the source (e.g., use real biosolids quality data with an imaginary city name). Using fictional names also allows people to have fun with people and place names that are rarely found in real life.

We most often use case studies for group problem solving, but this approach also could be used for testing or individual study.

The case study presentation method suggested here is one way of using a case study with a group. There are many other options. Be creative!

For a case study involving participant groups, you first must explain the situation (provide data). Usually a written explanation is used, but you also could provide data in the form of slides, videotape, or other media. After providing the case study data, assign participants to smaller groups to analyze and propose solutions for the case. After groups have formulated a solution, ask the smaller groups give a presentation on their findings to the larger group. After the

small group reports are complete, the facilitator summarizes the findings of the small groups and provides additional observations. It is important for the facilitator to recognize innovative solutions to the case study problem, even if radically different from what he had in mind.

Presentation method example

The case study presented here was used at the end of an extended training session on biosolids quality and land application management. Our objective was to get participants to apply their accumulated knowledge.

Participants were given data on a city's effort to comply with EPA Part 503 regulations (see below). They are asked to evaluate the city's compliance in small groups of five to eight people. After 20 to 30 minutes to prepare an assessment, each small group presented its findings to the larger group. At the conclusion, the facilitator discussed several items that the small groups failed to consider.

Case study problem: City of Ecotopia

The current date is 1998. You are employed by the City of Ecotopia wastewater treatment facility. You recently were appointed biosolids coordinator. It is your job to assure that the city meets all monitoring and record-keeping requirements connected with biosolids quality. You also are to supervise the city's contractors and land application sites. The facility has a design capacity of 2 MGD with dry weather flow of 0.4 MGD.

Raw solids from wastewater treatment are discharged to a lagoon. Every 6 years, the city contracts with a custom dredge operator to remove accumulated solids from the bottom of the lagoon. Sam's Udredge It, a dredging contractor, has a contract to dredge the lagoon in the coming year. The contract specifies liquid biosolids with 2 to 6 percent total solids.

The city received wastewater from one large industrial facility, Copper-Zinc Alloys Inc., from 1981 to 1996. The

lagoon was last dredged in 1992. Copper-Zinc Alloys Inc. no longer discharges to the wastewater facility.

Rancher Bob, who raises beef cattle on the Singing River Ranch, has received biosolids ("sewage sludge" before 1993) from your treatment facility since the 1970s. He has 2,000 acres, which include critical riparian habitat for the endangered yellow-nosed suckerfish. In the past, the City hauled liquid sludge to Bob's on-farm storage (a large concrete tank). Bob's employees then mixed the biosolids with additional water and irrigated it on pastures with a pressurized, big gun applicator. Mr. Black, the previous biosolids manager, entered into a 20-year contract to deliver all of the City's biosolids to Rancher Bob on the City's behalf. The contract expires in 2008.

Your new mayor, who directly oversees the treatment facility, recently was elected as a candidate for the We Love the Earth party. She is concerned that the solids in the lagoon are contaminated and will have to be sent to a hazardous waste landfill.

The previous biosolids coordinator, Mr. Black, left you the following biosolids analyses from the last two times the lagoon was dredged:

Element	1992 Concentration mg/kg	1986 Concentration mg/kg
Cadmium	10	12
Copper	4,000	5,000
Lead	200	250
Nickel	50	70
Zinc	8,000	10,000

You have called a meeting of other personnel from your wastewater treatment facility. Your mission, together with the other members of your team, is to revamp the City's biosolids program to meet EPA requirements. Specifically, the mayor wants the answer to these questions:

Case Study Problem *continued*

Questions for participant groups to consider

- Are the solids in the lagoon suitable for application to pasture at the Singing River Ranch? What is the basis for your conclusion?
- What records must be kept in connection with biosolids quality at the wastewater treatment facility?
- How often, and for what constituents, should the biosolids be tested as they are dredged out of the lagoon?
- What records or other documentation should be kept by the applier at the land application site?
- What pre- and post-application monitoring is required or recommended at the application site?
- What long-term changes should be made in the City's overall strategy for biosolids management?

Take-Home Test

Presentation method overview

A take-home test provides an additional learning experience for workshop participants. Through completion of the test, participants become familiar with where to find information on a variety of topics. The test also provides feedback to instructors on what participants learned. Satisfactory completion of a take-home test can serve as a minimum requirement for a workshop completion certificate.

Presentation method description

The test is provided to participants at the end of the training workshop. For computer-scoring, the test must be multiple choice or true/false. For workshops with a small number of participants and a willing instructor, short-answer problem-solving questions can be used.

Another way of giving a test is to make the test available on the World Wide Web. This kind of testing is routinely used in distance education classes offered by universities.

Presentation method example—Take-home test

For the Oregon workshops, we provided a take-home test of about 100 questions and gave workshop participants about 10 days to return the test for computer scoring. Participants receiving a score of 70 percent or higher received a completion certificate. An individualized computer score sheet, listing the correct answer for incorrect responses, was sent back to participants with the completion certificate. Example test questions for each area of the curriculum are listed on the following pages.

Training idea:

Provide workshop completion certificates to participants who successfully complete a take-home test.

Take-Home Test *continued*

Take-home test—Sample questions

Regulatory Compliance (Training Module 1)

1. Federal and state biosolids rules apply to
a) Metal concentrations in the biosolids
b) The land application sites
c) Pathogen levels in the biosolids
d) All of the above

2. Certification statements, required by the EPA Part 503 regulation, state that the land applier and his or her employees are qualified to gather information and perform the tasks required by EPA.
a) True
b) False

3. As a minimum, how often does the permittee have to show compliance with vector attraction reduction requirements?
a) Once during the report year.
b) Daily during the time biosolids are land-applied under reduction options 1 to 8
c) On the same frequency as pollutant monitoring when vector attraction reduction options 1 through 8 are met
d) None of the above

Biosolids Quality: EPA Part 503 Requirements (Training Module 2.1)

1. Most biosolids produced at Oregon wastewater treatment facilities are
a) Land -applied as a beneficial use
b) Dumped into hazardous waste landfills
c) Incinerated
d) Taken to Washington D.C. to fertilize the White House lawn

2. Class A and B refer to the level of pathogen reduction achieved in the biosolids treatment process.
a) True
b) False

3. If you have Class A biosolids, you don't have to worry about vector attraction reduction standards.
a) True
b) False

4. Using a designated PFRP process to treat municipal sewage sludge will
a) Produce Class A biosolids
b) Eliminate the requirement to monitor fecal coliform or salmonella
c) Eliminate the requirement to monitor vector attraction reduction
d) Eliminate the requirement to monitor solids treatment operations
e) All of the above

5. Using a designated PSRP process to treat municipal sewage sludge will
a) Produce Class A biosolids
b) Eliminate the requirement to monitor fecal coliform
c) Eliminate the requirement to monitor vector attraction reduction
d) Eliminate the requirement to monitor solids treatment operations
e) All of the above

6. Which of the following solids treatment processes can be used to produce a Class A liquid biosolids product that also meets one of the first eight vector attraction reduction options?
a) Composting
b) Lime treatment
c) Anaerobic digestion (mesophilic)
d) Thermophilic aerobic digestion

7. Biosolids storage volume requirements generally are most dependent upon
a) Annual generation of total dry solids
b) Annual generation of raw sludge volume
c) Annual volume of biosolids generation
d) Seasonal use of biosolids
e) d and e

8. Concentrations of regulated pollutants in biosolids products can be reduced by pre-treatment programs, lime treatment, or composting.
a) True
b) False

9. Materials that can be beneficially recycled or meet all applicable regulatory requirements for biosolids include
a) Grit and screenings from municipal wastewater treatment plants
b) Municipal sewage sludge after treatment
c) Food processing sludges after treatment
d) All of the above

Take-Home Test *continued*

10. A well-designed biosolids product will
a) Be easily applied with manure spreader
b) Provide all fertilizer needs of most farm crops
c) Meet user requirements
d) Be sold for a high price
e) All of the above

11. Wet cake biosolids (approximately 10 to 17 percent solids) can be applied easily to the land with a
a) Big gun sprinkler
b) Manure spreader
c) Tank truck with splash bar
d) None of the above

12. All biosolids products have slightly acid to slightly alkaline range in pH.
a) True
b) False

13. PC-Class B biosolids can be sold or given away to the public.
a) True
b) False

14. Trace elements in biosolids
a) Include the "heavy metals"
b) Include cadmium and copper
c) Include phosphorus and sulfur
d) a and b
e) None of the above

15. If you deliver your city's biosolids to an application contractor, you must
a) Make sure that the contractor will assume full and complete liability in case of any problems that arise
b) Provide biosolids nitrogen analyses to the contractor
c) Notify and provide information to the contractor to comply with EPA Part 503 regulations
d) b and c

16. CPLR refers to
a) Cumulative pollutant loading rate, applicable to all Class B biosolids
b) Cumulative pollutant loading rate, applicable to biosolids that exceed the EPA Ceiling Concentrations for pollutants
c) Classic Polluted Landfill Regulations, applicable to biosolids that do not meet hazardous waste regulations
d) Cumulative pollutant loading rate, applicable to biosolids that exceed EPA pollutant concentration limits but are below ceiling limits

17. There are no federal land application management requirements applicable to Exceptional Quality biosolids.
a) True
b) False

18. The frequency of monitoring required for pollutants, pathogen densities, and vector attraction reduction depends on the amount of biosolids produced annually by a WWTP.
a) True
b) False

19. The nine trace inorganic pollutants regulated by EPA where biosolids will be land applied are
a) Arsenic, cadmium, copper, lead, manganese, mercury, molybdenum, nickel, and zinc
b) Arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, and zinc
c) Arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc
d) Arsenic, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, and zinc

20. Which best describes Exceptional Quality (EQ) biosolids?
a) Biosolids must meet one of the Class A pathogen reduction options, one of the 10 vector attraction reduction options, and trace inorganic ceiling pollutant limits.
b) Biosolids must meet one of the Class A pathogen reduction options, one of the first eight vector attraction reduction options, and trace inorganic ceiling pollutant limits.
c) Biosolids must meet one of the Class B pathogen reduction options, one of the first eight vector attraction reduction options, and trace inorganic PC pollutant concentration limits.
d) Biosolids must meet one of the Class A pathogen reduction options, one of the first eight vector attraction reduction options, and trace inorganic PC pollutant concentration limits.

21. If EQ or PC biosolids are land applied, do records on cumulative application have to be kept for the site?
a) Yes
b) No

22. Are both Class A and Class B biosolids, in regards to pathogens, protective of public health and the environment, even though biosolids with Class B pathogen status still may contain pathogens and biosolids with Class A status do not?
a) No; only Class A pathogen standards are protective of public health.
b) Yes; Class B standards plus site restrictions are as protective of public health as Class A Standards.
c) Yes; Class B standards plus site restrictions + management practices are as protective of public health as Class A standards.
d) None of the above

Biosolids Quality: Sampling and Testing Biosolids (Training Module 2.2)

1. How many samples per sampling event are required to document Class A pathogen reduction?
a) 1
b) 16
c) 7
d) None of the above

2. The most critical component for biosolids sample handling is
a) Ice
b) Shipping method
c) Sample volume
d) Time of year

3. For biosolids metal analyses, water and wastewater analytical methods are preferable to solid-waste analytical methods.
a) True
b) False

4. For a metals analysis, the laboratory should digest the amount of biosolids equivalent to 1 gram of dry weight.
a) True
b) False

Public Information (Training Module 3)

1. You can assume that good works and honorable intentions will produce favorable public opinions and credibility.
a) True
b) False

2. It's OK to tell the inside story to a reporter as long as it is "off-the-record."
a) True
b) False

3. Getting angry with a media representative helps get your point across.
a) True
b) False

4. During an interview you should have a message or some image/accomplishment you want to leave with the public.
a) True
b) False

5. If you don't know the answer, then the best policy is to give a long-winded rambling answer that puts the media representative to sleep.
a) True
b) False

6. The best way to deal with the public is
a) Have your mother talk to them.
b) Deal with them first, no surprises.
c) Wait until there is a problem.
d) Put an ad on the radio.

7. Lack of product knowledge is the main reason the public objects to biosolids application sites.
a) True
b) False

Take-Home Test *continued*

Transportation to Land Application (Training Module 4)

1. Which of the following is *not* a required part of a complete spill response plan?
a) Route description
b) Identification of sensitive areas
c) Commercial driver identification
d) Spill notification system

2. The following factors can affect your biosolids transportation route from a biosolids production facility to a biosolids application site
a) Weight, width, and length restrictions
b) Road conditions
c) Location of favorite fast-food outlets
d) Phone calls from residents complaining about the dust and noise
e) a, b, and d

3. Having written documentation of what your load is (biosolids) and the proper methods for spill cleanup:
a) Helps make sure that biosolids are not considered hazardous waste
b) Helps get the right equipment to the spill as soon as possible
c) Prevents you from being sued
d) a and b

4. Spill responders should be identified before a spill happens.
a) True
b) False

5. The driver should never clean up a biosolids spill.
a) True
b) False

6. After a big spill that requires a call to 911, the driver should get out of the area as quickly as possible.
a) True
b) False

7. Shovels and sand are the tools needed for cleanup of a small spill on an impervious surface.
a) True
b) False

8. Truck drivers should be aware that biosolids are a subtitle C hazardous waste.
a) True
b) False

9. If a driver gets biosolids on his or her hands, he/she should wash his/her hands before eating, drinking, or smoking.
a) True
b) False

10. Sensitive areas along haul routes include scenic areas, wetlands, waterways, bridges, and designated wildlife habitat areas.
a) True
b) False

11. What should a driver who is exposed to class B biosolids do?
a) Go to the hospital immediately.
b) Wash area of exposure prior to eating, drinking, or smoking,
c) Wear protective clothing during a spill cleanup.
d) b and c
e) a, b, and c

12. Biosolids can be defined as solids derived from domestic wastewater that has been treated in a controlled process that totally eliminates pathogens and volatile solids.
a) True
b) False

13. An emergency contact list should include the following:
a) Responders
b) Contractors
c) Agency contacts
d) All of the above

Land Application: Nutrient Management (Training Modules 5.1 and 5.2)

Introduction and Calculation of Agronomic Rates

1. Biosolids supply lots of potassium, so farmers using biosolids can be certain that they don't need to fertilize crops with potassium fertilizers.
a) True
b) False

2. Alkaline-stabilized biosolids are a desirable amendment for a soil with a pH of:
a) 6.0
b) 5.0
c) 8.2
d) a and c
e) a and b

3. Nitrate-nitrogen can be leached from soils if
a) Precipitation or irrigation exceeds the water holding capacity of the soil
b) Biosolids are applied
c) Commercial fertilizer is applied
d) All of the above
e) None of the above

4. Soil clays and organic matter carry a net positive charge.
a) True
b) False

5. Organic matter in soils holds two to three times its weight in water, giving plants access to more soil water.
a) True
b) False

6. Biosolids benefit soils and crops by improving the metaphysical, biological, and chemical properties of soils.
a) True
b) False

7. Organic matter is the "food" that soil organisms need to function.
a) True
b) False

8. The following element is *not* essential for plant growth
a) Nitrogen
b) Phosphorus
c) Zinc
d) Lead
e) Sulfur

9. University fertilizer guides estimate average crop nitrogen requirements for crops produced in a given geographic area under good management.
a) True
b) False

10. After biosolids applications, the conversion of biosolids organic N to plant-available forms in soil is:
a) Complete 6 weeks after application
b) Complete 1 year after application
c) Most rapid when biosolids are composted prior to application
d) Most rapid when biosolids are stored in a lagoon for a couple of years prior to application
e) Most rapid when soils are warm and moist

11. NH_4-N is:
a) Ammonia nitrogen
b) Ammonium nitrogen
c) Plant-available
d) Present at high concentrations in lime-stabilized biosolids
e) b and c

12. The method of biosolids stabilization (processing) does not affect the agronomic rate.
a) True
b) False

13. Loss of ammonia-nitrogen to volatilization after land application is affected by tillage.
a) True
b) False

14. Mineralization is the release of plant-available nitrogen from organic nitrogen.
a) True
b) False

15. Nitrogen, rather than heavy metals, usually limits biosolids land application rates.
a) True
b) False

16. A qualified agronomist can provide a recommended nitrogen application rate that differs from university fertilizer guides, but supporting documentation is required.
a) True
b) False

17. Information needed to calculate agronomic application rates for biosolids includes
a) Biosolids analyses for total nitrogen (TKN) and ammonium-nitrogen (NH_4-N)
b) Total solids content of biosolids
c) Crop yield goal
d) Crop nitrogen requirement
e) All of the above

18. Other sources of nitrogen that may be important at some agricultural sites include
a) Irrigation water
b) Nitrate-nitrogen present in the soil before biosolids application
c) Nitrogen mineralized from previous biosolids or manure applications
d) All of the above
e) None of the above

19. Organic nitrogen in biosolids is estimated by subtracting nitrate-N from biosolids total N content.
a) True
b) False

20. Tillage immediately after biosolids application reduces ammonia loss.
a) True
b) False

21. Ammonium nitrogen is
a) The same as NH_4-N
b) A positively charged ion
c) Found in biosolids
d) Found in soils
e) All of the above

22. Nitrate-nitrogen is
a) The same as NO_3-N
b) Positively charged
c) Found in large quantities in anaerobically digested biosolids
d) All of the above
e) None of the above

23. Ammonium nitrogen is adsorbed to clay and organic matter in soils.
a) True
b) False

Land Application: Nutrient Management (Training Module 5.3)

Soil testing

1. When sampling soils for nitrate-nitrogen, it is important to preserve the sample by
a) Freezing
b) Air drying within 24 hours
c) Delivery to the laboratory within 24 hours
d) None of the above
e) a, b, or c

2. To convert a laboratory soil sample analysis from units of mg/kg to lb/acre, you need to know
a) Soil depth sampled
b) Approximate soil bulk density
c) Laboratory that performed the nitrate analysis
d) Number of soil cores included in a composite sample
e) a and b

3. A lab qualified to conduct soil fertility tests should be familiar with
a) EPA laboratory methods for metals
b) Soil test methods recommended by the land-grant university for determination of nutrient availability
c) State water quality criteria
d) None of the above

4. How many subsamples are required for a representative composite soil sample?
a) 1–5
b) 10–20
c) 50–100
d) 100–200

5. What is the best sampling pattern for collecting soil samples from a land application site?
a) The shortest route
b) Parallel to the normal direction of tillage
c) Wherever you can drive with the pickup
d) Across the normal direction of tillage

6. Which of the following is not a critical item in a soil test laboratory report for nutrient analyses?
a) Reporting in dry-weight units
b) Approved methodology for nutrient assessment
c) Units of measurement clearly listed
d) Quality assurance and control protocol

7. Equipment needed for taking a soil sample includes
a) A core sampler
b) A plastic bucket
c) Ziploc bags
d) All of the above

8. A fall (October 1) soil sample was collected from a corn field in western Oregon (winter precipitation >20 inches per year). The site was fertilized the previous spring with biosolids. In a 2-foot depth, you calculated that on October 1, the soil contained 300 lb nitrate-N per acre. Based on this analysis, you should
a) Apply a higher rate of biosolids next year
b) Take another soil sample for nitrate-N in March
c) Talk with the grower about his corn yields
d) Check the soil organic matter
e) Discontinue biosolids application at the site until you can determine the cause of the high fall soil nitrate concentrations

Land Application: Site Management (Training Module 6.1)

Site suitability

1. Soils that tend to be poorly drained are better for reducing pathogens in biosolids.
a) True
b) False

2. The more permeable soils are, the better they are for biosolids application.
a) True
b) False

3. Trafficability refers to how long it takes to drive to the land application site.
a) True
b) False

4. Application of biosolids always improves infiltration and reduces soil erosion.
a) True
b) False

Land Application: Site Management (Training Module 6.2)

Biosolids application

1. Methods to measure acreage and buffers at a site include
a) A global positioning system
b) Transit and a distance meter, chain, or wheel
c) Compass and a chain or wheel
d) a, b, or c, depending on the accuracy desired
e) Hitting a golf ball with a 5-iron until you reach the property edge

2. A property measures 400,000 square feet, which is equal to
a) 19.2 acres
b) 9.2 acres
c) 92 acres
d) 9.9 acres

3. An important tool for locating biosolids application sites for documentation purposes is
a) A compass
b) State road maps
c) NRCS soil survey aerial photos
d) None of the above

4. When calibrating biosolids application equipment, you need to measure
a) The weight of biosolids the spreader will hold
b) The acreage covered by application of a full spreader load
c) The width of the tires
d) The orientation of the sun relative to true north
e) a and b

Take-Home Test *continued*

5. To change biosolids application rates, you could
a) Increase the speed of the application equipment
b) Change the gear settings of the application equipment
c) Decrease the speed of the application equipment
d) All of the above
e) None of the above

6. You applied 18,000 lb of biosolids to an area measuring 50 by 800 feet. You applied
a) 19.6 wet tons per acre
b) 9.8 wet tons per acre
c) 1.96 wet tons per acre
d) None of the above

7. You applied 400 wet tons of biosolids containing 5 percent total solids to 10 acres. Your application rate was approximately
a) 4 dry tons per acre
b) 9 dry tons per acre
c) 2 dry tons per acre
d) 7 dry tons per acre

8. You applied 160 dry tons of biosolids to a site with 80 acres. The biosolids contained 5 percent total nitrogen on a dry-weight basis. You applied
a) 40 lb total N per acre
b) 200 lb total N per acre
c) 400 lb total N per acre
d) 800 lb total N per acre

9. You applied 2 dry tons per acre of biosolids containing 15,000 mg/kg ammonium-N (dry weight basis). You applied
a) 20 lb ammonium-N per acre
b) 40 lb ammonium-N per acre
c) 60 lb ammonium-N per acre
d) 80 lb ammonium-N per acre

10. You applied 4 dry tons per acre of biosolids containing 35,000 mg/kg of organic N on a dry-weight basis. You applied
a) 180 lb organic-N per acre
b) 220 lb organic-N per acre
c) 280 lb organic-N per acre
d) 420 lb organic-N per acre

Participant evaluation of the training workshop

1. I participated in last year's biosolids training program.
a) Yes
b) No

2. I received a completion certificate for last year's biosolids training program.
a) Yes
b) No

3. I am currently responsible for biosolids management as an employee of
a) A wastewater treatment facility
b) Government agency
c) Private company
d) None of the above

4. Biosolids management has been part of my job description for
a) Less than 2 years
b) 2 to 4 years
c) 4 to 10 years
d) More than 10 years

5. The percentage of my work time I devote to biosolids management is
a) Less than 10 percent
b) 10 to 30 percent
c) 30 to 60 percent
d) Over 60 percent

6. Overall, the 2-day training program, in my opinion,
a) Was too long
b) Was too short
c) Was about right
d) Could be condensed into 1 day

7. During the training program, I attended
a) 0 to 4 sessions
b) 5 to 8 sessions
c) 9 to 12 sessions

Take-Home Test *continued*

8. The biggest incentive for attending the biosolids training program was
a) Continuing education credits
b) The expertise of the speakers
c) Skills learned
d) Opportunity to become acquainted with a new field

9. The most valuable portion of the training was the
a) Oral presentations
b) Notebook with handout materials
c) Take-home test
d) Opportunity to ask questions of experts

10. I would recommend this training to others at my place of business
a) Yes
b) No

11. If I were to change the method of presentation for the training course, I would allow more
a) Time for questions and answers
b) Group participation activities
c) Time to practice calculations
d) Time for technical information presentation

12. The notebook provided with the training course
a) Was extremely valuable
b) Was somewhat valuable
c) Was a waste of paper
d) Could be a lot shorter and still contain the needed information

13. If there were an additional charge to support future training workshops, I would be willing to pay
a) Up to $15
b) $15 to $30
c) More than $30
d) Nothing

14. If the training materials were provided via other media, I would be most likely to use
a) A World Wide Web site
b) A compact disc
c) A videotape
d) There is no substitute for a face-to-face workshop

Take-Home Test Key

Regulatory Compliance (Training Module 1)

1. D
2. A
3. C

Biosolids Quality: EPA Part 503 Requirements (Training Module 2.1)

1. A
2. A
3. B
4. A
5. B
6. D
7. E
8. A
9. B
10. C
11. D
12. B
13. B
14. D
15. D
16. D
17. A
18. A
19. C
20. D
21. B
22. C

Biosolids Quality: Sampling and Testing Biosolids (Training Module 2.2)

1. C
2. A
3. B
4. A

Public Information (Training Module 3)

1. B
2. B
3. B
4. A
5. B
6. B
7. A

Transportation to Land Application (Training Module 4)

1. C
2. E
3. D
4. A
5. B
6. B
7. A
8. B
9. A
10. A
11. D
12. B
13. D

Land Application: Nutrient Management

Introduction and Calculation of Agronomic Rates (Training Modules 5.1 and 5.2)

1. B
2. E
3. D
4. B
5. A
6. B
7. A
8. D
9. A
10. E
11. E
12. B
13. A
14. A
15. A
16. A
17. E
18. D
19. B
20. A
21. E
22. A
23. A

Land Application: Nutrient Management

Soil Testing (Training Module 5.3)

1. E
2. E
3. B
4. B
5. D
6. D
7. D
8. E

Land Application: Site Management

Site Suitability (Training Module 6.1)

1. B
2. B
3. B
4. B

Land Application: Site Management

Biosolids Application (Training Module 6.2)

1. D
2. B
3. C
4. E
5. D
6. B
7. C
8. B
9. C
10. C

Participant Evaluation of Training Workshop

1–14, all answers can be correct

References for effective presentation methods

Mandel, Steve. 1993. Effective presentation skills. Crips Publications, Menlo Park, CA.

Raab, Margaret Y. 1990. The presentation design book. Veneta Press, Chapel Hill, NC.

van Oech, Roger. 1990. A whack on the side of your head. Warner Books, Inc., New York, NY.

General references for training modules

California Water Environment Association. 1998. Manual of good practice for agricultural land application of biosolids. 510-382-7800. Fax: 510-382-7810.

NBMA. 1998. Biosolids program checklist. Prepared by Steve Wilson (Brown and Caldwell) for the Northwest Biosolids Mgmt. Assoc., Seattle, WA.

Oregon Dept. of Environmental Quality, Water Quality Division. 1998. Policies for biosolids land application. Douglas Peters, Biosolids Coordinator, 503-229-6442. E-mail: peters.douglas@deq.state.or.us

Sullivan, D. M., D. M. Granatstein, C. G. Cogger, C. L. Henry, and K. P. Dorsey. 1993. Biosolids management guidelines for Washington State. Washington State Dept. of Ecology Publication 93-80. (Revised edition available in 1999.) Kyle Dorsey, Biosolids Coordinator, 360-407-6107, e-mail: kdor461@ecy.wa.gov

USEPA, 1995. Part 503 Implementation Guidance. EPA-833-R-95-001. Office of Wastewater Management/Permits Division.

USEPA, 1995. Process design manual, land application of sewage sludge and domestic septage. Office of Research and Development, Washington, D.C. 20460, EPA-625-R-95-001.

USEPA, 1993. Land application of sewage sludge: a guide for land-appliers on the requirements of the federal standards for the use or disposal of sewage sludge, 40 CFR Part 503. EPA-831-B-93-002b.

USEPA, 1993. Preparing sewage sludge for land application or surface disposal: a guide for preparers of sewage sludge on the monitoring, record keeping and reporting requirements of the federal standards for use and disposal of sewage sludge, 40 CFR Part 503. EPA 831-B-93-002a.

References for specific training modules

Biosolids Quality (Training Modules 2.1 and 2.2)

USEPA. 1993. A plain English guide to the EPA Part 503 biosolids rule. EPA Publ. 832-R-93-003. Office of Wastewater Enforcement and Compliance.

USEPA. 1992. Environmental regulations and technology—Control of pathogens and vector attraction in sewage sludge, US EPA, Office of Research and Development, Washington, D.C. 20460, EPA-626-R-95-013.

Public Information (Training Module 3)

USEPA. 1994. Biosolids recycling: beneficial technology for a better environment. EPA Publ. 832-R-94-009. Office of Water Resource Center, 401 M St SW (RC-4100), Washington, D.C. 20460.

NBMA. Biosolids questions and answers. Northwest Biosolids Mgmt. Assoc, Seattle, WA.

NBMA. Fact sheets: wastewater treatment, forestry, land reclamation, agriculture, environmental effects. Northwest Biosolids Mgmt. Assoc, Seattle, WA.

Sullivan, D. M. 1996. Biosolids recycling in Oregon. EC 1471. OSU Extension Service, Corvallis, OR.

Transportation to Land Application (Training Module 4)

USEPA, 1995. General design considerations. Chapter 14 in: Process design manual, land application of sewage sludge and domestic septage, EPA-625-R-95-001.

California Water Environment Association. 1998. Transporter management practices. Chapter 3 in: Manual of good practice for agricultural land application of biosolids. 510-382-7800. Fax: 510-382-7810.

Land Application: Nutrient Management

Introduction (Training Module 5.1)

Sullivan, D. M. 1998. Fertilizing with biosolids. Pacific Northwest Extension Publ. 508. Oregon State University Extension Service, Corvallis, OR.

Calculation of Agronomic Rates (Training Module 5.2)

Cogger, C. G. and D. M. Sullivan. 1999. Worksheet for calculating biosolids application rates in agriculture. Pacific Northwest Extension Publication 511. Washington State University Cooperative Extension, Pullman, WA.

Henry, C. L., D. M. Sullivan, K. P. Dorsey, and C. G. Cogger. [In Press]. Managing nitrogen from biosolids. Northwest Biosolids Mgmt. Assoc., Seattle, WA.

Soil Testing (Training Module 5.3)

Gardner, E. H. and J. Hart. 1995. How to take a soil sample...and why. EC 628. OSU Extension Service, Corvallis, OR.

Hart, J. 1996. A list of analytical laboratories serving Oregon. FG 74. OSU Extension and Experiment Station Communications, Corvallis, OR.

Marx, E. S., J. Hart, and R. G. Stevens. 1996. Soil test interpretation guide. EC 1478. OSU Extension Service, Corvallis, OR.

Schreiber, A. and C. H. Daniels. 1994. Analytical laboratories and consultants serving the Pacific Northwest. EB 1578. Washington State University Cooperative Extension. Pullman, WA.

Mahler, R. and T. Tindall. 1994. Soil sampling. Bulletin 704. University of Idaho Cooperative Extension. Moscow, ID.

Westerman, R. L. (ed). 1990. Soil testing and plant analysis. Soil Science Society of America. SSSA Book Series No. 3. Soil Science Society of America. Madison, WI.

Land Application: Site Management

Site Suitability (Training Module 6.1)

Huddleston, J. H. and M. P. Ronayne. 1995. Guide to soil suitability and site selection for beneficial use of domestic wastewater biosolids. Manual 8, OSU Extension Service, Corvallis, OR.

Biosolids Application (Training Module 6.2)

See “General references for training modules” on first page of “Training Resources—Publications.”

Organizations with Educational Materials

National

U.S. Environmental Protection Agency
Office of Water Resources
401 'M' St., Mail Code 4204
Washington, D.C. 20460
Phone: 202-260-7283
Fax: 202-260-0116
Web: http://www.epa.gov/owmitnet/pubb.htm

Water Environment Federation
601 Wythe St.
Alexandria, VA 22314
Phone: 703-684-2400
Fax: 703-684-2492
Web: http://www.wef.org/biosolids.html

Association of Metropolitan Sewerage Agencies
1000 Connecticut Avenue, NW, Suite 410
Washington, D.C. 20036-5302
Phone: 202-833-4655
Fax: 202-833-4657
Web: http://www.amsa-cleanwater.org/

National Biosolids Partnership
601 Wythe St.
Alexandria, VA 22314
Phone: 703-684-2438
Fax: 703-684-2492
Connections to the Partnership can be found on the WEF, AMSA, and EPA Web sites

Natural Resources Conservation Service
United States Dept. of Agriculture
P.O. Box 2890
Washington, D.C. 20013
Web: http://www.nrcs.usda.gov/

Pacific Northwest

Northwest Biosolids Management Association
821 2nd Ave. MS 81
Seattle, WA 98104-1598
Phone: 206-684-1145
Fax: 206-689-3485
Web: http://www.nwbiosolids.org/

USEPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
Phone: 206-553-1941
Fax: 206-553-0165
Web: http://www.epa.gov/r10earth/index.htm

Washington State Dept. of Ecology
Publications Distribution
P.O. Box 47600
Olympia, WA 98504-7600
Web: http://www.wa.gov/ecology/

Oregon Dept of Environmental Quality
811 SW Sixth Ave.
Portland, OR 97204
503-229-5696
1-800-452-4011 (toll free in Oregon)
Web: http://www.deq.state.or.us/

Oregon Association of Clean Water Agencies
537 SE Ash Avenue, Suite 12
Portland, OR 97214
Phone: 503-236-6722
Fax: 503-236-6719
Web: http://www.oracwa.org

Organizations with Educational Materials *continued*

Idaho Dept. of Health & Welfare
Div. of Environmental Quality
1410 N Hilton
Boise, ID 83720-9000
Phone: 208-373-0502
Fax: 208-373-0417
Web: http://www2.state.id.us/deq/

Alaska Dept. of Environmental Conservation
610 University Ave
Fairbanks, AK 99709-3643
Phone: 907-451-2134
Fax: 907-451-2187
Web: http://www.state.ak.us/local/akpages/ENV.CONSERV/home.htm

Pacific Northwest Pollution Control Association (PNPCA)
P.O. Box 23693
Tigard, OR 97281-3693
Phone: 503-579-1472
Fax: 503-579-2042
Web: http://www.pnpca.org/

Appendix: State and National Biosolids Training Programs

What's in the appendix?

This appendix was developed by Dan Sullivan (Oregon State University) and the Northwest Biosolids Management Association as a part of the final report for the NBMA/EPA Cooperative Agreement in July, 1998. The appendix describes in detail the pilot biosolids training workshops presented in Oregon in 1997 and 1998, and provides our vision for the future of biosolids training on a national scale. It is provided here as "food for thought" for those involved in planning and executing biosolids training activities.

Appendix focus: Pilot Oregon biosolids training workshops and suggestions for a coordinated national training program.

The first part of the appendix, "Pilot Training Programs in Oregon 1997–98," provides an illustration of how a state or regional biosolids organization can create a training program. The reasons for promoting training in Oregon as a voluntary activity are discussed in detail.

The second part of the appendix, "Outlook for a Coordinated National Training Program," discusses the organization and maintenance of a national training effort. As this manual goes to press, such a program is under discussion by the National Biosolids Partnership and cooperating organizations. We anticipate that in a few years, this appendix will serve mainly to see how far training efforts have progressed.

Pilot Biosolids Training Programs in Oregon 1997–98

Quick summary

Biosolids land application programs will continue only if they are well managed and are accepted by the public. To reach entry-level biosolids personnel, the Oregon Association of Clean Water Agencies (ACWA), together with the Northwest Biosolids Management Association (NBMA), provided support for pilot training workshops in Oregon in 1997–98. The workshops covered biosolids quality, transportation, application, site management, monitoring, record keeping and reporting. Speakers were recruited from the state regulatory agency, the larger municipal treatment facilities, private consulting firms, and the land-grant university. Completion certificates were awarded to participants who successfully completed a take-home multiple-choice test. The training workshop approach, utilizing locally available resources, is an effective way to improve the quality of biosolids land application programs.

Need for a training program

Training in biosolids management is not a new concept in the Pacific Northwest. Organizations such as the Northwest Biosolids Management Association (NBMA), the Oregon Association of Clean Water Agencies (ACWA), and the Pacific Northwest Pollution Control Association (PNPCA) all conduct continuing education activities.

The present project grew out of a desire to formalize biosolids training to make it a more rigorous and predictable process. An Oregon ACWA subcommittee, formed in 1996, studied the certification concept and concluded that formalized training, or certification, would:

- Enhance the public's overall acceptance of beneficial use of biosolids
- Ensure that operators, technicians, and managers have thorough knowledge of biosolids characteristics, policies, procedures, and regulatory compliance
- Enhance the ability of agencies to self-regulate, reducing the need for regulatory oversight

Pilot Biosolids Training Programs in Oregon 1997–98 *cont.*

- Reduce the potential for negative environmental impacts (surface or groundwater contamination, odors)
- Reduce the likelihood of fines or lawsuits
- Save agency training dollars through the creation of one-stop training opportunities
- Develop a qualified applicant pool for agency recruitment efforts

During further discussions of the certification concept with a wider audience, several barriers to mandatory certification in Oregon were encountered:

- Mandatory certification was viewed as an unfunded mandate by some local government officials
- Some wastewater treatment plant managers were concerned that certified employees would demand salary increases
- An agency interested in collecting fees and maintaining a registry of certified individuals was not identified

In view of the benefits associated with formalized training but the baggage associated with mandatory certification, the Oregon ACWA decided to pursue voluntary comprehensive training programs. The first targeted group was entry-level biosolids personnel.

Oregon ACWA decided to pursue voluntary training programs.

Description of pilot training workshops

To reach entry-level biosolids personnel, ACWA decided to offer training over a 2-day period in conjunction with an established wastewater short school. This afforded several benefits. First, operators could receive CEUs and/or college credits for training at the short school. Second, the date and location was well publicized without a special effort just for the biosolids training. Third, the training was located in the Portland metropolitan area, where substantial expertise in biosolids management (potential trainers) is concentrated. Fourth, the short school is designed to be affordable for the smallest wastewater facilities (cost is approximately $40 per day including lunch).

Pilot Biosolids Training Programs in Oregon 1997–98 *cont.*

Pilot biosolids training program designed and presented by the Oregon Association of Clean Water Agencies. Each session is 50 minutes.

Topic	Session title	Activity description	Speaker description
Introduction	Biosolids Jeopardy	Icebreaker; allows presenters the opportunity to assess current participant knowledge on a variety of biosolids management topics.	Fun-loving person with game-show mentality
Introduction	Biosolids management: The big picture	Previews all of the topics covered in the workshop and shows how they fit together. Includes state-specific regulations.	State regulator familiar with facility and site approval process
Biosolids quality (2 sessions)	Meeting EPA Part 503 requirements	Technology options to meet EPA requirements for pathogen reduction and vector attraction reduction. Calculating volatile solids reduction. Case studies demonstrating how small treatment plants are meeting EPA requirements.	Consultant: wastewater treatment/ biosolids processing
Biosolids quality	Record keeping and sampling	Sampling and reporting methods for trace elements and pathogens.	Biosolids manager
Exercise	Case study: biosolids program management	Group activity. A case study for a small treatment facility is presented. Students evaluate the situation and suggest alternatives to improve management.	University or private consultant
Public information	Working with the public and the media	How to inform the public about biosolids and respond to complaints. Working with the media to get your story told.	Biosolids manager or communications specialist
Transportation	Assuring safe transportation and handling of biosolids	Transportation planning and execution, including contracts with trucking firms, alternative transport vehicles, rules of the road, route planning, spill response plans, transportation provider meetings	Transportation coordinator, large municipal facility
Site management	Site planning and calibration	Evaluating potential sites. Measuring buffer areas. Using maps. Required site management practices. Methods of calibrating application equipment.	Biosolids manager, university or private consultant
Site management	Agronomic rates, soil sampling, site monitoring, site logs	Calculating agronomic rates. Recommended protocols for soil sampling and interpreting soil testing data. Site records needed to document agronomic use of biosolids.	University or private consultant
Site management	Farmer viewpoint	Why farmers want biosolids. Crop and land management practices that complement biosolids utilization.	Farmer with experience in utilizing biosolids
Quality assurance	Self-assessment procedures	How facilities can perform self-assessments to verify that their management system meets or exceeds regulatory requirements	Consultant familiar with quality assurance

Pilot Biosolids Training Programs in Oregon 1997–98 *cont.*

ACWA conducted two training workshops at the Clackamas Short School (Portland Metro area) in 1997 and 1998. The 2-day training covered the basics of biosolids quality, transportation, application, site management, monitoring, record keeping and reporting. The curriculum was designed by a planning committee, and then speakers were contacted to cover a portion of the curriculum. Over the 2 days, 8 to 10 speakers presented a total of 12 hours of classroom instruction (see matrix table on previous page). Speakers were recruited from the state regulatory agency, the larger municipal treatment facilities, private consulting firms, and the land-grant university. At the end of the 2-day session, a take-home multiple-choice test was given to those who wanted to obtain a certificate of completion for the training course. Tests were computer-scored at Oregon State University, and certificates of completion sent to those with a score of 70 percent or higher. A test summary sheet with the student's responses and the correct answers for each question also was sent to participants.

Training idea:

Provide a detailed workshop outline to reduce overlap between training sessions.

To assist participants in completing the take-home test, speakers were asked to provide need-to-knows, handout materials for self-study, and test questions for their portion of the training. Most speakers provided handout materials and test questions. A three-ring binder with 150 to 250 pages of handout materials was provided to participants. Need-to-knows and a short summary of recommended practices for each session were more difficult to get from the speakers. Only one or two speakers each year provided the requested one-page list of need-to-knows and recommended management practices.

Evaluation of pilot workshops

Oral and written evaluations of the short school training indicated that the participants were very positive about the training effort. They appreciated the "one-stop shopping" afforded by having a collection of experts present at one location. Many of the participants in the second year of training attended based on recommendations from others at their agency who attended the previous year.

Pilot Biosolids Training Programs in Oregon 1997–98 *cont.*

During the first year of short school training (1997) there was considerable overlap in the subject area covered by speakers. For example, Table 3 of EPA Part 503 appeared in 3 of the 12 presentations. This was not necessarily all bad. Participants indicated that the concepts were sufficiently complex that some repetition was helpful in clarifying points they missed the first time. Overlap between sessions was reduced in 1998 by sending speakers a detailed short school outline well in advance of the training.

Twenty-five participants completing the take-home test in 1998 completed a multiple-choice evaluation included with the test. More than 90 percent of participants said they would recommend the workshop to others at their place of business. About 60 percent of participants indicated that the notebook containing speaker handouts was the most valuable part of the training. Most participants indicated that the workshop approach was the best educational choice for them, rated much higher than distance learning alternatives. Participants indicated a preference for a 2-day workshop, rather than a 1-day event. They strongly supported the time-consuming Biosolids Jeopardy session. Participants wanted more time to practice calculations during the workshop.

Conclusion

The training workshop approach, utilizing locally available resources, is an effective way to improve the quality of biosolids land application programs. The keys to the success of the 2-day training workshops included:

- Development of a comprehensive curriculum
- The opportunity to hold the biosolids training in conjunction with an existing wastewater short school
- Volunteer assistance provided by local experts
- Financial assistance provided by Oregon ACWA

Outlook for a Coordinated National Training Program

Quick summary

This section is designed for state or regional leaders who are thinking about establishing a biosolids training program. We analyze the structure of other professional training and certification programs and suggest a course of future action for biosolids professionals. Several ongoing mandatory and voluntary training/certification programs were investigated, including commercial pesticide applicator licensing, wastewater operator certification, and certified crop advisor certification. We found that the certified crop advisor (CCA) program, coordinated by the American Society of Agronomy, has a basic structure that could be adapted for national voluntary biosolids certification. Suggested short-term EPA-sponsored activities that would assist in coordinating training efforts include a National Training Conference, a Training Resources Center, and support for regional training coordinators. We recommend that biosolids training programs be promoted on the local/regional level in the short term (1 to 3 years), with the long-term goal of establishing voluntary training standards on a national level within the next 5 years.

Strong state and regional leaders are the key to establishing a quality biosolids training program.

Existing professional training and certification programs

We briefly explored several ongoing mandatory and voluntary training/certification programs to learn how other organizations have formalized the training process. The biosolids industry is unique, but the available mechanisms for training/certification are similar across a broad spectrum of technically based occupations/industries. Our brief investigation included the following programs: commercial pesticide applicator licensing, wastewater operator certification, and certified crop advisor certification.

All of the training/certification programs we investigated shared the following characteristics:

- Different levels of training are provided (basic and continuing education)

Outlook for a Coordinated National Training Program *cont.*

- Passing written tests, together with a minimum amount of professional experience, is required for certification or licensing. College education can reduce the need for on-the-job experience. Certification or licensing is sometimes granted on a provisional basis for applicants with no professional experience.
- To maintain certification, approved continuing education activities are required.
- The curriculum is divided up into 4 to 10-plus subtopics or competency areas. For example, for certified crop advisors, competency areas include: soil fertility, soil and water management, integrated pest management, and crop management. This is done to assure a balance in continuing education activities (certified crop advisors) or technical knowledge in a specialty area (wastewater operator certification or pesticide applicator certification).
- Advisory boards representing the regulated community, professional organizations, and state and federal agencies oversee the programs and recommend minimum standards and approve policy changes.

The programs accommodate regional differences due to different operating conditions including climate, infrastructure, and equipment. Pesticide certification and crop advisor certification accommodate a wide range of crop and soil management practices.

Below we describe how each program operates, giving more details on the Certified Crop Advisor Program, since we believe it is the best model for a national biosolids training effort:

Pesticide certification/licensing (mandatory)

- Regulatory requirements: EPA and state
- Testing, fee collection, and licensing: state departments of agriculture
- Education and training: USDA Cooperative Extension Service through land grant university

Outlook for a Coordinated National Training Program *cont.*

Wastewater operator certification (mandatory)

- Regulatory requirements: EPA and state
- Administration, testing, fee collection, and certification: state environmental agency
- Local training: community colleges
- National training materials: Water Environment Federation—including manuals of practice, videos, compact disks, study guides, and student survival guides

Certified crop advisor program (voluntary)

The certified crop advisor (CCA) program is the only voluntary certification program we investigated. The CCA program, begun in 1992, has received over 18,000 applications, with 7,200 individuals meeting all requirements. The program is active in 44 states.

Overall program administration is provided by the American Society of Agronomy, which is responsible for major policy decisions and for maintaining a registry of certified individuals.

Regional program administration is performed by state or regional boards made up of representatives of land grant universities, agribusiness, and state and federal agencies. The state/regional boards approve training events, offer state/regional tests once per year, and maintain records of continuing education credits.

The CCA program relies heavily on volunteers from established industry organizations and government entities. It delegates most of the responsibility for training activities to voluntary state or regional boards. The regional programs are coordinated by volunteers in cooperation with industry associations. The Pacific Northwest crop advisor training is provided annually in conjunction with the Far West Fertilizer and Agri-Chemical Conference in Spokane, WA. Smaller-scale training activities are organized by Extension specialists, Extension agents, or industry technical representatives (pesticide or fertilizer manufacturers/wholesalers).

Training materials for the CCA program have been developed by trainers within each region. There is informal sharing of training materials between trainers and regions, but there is no library of training materials. Trainers utilize Extension publications, their personal professional experience, and published and unpublished results of applied research for handouts, overheads, and slides at training activities. There is no basic training (1 or 2 days) for novice crop advisors. Those testing for certification are expected to have received basic training on the job or at a university or community college. Funding for the trainers (travel expense plus some honorariums) is provided through fees charged to participants in the training activities. Some private companies that market wholesale products to fertilizer dealers subsidize the training sessions.

The CCA program includes a code of ethics, similar to the NBMA Code of Good Practice for biosolids.

A major problem with the CCA program has been in scheduling enough continuing education events to meet the program requirements (40 contact hours over a 2-year period). This is especially true for two of the major training areas: soil and water management and crop management. These subject areas have few commercial training sponsors (pesticide or fertilizer wholesalers).

Short-term goal: Promote training on a local/regional level. Long-term goal: Establish national training standards.

National training program structure—Mandatory or voluntary?

For biosolids training, we recommend a voluntary program with a national organizational structure similar to that of the Certified Crop Advisors program. We recommend that training efforts be promoted on the local/regional level in the short term (1 to 3 years), with the long-term goal of establishing voluntary training standards on a national level within the next 5 years. This recommendation is based on our experience in Oregon with the Clackamas Short School, and our investigation of other training programs. A voluntary program is recommended, rather than a mandatory program, for the following reasons:

Outlook for a Coordinated National Training Program *cont.*

- Voluntary programs are more likely to involve non-regulatory professionals in training and curriculum development.
- Voluntary programs can have higher standards than mandatory programs.
- Voluntary programs have greater state/regional flexibility.
- Existing voluntary programs have much lower operating costs (e.g., certified crop advisors) than mandatory programs (pesticide applicators).
- Voluntary programs aren't opposed by state/local governments as unfunded mandates.

Local/regional training (short-term goal)

The following are suggested activities to precede the establishment of a voluntary national certification program. Financial support would be needed from EPA or another source.

National training conference

A 2–3 day conference could be organized to bring together those with training experience to discuss how to make training happen on a national basis. There already are several forms of biosolids training offered across the country, including programs in Minnesota, Pennsylvania, North Carolina, California, and in the Pacific Northwest. Such a conference could be hosted by a regional biosolids organization (e.g., NBMA) or a national biosolids organization (WEF). This group would provide a logical nucleus for a national training effort. It also might provide inspiration for new state or regional training efforts.

Training resources center

Provide start-up funds for a training resources center to operate from a Web site. The center would assist new states/regions in developing training programs. The center would provide written training resources and individualized consultation to states or regions.

Outlook for a Coordinated National Training Program *cont.*

Regional training coordinator support

Provide start-up funds to support regional training coordinators. Regional training coordinator duties could include:

- Work with established organized agencies to establish training opportunities in state/region.
- Develop state/region specific curriculum components.
- Attend training events and evaluate success in meeting training objectives.
- Coordinate testing of training participants and participant evaluations of training workshop.
- Communicate with national/regional training board.

The most likely source of training coordinators is educators, either at the community college or university level. Start-up funds from EPA could be offered for a period of 2–3 years, with local agencies to assume responsibility at the end of the start-up period.

Structure of a national training effort (long-term goal)

A national board of directors could supervise the overall program, setting minimum standards for voluntary national certification. This national board should include all parties involved in biosolids management, including representatives from:

- United States Environmental Protection Agency (EPA; probably departments)
- Each regional biosolids organization (e.g., Northwest Biosolids Management Association)
- Water Environment Federation (WEF; including regional representation, if desired)
- Association of Metropolitan Sewerage Agencies (AMSA)
- United States Dept. of Agriculture-Natural Resources and Conservation Service (USDA-NRCS)
- USDA-Cooperative State Research Education and Extension Services (USDA-CREES)

Outlook for a Coordinated National Training Program *cont.*

- USDA W-170 Technical Committee
- A state regulatory agency in each region (East, South, North Central, and West)

We envision a training resources center and a national coordinator position to provide leadership for a voluntary national training program.

The training resources center would be initiated and staffed under the supervision of the national board of directors. It would provide training materials to interested states and regions. The national coordinator would be responsible for working with the board of directors, state and regional representatives, and other interested parties to develop and maintain a national training effort. Funding for the national coordinator position would have to be provided on an ongoing basis. The most likely source of such funding is through an established biosolids organization that collects service fees from its members.

Task-oriented committees also are needed to launch the national training effort. Ongoing improvements to the voluntary training program would be accomplished by the national coordinator, in cooperation with the following task-oriented committees:

- **Continuing education committee**. Duties: Oversee national continuing education efforts. Evaluate standards for granting continuing education credits (CEUs) and propose revisions to the national board of directors.
- **Budget committee**. Duties: Determine resources needed to build and sustain the voluntary certification program. Receive and review proposals from regional biosolids organizations (e.g., NBMA) and forward selections to EPA or other sources for funding.
- **Examination committee**. Duties: Responsible for construction and administration of national exam.
- **Publicity committee**. Duties: Arrange for publicizing the voluntary certification program through most effec-

Suggested short-term activities: National Training Conference; Training Resources Center; Support for regional training coordinators.

tive means (possible choices: newsletter, articles in national biosolids publications, Web site, etc.).

Conclusion

We recommend that training efforts be promoted on the local/regional level in the short term (1 to 3 years), with the long-term goal of establishing voluntary training standards on a national level within the next 5 years. The certified crop advisor (CCA) program, coordinated by the American Society of Agronomy, has a basic structure that could be adapted for national voluntary biosolids certification. Short-term support from EPA will assist in bringing together a critical mass of interested parties, and in making training materials available nationally. Suggested short-term EPA-sponsored activities that would assist in reaching the goal of national certification/training include a national training conference, a training resources center, and support for regional training coordinators.