
Contract No. 044-04

Commercial Composting Water Quality Permit Development

Prepared for
**Oregon Department of Environmental Quality
Land Quality and Water Quality Divisions**

May 12, 2004

CH2MHILL



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Executive Summary

The Oregon Department of Environmental Quality (DEQ) is currently in the process of examining and revising the existing rules for the operation of commercial composting facilities. The main purpose for revising these rules is to formulate them in a manner that promotes commercial composting in the state of Oregon while providing adequate protection against the risks specific to the commercial compost industry. This report focuses on the water quality component of the rule revision process and provides recommendations that the Solid Waste and Water Quality programs can use to structure a new general water quality permit for DEQ-regulated commercial compost facilities. This new general water quality permit will cover all of the different water streams that are involved in the composting process (stormwater, compost leachate, and washwater) and will more adequately protect the waters of the state from risks and other issues unique to composting facilities. This is intended as a living document. As comments are received regarding this document, it is expected that they will contribute to the State's effort to improve the general water quality permit.

Depending on the type of compost feedstock and compost method used, water streams associated with commercial compost facilities may contain a variety of pollutants. Without proper controls these pollutants can migrate into the environment and potentially affect human health and the environment. New design criteria, definitions of compost feedstock categories, best management practices (BMPs), and benchmarks are needed to address this potential.

There are a variety of BMPs that can be used to prevent or reduce adverse impacts to waters of the state by managing the quality and quantity of the stormwater, compost leachate, and washwater runoff from the site. Only the BMPs most applicable to the commercial composting operation are included in this report. BMPs in this report have been organized into the same categories as under the existing 1200-Z (with slight modifications to the titles and definitions): containment; oil and grease; waste chemicals and material disposal; erosion, sediment, and debris control; stormwater, compost leachate, and washwater diversion; covering activities; and housekeeping. If technically and economically feasible, each site should employ some type of BMP in each of these BMP categories. Due to the vast difference between site location, types of incoming compost feedstocks, compost facility size, and compost method used, the specific BMPs most applicable to a site will vary. This report includes information on design and operational considerations, cost, and a variety of other effectiveness factors that will help a specific facility determine what BMPs are most applicable. This report is not intended to offer detailed and prescriptive solutions for specific sites.

In addition to BMPs, this report recommends minor changes to the definitions of compost feedstock categories and modifications to the benchmarks for stormwater runoff. Both the compost feedstock definitions and stormwater benchmarks require some revisions to more adequately control the water quality at compost facilities. Benchmarks should be added for some new constituents. The new list of benchmarks should include: total copper, total lead,

total zinc, pH, total suspended solids, total oil and grease, e. Coli, BOD₅, nitrate/nitrite as nitrogen, total phosphorus, floating solids, and oil and grease sheen. These benchmarks were determined based on an evaluation of risks/factors associated with commercial composting operations and a comparison of regulations currently used in other states. In regards to washwater, this report recommends that it be kept separate and contained and therefore the existing limitations in the 1700-A are sufficient. Only minor modifications to the monitoring requirements are recommended.

These new definitions, BMPs, benchmarks and monitoring requirements will more adequately control the water quality at commercial compost facilities. However it is advisable that the new water quality permit acknowledge the ongoing changes in the compost industry and that it be written in a manner that is easy to change as new information regarding technology, BMPs, human health and the environment is available.

Introduction

The state of Oregon, acting by and through its Department of Environmental Quality (DEQ), regulates composting activities through Solid Waste and Water Quality permits. Oregon also regulates Water Quality permits for general and specific industries. Currently, the “General Industrial” Form 1200-Z stormwater permit is used to regulate discharges of stormwater from composting facilities¹. Wastewater permits are used to regulate discharges of compost leachate or washwater from the site. DEQ currently is in the process of examining and revising the existing rules for the operation of commercial composting facilities in Oregon (including water quality requirements) (DEQ, 2004).

1.1 Background

The 1200-Z permit was developed to cover numerous industrial categories. The permit has limitations with regard to the special issues associated with composting facilities. Compost (in its various stages) contains a significant amount of organic material, debris, and nutrients (nitrogen and phosphorus) and potentially can contain metals, pesticide residues and other organic chemicals, and pathogens (Governo, 2003). Historically, stormwater compliance issues have been noted at composting facilities in the areas of bacteria, nutrients, suspended solids, and aesthetic qualities (e.g., color and odor). The 1200-Z benchmarks, which include metals, pH, suspended solids, oil and grease, bacteria (E. Coli), and floating debris or oil, do not provide appropriate coverage for the constituents found in runoff from these facilities. Regulations concerning the management of compost leachate and washwater at composting facilities have similar limitations.

In Oregon, composting operations typically are performed outdoors and potentially involve multiple water streams (stormwater, process stormwater, compost leachate, and washwater). These factors make the separation and control of the various water streams a special challenge. A variety of controls can be applied (and are currently being applied at some facilities). However, the existing rules and requirements do not adequately incorporate all of these controls into the existing permits and their use is generally based on the facility’s willingness to implement these controls on their own without a unified approach such as is described in this document.

These factors increase the risk of potential exposure of pollutants to groundwater and surface water and are driving the need for revised design criteria, definitions of compost feedstock types, best management practices (BMPs), benchmarks, and monitoring requirements.

¹ The 1200-Z permit is used unless the facility drains to the Columbia Slough. If the facility drains to the Columbia Slough the 1200-COLS permits is used. The 1200-COLS permit benchmarks are based on the pollutants of concern in the Columbia Slough and the Columbia Slough total maximum daily load (TMDL) limits.

1.2 Purpose of This Document

This document provides recommendations that the Solid Waste and Water Quality programs can use to structure a new general water quality permit for DEQ-regulated commercial compost facilities. The 1200-Z permit was used as the template, or starting point, for this study. Multiple sources were reviewed to obtain information that could be used in the formation of new BMPs and benchmarks. Existing compost facility stormwater and compost leachate control regulations were reviewed and compared for Oregon, Washington, California, and Maine. Based on these reviews, recommendations for modifications to the 1200-Z were made. The recommendations include BMPs for onsite management or discharge of stormwater, process stormwater, washwater, and compost leachate that are compatible with existing Solid Waste compost permits and recommendations on benchmarks and monitoring procedures.

1.3 Organization of This Document

Report sections subsequent to this introduction are organized as follows:

- **Section 2, Human Health and the Environment.** Evaluates the types of constituents associated with compost and their potential to affect human health and the environment.
- **Section 3, Best Management Practices.** Describes the specific types of BMPs that can be used at compost facilities to control water quality.
- **Section 4, Current Regulations.** Compares compost regulations in Oregon, California, Washington, and Maine.
- **Section 5, Recommendations.** Recommends definitions, BMPs, benchmarks, and monitoring requirements for a new general water quality permit for composting facilities.
- **Section 6, Conclusions.** Summarizes the report results.
- **Section 7, References.** Provides bibliographic information on references consulted during preparation of this report.

SECTION 2

Human Health and the Environment

Compost consists of a variety of different compost feedstocks and associated nutrients, organic and inorganic constituents, and pathogens. The types of constituents associated with compost are dependent on the compost feedstocks used to prepare the compost. Depending on the type of compost feedstocks used, varying potential risks arise. This section evaluates the constituents associated with different compost feedstocks and examines the potential for these constituents to affect human health and the environment.

2.1 Constituents Found in Various Compost Feedstocks

For the purpose of this report, compost feedstocks (in this section) have been separated into three categories: green compost feedstock, green compost feedstock mixed with animal manure, and nongreen compost feedstock. As defined in this section, green compost feedstock includes yard debris, wood waste, and vegetative food waste. Nongreen compost feedstock includes mixed food waste (i.e., animal parts and byproducts). Biosolids are not considered in this report (see Oregon Administrative Rule 340-050 for biosolids rules).

Green compost feedstocks are typically less regulated than nongreen compost feedstocks because they generally pose less of a risk to human health and the environment. Green compost feedstocks can however, have traces of pesticides, herbicides, fungicides, pathogens, wood preservatives (if structural or finished wood products are included in the compost feedstocks), and a variety of nutrients (W&H Pacific, Inc., September 1991). Animal manures can contain nitrate-nitrogen, ammonia, organic acids produced during decomposition, and pathogens. Nongreen compost feedstocks can contain all of the constituents found in green compost feedstocks and manures plus additional pathogens (however they typically have less metals, pesticides, and herbicides than yard debris). Table 2-1 shows some of the sources of pathogenic microorganisms in nongreen compost feedstocks. (NRAES, June 1992)

TABLE 2-1
Summary of Literature Regarding Pathogens and Their Sources

Organism	Mixed Food Waste	Dairy Products	Meat Products	Cattle	Poultry	Fish
<i>Salmonella</i>	X	X	X	X	X	X
<i>Shigella</i>	X	X	X			X
<i>E. Coli</i>	X	X	X	X	X	X
<i>Listeria monocytogenes</i>	X	X		X		
<i>Yersinia enterocolitica</i>	X		X		X	X

TABLE 2-1
Summary of Literature Regarding Pathogens and Their Sources

Organism	Mixed Food Waste	Dairy Products	Meat Products	Cattle	Poultry	Fish
<i>Vibrio cholerae</i>						X
<i>Campylobacter jejuni</i>	X	X	X	X	X	
<i>Staphylococcus aureus</i>	X	X	X	X	X	
Hepatitis A virus	X	X	X			
Norwalk virus group	X					X
<i>Cryptosporidium parvum</i>				X		
<i>Giardia lamblia</i>	X	X			X	
<i>Mycobacterium paratuberculosis</i>				X		
<i>Streptococcus</i>	X	X	X			X
<i>Vibrio</i>						X

Notes: Adapted from (Tetra Tech, Inc./E&A Environmental Consultants, Inc., August 2001). Literature search included: live animals, animal products and in some cases manure.

2.2 Constituents Altered in the Composting Process

Although there are multiple potential pollutants associated with composting operations, most are only found as trace concentrations of the compost feedstocks or compost. In addition, many of these pollutants are actually reduced or eliminated in the composting process. The key to determining the potential for adversely impacting human health or the environment is to determine what constituents are present in the various stages of the composting process and what constituents are actually migrating from these materials.

2.2.1 Organic Chemicals and Pathogens

Composting by definition is the managed process of controlled biological decomposition of organic or mixed solid waste. As such, the composting process is very effective in reducing pathogens and breaking down other organic chemicals. Various studies have proven that temperatures reached during the Process to Further Reduce Pathogens (PFRP) stage of composting (provided that temperatures exceeding 55°C [131°F] are reached and maintained throughout the mass of material that is being composted for a given amount of time) effectively destroy both human and plant pathogens, and invasive weed seeds (in green and nongreen compost feedstocks) (Governo et al., October 2003; Tetra Tech, Inc./E&A Environmental Consultants, Inc., August 2001; and W&H Pacific, Inc., September 1991). However, studies have also shown that regrowth of bacterial pathogens is a potential concern. Bacteria such as *Salmonella spp.* and Fecal coliform can rapidly reproduce under the proper conditions (appropriate moisture, presence of food, lack of competitive organisms).

Most of the studies that have been performed to evaluate regrowth of pathogens in compost have been focused on biosolids. However, one recent study in the State of Oregon focused on food waste. Although these studies have shown that both *Salmonella spp.* and Fecal coliforms can regrow in compost, the competition between various organisms (including pathogens) for the available food source (primarily carbon) becomes greater as the composting process progresses. During the curing stage, as the product becomes more stable, the carbon becomes more scarce and the pathogens are less able to survive. Based on this information, properly processed compost should not contain pathogens at concentrations of significant concern to human health or the environment (Governo et al., 2003; Tetra Tech Inc., 2002; and Tetra Tech, Inc./E&A Environmental Consultants, Inc., 2001).

Composting has also been shown to reduce or eliminate pesticide and herbicide residues. Although some pesticide residues (chlorinated hydrocarbons) and herbicide residues (the pyridine carboxylic group) are not affected by the composting process (Governo et al., October 2003), studies have shown (see below) that they are generally only detected in compost at levels that are not harmful to human health and the environment. Additionally, banning the acceptance of treated wood into the compost facility will also help control the concentrations of these pesticide and herbicide residues.

In a study conducted by Portland Metro between 1988 and 1993, yard debris compost samples were analyzed for a variety of chlorophenoxy herbicides, chlorinated hydrocarbons, organophosphates, and a few other miscellaneous organic constituents. Of the nine chlorophenoxy herbicides tested, only two were detected (2,4-dichlorophenoxyacetic acid and pentachlorophenol). Six of the ten chlorinated hydrocarbons that were analyzed were detected (chlordane, aldrin, toxaphene, dieldrin, dichlorodiphenyldichloroethylene (DDE), and p.p. dichlorodiphenyltrichloroethane (DDT)). Only one organophosphate was detected from the group of four that were analyzed (dursban). Two of the five miscellaneous compounds that were tested for were detected (trifluralin and casoron). Most of the detections were either below reporting limits but above instrument detection limits or at concentrations that were not harmful to human health or the environment. The compounds that were most frequently present were chlordane (ranging from nondetect to 0.49 ppm) and pentachlorophenol (ranging from nondetect to 0.53 ppm), which are both most commonly associated with treated wood for rot and termite control (Chlordane is also associated with insect dusts for roses and other plants).

Similar results were found in the Puget Sound area during the same period in the City of Seattle in 1992. Chlordane and DDT variants were found at levels generally considered background levels in the environment. They were also below the FDA Action Levels for removal of edible foodstuffs being sold to the public for consumption (per federal regulation 40 CFR 180.34(f)). After several years of review by the Washington State Department of Agriculture Organic Certification Program, green feedstock compost that originated from urban curbside collection programs was certified for use in organic food production. (State of Washington Department of Agriculture, April 1998)

These and other studies on pesticides in composting have concluded that although several pesticides can be detected in composts, concentrations are low and pesticide residues do not appear to be a concern to human health or the environment (Governo et al., October 2003; and W&H Pacific, Inc., September 1991). Furthermore, banning the acceptance of treated

wood into the compost facility will help keep concentrations of pesticide and herbicide residues to a minimum.

Some studies also show that composting may facilitate the breakdown of hormones and antibiotics (also known as endocrine disrupters) in the environment (Governo et al., October 2003).

2.2.2 Nutrients

During the composting process, nutrient (nitrogen and phosphorus) concentrations are also changed. Depending on the type of compost feedstocks used, the composting process used, and the climate, reductions in nutrient concentrations can vary. Studies have shown a reduction of total nitrogen up to 42 percent (in beef feedlot compost). Nitrogen is primarily lost to the atmosphere (due to the release of ammonia) or through leaching. Reductions in phosphorus are typically much less (2 percent in beef feedlot manure). Phosphorus is lost primarily through leaching and runoff. (Governo et al., 2003)

2.3 Migration Pathways

Constituents associated with compost can migrate into the environment in a variety of ways. This report focuses on migration pathways to surface water or groundwater. Pollutants can migrate to surface water via runoff from the compost site which may be composed of single streams or mixtures of stormwater, process stormwater, compost leachate, or washwater. Pollutants can migrate to groundwater via infiltration of contaminated stormwater, process stormwater, compost leachate, or washwater. Most of the studies that have been done to evaluate the presence of compost related constituents in these water streams have focused either on the compost leachate or runoff streams. These studies are discussed in additional details in the following sections.

The following definitions describe the meaning of each water stream, as used in this report.

Stormwater - Stormwater is the precipitation that falls on the compost site but does not come into contact with the compost itself.

Process Stormwater - Process stormwater is the precipitation that falls on the compost site and contacts the compost (without flowing through the mass of the compost). An example of this would be stormwater that runs off the surface of a pile or comes into contact with compost that has strayed from the pile.

Compost Leachate - Compost leachate is the liquid that percolates through the compost pile and that contains extracted, dissolved, or suspended material from the pile.

Washwater - Washwater is water that is generated in the process of washing vehicles and equipment.

Runon - Runon is water that enters the site during storms.

Runoff - Runoff is water that can be composed of mixtures of stormwater, process stormwater, compost leachate, or washwater and that leaves the site.

2.3.1 Compost Leachate

A variety of factors affect the nutrient or other constituent concentrations in compost leachate (compost feedstock type, compost method, carbon to nitrogen [C:N] ratio, climate, decomposition rate, and stability of compost). Based on these factors, compost leachate can potentially have high concentrations of organic compounds, nutrients, and salts (E&A Environmental Consultants, Inc., January 2000). One of the primary concerns with compost leachate is the infiltration of nitrate into the groundwater. Studies have shown that composting of high-nutrient compost feedstocks (e.g., manure) to transform them into less soluble forms, can result in elevated nitrates in groundwater near the subject facility. A number of studies have been performed on the compost leachate generated at different types of composting facilities. Table 2-2 shows reported concentrations of nutrients in the compost leachate of two different compost feedstocks. As shown in the table, compost leachate composition can be extremely variable. These results demonstrate that the nutrient-rich manure compost had the greatest concentrations of nutrients in its compost leachate stream. Of all the nutrients that were tested, nitrate-nitrogen was found in the greatest concentrations.

TABLE 2-2
Reported Concentrations of Nutrients in Compost Leachate

Compost Feedstock Type	Total Nitrogen (N) (mg/L)	Ammonia-Nitrogen (NH ₄ -N) (mg/L)	Nitrate-Nitrogen (NO ₃ -N) (mg/L)	Total Phosphorus (P) (mg/L)	Ortho-Phosphorus (Ortho-P) (mg/L)
Yard Debris ^a	NA	5.1-10.5	3.6-5.8	NA	NA
Yard Debris (average of 16 samples) ^b	NA	0.44	0.96	0.07	NA
Manure ^c	NA	0.58-34.3	1.84-120	NA	17.0-26.0
Manure ^d	57	NA	8	9	NA

Notes:

- The site was on a clay pad. Compost leachate was collected below the windrow. No specific mention of additional BMPs. (Governo et. al, October 2003)
- No specific mention of composting method used, additional BMPs, or whether compost leachate was from the raw compost feedstocks, composting piles, or finished piles. (EPA, May 1994)
- The site was on a geomembrane over soil. No specific mention of composting method used, additional BMPs, or whether compost leachate was from the raw compost feedstocks, composting piles, or finished piles. (Governo et. al, October 2003)
- The site was on a concrete paving stone. No specific mention of composting method used, additional BMPs, or whether compost leachate was from the raw compost feedstocks, composting piles, or finished piles. (Governo et. al, October 2003)

Table 2-3 shows reported concentrations of compost leachate from a leaf composting facility in Croton Point, New York. Concentrations are compared with the benchmarks from the 1200-Z and 1200-COLS NPDES Permits. Benchmarks are not available for all of the constituents. Lead, phosphorus, and biochemical oxygen demand (BOD) all exceeded the 1200-COLS benchmarks. No constituents exceeded the 1200-Z benchmarks.

TABLE 2-3
Reported Concentrations of Various Constituents in Compost Leachate from a Leaf Composting Facility

Constituent	Yard Trimmings (Leaf Composting) Average (mg/L)	1200-Z Benchmarks (mg/L)	1200-COLS Benchmarks (mg/L)
Aluminum (Al)	0.33	NA	NA
Iron (Fe)	0.57	NA	NA
Lead (Pb)	0.01	0.4	0.006
Potassium (K)	2.70	NA	NA
Zinc (Zn)	0.11	0.6	0.24
Phosphorus (P)	0.07	NA	0.016
Phenols (total)	0.18	NA	NA
Biochemical Oxygen Demand (BOD ₅)	>41 ^a	NA	33
Chemical Oxygen Demand (COD)	56	NA	NA
pH	7.8 S.U.	5.5-9.0 S.U.	6.5-8.5 S.U.

Notes:

The study didn't discuss whether BMPs were used or properly maintained. (EPA, May 1994)

a. Includes 3 samples above detection limit of 150 mg/L

NA = not available

Table 2-4 shows concentrations of Salmonella and Fecal coliform in the compost leachate from two different composting methods at two different times of the year to represent different precipitation levels (Period 1 ran from November to March and Period 2 ran from March to June). Compost feedstocks used in this study consisted of a combination of commercial mixed food waste, chicken offal, sheep heads (only used in Period 2), dairy manure, yard debris, sawdust (only used in Period 1), and sawdust/shredded yard debris (only used in Period 2).

In Period 1, Salmonella concentrations were consistent the entire time compost leachate was collected (process weeks 2 to 8) for both composting methods. Fecal coliform followed similar trends (increased in week 4, decreased midway through, and then increased at the end) in both composting methods, but it was found in concentrations that were one to two orders of magnitude higher in the passively aerated windrow. In Period 2, compost leachate was only present during process weeks 2 through 5. During Period 2 salmonella was detected in similar concentrations in both composting methods. Fecal coliform showed a steady decrease in process weeks 4 and 5 in the turned windrow and a steady increase in those same weeks in the passively aerated windrow. Fecal coliform was one to four orders of magnitude higher in the turned windrow method. There is not a clear indication for the difference in performance between the two periods. The obvious differences between the

two periods are the greater level of precipitation in Period 1 and the differences in compost feedstock used for both periods.

No pathogen discharge standards exist for compost leachate. Based on a comparison with the Willamette River Basin Water Quality Standards (OAR 340-041-0445) for bacteria in freshwaters and estuarine waters, one Fecal coliform sample from Period 1 and three Fecal coliform samples from Period 2 exceeded the 406 MPN/100mL value for E. Coli organisms. Although these standards are not directly applicable to Fecal coliform (E. Coli is a subset of Fecal coliform), it is clear that this compost leachate would require some treatment for pathogens.

TABLE 2-4
Reported Concentrations of Pathogens in Food Waste Compost Leachate

Date	Turned Windrow		Passively Aerated Windrow	
	Salmonella (MPN/100ml)	Fecal coliform (MPN/100ml)	Salmonella (MPN/100ml)	Fecal coliform (MPN/100ml)
Period 1 (November to March Scenario)				
December 13, 2001 (process week 2)	<0.3	<0.3	<0.3	<0.3
December 27, 2001 (process week 4)	<0.3	4.3	<0.3	110
January 03, 2002 (process week 5)	<0.3	4.3	<0.3	46
January 10, 2002 (process week 6)	<0.3	2.3	<0.3	0.36
January 17, 2002 (process week 7)	<0.3	0.91	<0.3	290
January 24, 2002 (process week 8)	<0.3	24	<0.3	1,100
Period 2 (March to June Scenario)				
March 28, 2002 (process week 2)	0.23	50,000	0.14	<0.02
April 11, 2002 (process week 4)	0.02	900	0.60	3
April 18, 2002 (process week 5)	<0.20	300	0.08	90

TABLE 2-4
Reported Concentrations of Pathogens in Food Waste Compost Leachate

Date	Turned Windrow		Passively Aerated Windrow	
	Salmonella (MPN/100ml)	Fecal coliform (MPN/100ml)	Salmonella (MPN/100ml)	Fecal coliform (MPN/100ml)
April 25 to May 9, 2002 (process week 6-8)	N/A	N/A	N/A	N/A

Note: The Willamette River Basin Water Quality Standards (ORS 340-041-0445) for bacteria state that freshwaters and estuarine waters shall not exceed: (i) A 30-day log mean of 126 E. Coli organisms per 100 ml, based on a minimum of five (5) samples; (ii) No single sample shall exceed 406 E. Coli organisms per 100 ml. It is important to note that while the Clean Water Act names total and Fecal coliform as pollutants, they are not necessarily disease causing organisms, but are used as indicators to show fecal material might be present. It is also important to note that the widely reported E. Coli 0157:H7 has not been associated with compost products but has been associated with un-composted cattle manure in some cases of fruit and meat contamination.

Table adapted from: (Tetra Tech Inc., 2002)

N/A = Not Applicable

2.3.2 Runoff

Similarly to compost leachate, the quality of runoff is dependent on a variety of factors (e.g., compost feedstock type, compost method, age of compost, stability of compost, site controls, and climate). Runoff can be composed of mixtures of stormwater, process stormwater, compost leachate, or washwater that leaves the site. As such, the quality of the runoff can vary greatly depending on the site controls (for separation of water streams) that are present at the facility. One of the major concerns with runoff is the introduction of excess nutrients and high oxygen demand to surface waters. Table 2-5 shows the reported concentrations of various nutrients in runoff from three different types of facilities. The compost that used manure as a compost feedstock had the highest concentrations of nutrients. Out of all the constituents, ammonia-nitrogen was detected in the highest concentrations from all three types of compost. However, high concentrations of the other nutrients were also detected. Based on the concern associated with the introduction of nutrients and high oxygen demand into surface waters and the fact that ammonia is an unstable intermediate (and therefore not a reliable constituent to monitor), it may be very beneficial to monitor nitrate/nitrite as nitrogen, phosphorus, and BOD₅.

TABLE 2-5
Reported Concentrations of Nutrients in Runoff

Compost Feedstock Type	Total Nitrogen (N) (mg/L)	Ammonia-Nitrogen (NH ₄ -N) (mg/L)	Nitrate-Nitrogen (NO ₃ -N) (mg/L)	Total Phosphorus (P) (mg/L)	Ortho-Phosphorus (Ortho-P) (mg/L)
Yard Debris ^a	NA	9.6	6.6	NA	NA
Food waste ^b	NA	0.43-9.4	0-0.28	NA	0.05-0.33
Manure ^c	NA	2.1-37	0.11-6.7	NA	7.37-27.8
Manure ^d	100	NA	NA	50	NA

Notes:

- a. The site was on a sloped clay pad. No specific mention of additional BMPs. (Governo et. al, October 2003)
b. The site was on a sloped soil pad. No specific mention of additional BMPs. (Governo et. al, October 2003)
c. The site was on a geomembrane. No specific mention of additional BMPs. (Governo et. al, October 2003)
d. The site was located over gravel and plastic. No specific mention of additional BMPs. (Governo et. al, October 2003)
NA = not available

In addition to nutrients, runoff can also contain a variety of other constituents. Table 2-6 shows the range of concentrations that were detected from the runoff of four different types of facilities (a large yard debris and food waste composter, a medium yard debris facility, a manure and brush facility, and a manure facility). These concentrations are compared to benchmarks for the 1200-Z and 1200-COLS permits. For many of the constituents, no benchmark exists. All constituents that have benchmark values, exceeded at least one of the standards. Most of these constituents are present in the runoff at concentrations that could potentially degrade water quality if they were allowed to migrate offsite.

TABLE 2-6
Reported Range of Concentrations of Various Constituents in Runoff

Constituent	Mixed Facilities* (Ranges mg/L unless noted)	1200-Z Benchmarks (mg/L)	1200-COLS Benchmarks (mg/L)
Ammonia	32-1,600	NA	NA
Biochemical Oxygen Demand (BOD ₅)	20-3,200	NA	33
Chloride	52-2,100	NA	NA
Color	1,000-70,000 color units	NA	NA
Conductivity	887-16,500	NA	NA
Copper (total)	0.033-0.82	0.1	0.036
E. coli	200-2.4x10 ⁷ MPN/100mL as Fecal coliform, not E. coli	406 MPN/100mL	406 MPN/100mL
Nitrate+nitrite N	0-8	NA	NA
Ortho Phosphate	0-90	NA	NA
pH	6.7-9.5	NA	NA
Phosphorus (total)	4-170	NA	0.16
Potassium	170-4,600	NA	NA
Total Kjeldahl Nitrogen (TKN)	14-3,000	NA	NA
Total Suspended Solids (TSS)	1,100-20,000	NA	NA
Zinc (total)	0.1-1.5	0.6	0.24

Notes:

The type of BMPs that may have been used at these facilities is unknown. It was not reported in this study. Concentrations were reported as a range and therefore cannot be isolated to specific facility types. (E&A Environmental Consultants, Inc., July 1998)

*Mixed facilities = large yard debris and mixed food waste, food waste composter, medium yard debris facility, manure and brush facility, and manure facility.

NA = not available

2.3.3 Stormwater

In theory, stormwater should have the lowest concentrations of potential pollutants, as compared to compost leachate and runoff. However, there is the potential that the stormwater of the site may contact portions of the site or equipment that may be contaminated with pollutants from the site (process stormwater). Table 2-7 shows multiple years of stormwater data collected from an Oregon composter operating outdoors in an area of 37.07 inches of annual rainfall (using green compost feedstocks) (Oregon Climate Service, 2004). These samples were collected at catch basins which receive runoff from asphalt surfaces on their property. These results are compared with both the 1200-Z and 1200-COLS

benchmarks. Based on these data, the 1200-Z benchmarks are frequently exceeded for TSS and E. Coli. The 1200-COLS benchmarks are frequently exceeded for TSS, copper, lead, zinc, E. Coli, total phosphorus, and BOD.

TABLE 2-7
Stormwater Data from an Oregon Green Compost Feedstock Facility

Date Sampled	pH (S.U)	TSS (mg/L)	O&G (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)	E. Coli (counts/100mL)	Total P (mg/L)	BOD ₅ (mg/L)
December 13, 2000	8.2	34	3.6	0.023	0.022	0.050	NT	NT	39
November 28, 2001	6.5	650	ND	0.056	0.14	0.39	400,000	4.6	120
December 13, 2001	8	240	5.9	0.065	0.21	0.39	960	0.76	5.0
December 13, 2001	6.5	260	4.9	0.072	0.40	0.38	960	1.0	940
March 19, 2002	8.0	18	ND	ND	0.030	ND	12	0.99	4.0
March 19, 2002	6.6	530	4.9	0.097	0.31	0.42	>2,400	1.3	18
December 11, 2002	6.7	500	ND	0.058	0.02	0.47	>16,000	0.57	67
March 6, 2003	7.2	520	ND	0.062	0.15	0.34	>16,000	2.1	32
April 23, 2003	5.3	5,000	23	0.450	0.53	2.4	>240,000	250.00	250
<i>1200-COLS Benchmarks</i>	<i>6.5-8.5</i>	<i>50</i>	<i>10</i>	<i>0.036</i>	<i>0.006</i>	<i>0.24</i>	<i>406</i>	<i>0.16</i>	<i>33</i>
<i>1200-Z Benchmarks</i>	<i>5.9-9.0</i>	<i>130</i>	<i>10</i>	<i>0.1</i>	<i>0.4</i>	<i>0.6</i>	<i>406</i>	<i>N/A</i>	<i>N/A</i>

Notes: This green compost feedstock facility takes in the following compost feedstocks: uncompacted and compacted yard debris and wood waste (no manure). They employ catch basin filters and frequent machine sweeping of impervious surfaces to reduce sediment runoff.

Source of data: (Oregon DEQ, 2004)

TSS = Total Suspended Solids

O&G = Oil and Grease

P = Phosphorus

BOD₅ = Biochemical Oxygen Demand

ND = Not Detected

NT = Not Tested

N/A = Not Applicable

2.4 Summary

Compost potentially contains a variety of pollutants, from organic material/debris and nutrients to metals and pathogens (depending on the type of compost feedstocks and the compost method used). Compost leachate, runoff, and stormwater potentially have high concentrations of nutrients, metals, salts, organic constituents, and pathogens. Without proper controls, these constituents can migrate into the environment and potentially affect human health and the environment. New design criteria, definitions of compost feedstock types, BMPs, and benchmarks are needed to address this potential issue.

SECTION 3

Best Management Practices

BMPs are practices, procedures, or structural controls that can be used to prevent or reduce adverse impacts to waters of the state by managing the quantity and quality of the stormwater, compost leachate, and washwater runoff from the site. BMPs can be either engineered and constructed systems or institutional, education or pollution prevention practices. BMPs typically have design components, operational components, or both. Design components of BMPs address physical improvements and equipment that can control, treat, or protect water quality. Operational components of BMPs address the operation and maintenance of the improvements and equipment.

The following text summarizes the BMPs that are most applicable for controlling water quality from composting facilities. If technically and economically feasible, one or more of each of the following best management practice categories should be employed at the site. The BMPs in this section are primarily of the engineered/constructed type. There are also other types of controls such as Spill Prevention and Response Procedures, Preventative Maintenance, and Employee Education that should also be a part of controlling water quality at composting facilities. These additional procedures are adequately addressed in the 1200-Z permit under the Site Controls section in Schedule A of the 1200-Z permit and are a recommended addition to the new water quality permit.

3.1 Types of Best Management Practices

The BMPs addressed in this report have been organized into the same categories of BMPs that are included in the current 1200-Z permit: Containment, Oil and Grease, Waste Chemical and Material Disposal, Erosion and Sediment Control, Debris Control, Stormwater Diversion, Covering Activities, and Housekeeping. Each category is briefly described below. Additional details on the BMP options are included in Table 3-1 (located at the end of Section 3, starting on page 29).

This report is presented as a performance approach and is not intended to offer prescriptive solutions for specific facilities or locations or to provide detailed design information on these BMPs. There are a multitude of literature and other resources (see the resources used to compile the BMP information) available that can be consulted for detailed information.

3.1.1 Containment

Currently, the requirement for Containment is to store hazardous substances (as defined in the Federal Register, 40 CFR Part 302) within berms or other secondary containment devices, or in areas not draining to the stormwater system. Compost operations do not generally involve large quantities of hazardous substances. The main type of containment applicable in composting operations is the primary containment of compost feedstock areas, process areas, and finished product areas. These areas can benefit from containment in order to limit the degree of mixing between stormwater, process stormwater, compost

leachate, and washwater and to ultimately limit runoff. These types of containment are addressed under stormwater diversion and covering. There are not any BMPs that are specific to secondary containment of compost facilities. The recommendation for this category is to leave as is.

3.1.2 Oil and Grease

Currently the requirement for the Oil and Grease BMP is to utilize oil/water separators, booms, skimmers, etc. to eliminate or minimize oil and grease discharges to stormwater. These requirements are also applicable to compost facilities as they stand. The recommendation for this category is to leave as is, oil/water separators are recommended for use at compost facilities.

3.1.3 Waste Chemicals and Material Disposal

This BMP category currently requires that all waste chemicals and materials are properly recycled or disposed in a manner that eliminates or minimizes exposure to stormwater. This includes the appropriate storage of waste chemicals. Lubricants, fuel, waste oil, antifreeze, batteries, old oil filters, and old vehicle parts are all sources of chemicals at compost facilities that may fall under this category. These requirements are sufficient and there are no recommended changes for this category.

3.1.4 Erosion and Sediment Control and Debris Control

The BMP categories of Erosion and Sediment Control and Debris Control are very similar. The Erosion and Sediment Control category requires employing some type of erosion control to minimize soil erosion. In addition to this, Erosion and Sediment Control and Debris Control require that methods to limit sediment loads and other debris in stormwater discharges are employed. Both of these BMP categories are directly applicable to compost operations. Due to the magnitude of organic and other debris that are associated with composting, particular attention to these categories will be needed. The recommendation for this category is to leave as is, except to combine into one category called, Erosion, Sediment, and Debris Control. BMP options include:

- Grading Facility Areas
- Appropriate Site Vegetation
- Graveling or Paving
- Sediment Basins or Traps
- Bioswales or Grassy Swales
- Soil Filter
- Wetland
- Holding Pond or Detention Facility
- Sediment/Debris Control with Compost Filter Berms, Wattles, Bales, or Fences
- Sediment/Debris Control with Centrifugal Devices, Weirs, or Baffles
- Granular Filtration Tanks
- Soil and Plant Systems
- Chemical Treatment
- Coagulation and Sedimentation
- Aeration and Ozonation

- Underground Injection with Pretreatment

3.1.5 Stormwater Diversion

This BMP category currently requires that stormwater is diverted from certain areas including: fueling, manufacturing, treatment, storage, and disposal areas. The goal is to prevent exposure of stormwater to potential pollutants. Stormwater Diversion is extremely applicable to compost operations. However, compost facilities have multiple water streams that need to be addressed including: stormwater (nonprocess) runoff, process stormwater runoff (stormwater that has contacted the compost material), compost leachate, and washwater. They also have additional areas that can benefit from diversion including: compost feedstock areas, active composting and curing areas, and finished product areas. The terms manufacturing and treatment areas are not applicable to composting. It is recommended that this BMP category be renamed as stormwater, compost leachate, and washwater diversion and that it be expanded to include methods of preventing stormwater runoff, commingling of water streams, and site water runoff and that the areas mentioned for stormwater diversion are more applicable to compost facilities. BMP options include:

- Grading Facility Areas
- Paving
- Diversion with containment barriers, curbing, berms, or gutters
- Liner systems
- Collection and Reuse of Stormwater or Compost Leachate
- Minimize Runoff by Practicing Specific Operating Procedures

Due to the different requirements that are associated with the discharge of washwater to waters of the State (see Appendix B, 1700-A), particular attention should be given to keep washwater separate and contained from all other onsite water streams. The Oregon DEQ has a list of BMPs specific to keeping washwater separate and contained (*Oregon DEQ Recommended Best Management Practices for Washing Activities*, March 1998). This guidance should be consulted. If possible washing should be performed on a wash pad and should be discharged to the sanitary sewer. If a sanitary sewer is not available washwater may need pretreatment in order for it to meet the discharge limitations set forth in the 1700-A permit. If onsite water streams are allowed to contact washwater, all commingled streams should be subject to the limitations set forth in the 1700-A. If washwater is kept segregated, only the washwater should be subject to these limitations and all other streams should only be required to meet the benchmarks set forth in the new water quality permit.

3.1.6 Covering Activities

This BMP currently requires that certain areas are covered including: fueling, manufacturing, treatment, storage, and disposal areas. The goal is to limit/prevent exposure of stormwater to potential pollutants. This is directly applicable to composting operations; however, the areas should be modified to include fueling, storage (oil, gas, and chemicals), compost feedstock areas, active composting areas, curing areas, and finished product areas that have the potential to discharge to waters of the State, with preferential consideration of compost feedstock areas and younger piles. Options include:

- Roof Structures

- Membranes, Tarps, or Covers
- Indoor Operations

3.1.7 Housekeeping

This BMP currently requires that all areas that may potentially contribute pollutants to stormwater are kept clean. This includes, sweeping, prompt spill/leak repair, and prompt maintenance of vehicles. In order to make this representative of compost operations, housekeeping should also include keeping the area between piles free of debris. Options include:

- Elimination of Standing Surface Water
- Prompt Processing of Incoming Compost Feedstocks
- Shaping of Piles

Table 3-1 (which can be found at the end of this section starting on page 29) includes the description, intended use, and operational and design considerations associated with each of the BMPs listed above.

As shown in Table 3-1, the majority of BMPs for compost facilities fall in either the category of Erosion, Sediment, and Debris Control or Stormwater, Compost Leachate, and Washwater Diversion. This is due to the nature of compost operations which involves water-borne debris and potentially multiple water streams. Based on these characteristics, compost facilities should first try to focus on prevention of stormwater contamination and then on treatment. In general, controls should be in place so that water is not allowed to run onto the site and water that falls on the site is not allowed to combine with other water streams. Water that has been allowed to contact compost feedstocks, partially processed materials, or finished compost should not be allowed to run off site without proper treatment. Operating practices should also be in place which can help to minimize the amount of runoff generated by a site. Appendix A shows the results from a study that found that runoff can be reduced by 90 percent by using particular operational techniques.

3.2 Regional Climate Differences in Best Management Practices

Regional climate differences are significant in Oregon. Wet climate facilities in some ways have more of a challenge during the winter months when stormwater flows are relatively continuous over a period of several months. Yet, this does not mean this is the only challenge. Dry weather climates may find more value in storing and reusing water (BMP 9 and BMP 20), and in the use of berms, wattles, bales, and fences (BMP 10). However, that being said, each of these BMPs must be designed for the expected stormwater runoff intensity and facility surface and slope. Wet weather climates have a broader choice of wetland and soil & plant systems alternatives (BMP 8 and BMP 13). In some cases a roof structure (BMP 22) in wet climate areas can minimize costs and reduce the need for other treatment BMPs.

3.3 Economic Cost Assessment

Factors that affect the relative value of each BMP include scale, permit tier, climatic zone, seasonality, working surface, availability of roof or other weather protection, compost feedstocks, and compost method used. Scale is certainly significant, not so much in terms of mass or volume capacity, but according to surface area exposed to the weather. A 50 acre facility with 25 tons per day capacity can cause more harm to the environment than a 20 acre facility with 100 tons per day capacity.

An economic cost assessment was performed for these BMP options. This cost assessment is intended for strategic planning purposes. It is not specific to any single composting method or technology. It is also not specific to any specific climate or geographic area. The most common unit of measure across all methods and climate zones is surface area. Acres are used in this report to draw comparative results.

The estimate was prepared in accordance with the guidelines of the AACE (the Association for the Advancement of Cost Engineering) International. According to the definitions of AACE International, there are different classes of estimates. This report uses an approach that is similar to a Class 5 Estimate. A Class 5 Estimate is generally prepared based on limited information, where little more than the proposed industry, its setting or location, and the capacity are known. For strategic planning purposes, such as but not limited to market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, long-range capital planning, etc. the typical expected accuracy range for this class estimate are -20% to -50% on the low side and +30% to +100% on the high side.

Costs have been assigned to land requirements, capital costs, and operating costs. Costs are expressed on a "per acre" basis to allow comparison of the practices. The methods used, the sales pattern, and the seasonal nature of each composter's business can affect the throughput rate of any given site. For example turned windrow facilities (using 7 foot high windrows) may require twice the land that a static windrow facility (using 14 foot high windrows) might use. Over the last five years significant developments have occurred with regard to methods or technology choices. The list of methods includes but it not limited to turned windrow, static pile, membranes systems, and aerated static pile systems.

Estimated conceptual costs are shown in Table 3-2.

3.3.1 BMP 1—Oil/water separator

This involves purchase, preparation of site, and installation of a precast vault, manhole, or tank to retain floating emulsions of non water-soluble liquids (and solids). The retention is intended to allow capture and removal of oil and grease from vehicle washing, parking, or maintenance areas. In general it is assumed that washing, parking, and maintenance can be co-located and can be served by one trap. For this cost assessment it is assumed the device is a precast concrete vault. Sediment is usually also captured incidentally with this type of device. The floating emulsion and solids removed on a quarterly basis from this basin must be exported from the facility for proper disposal. No monthly maintenance is assumed. A service life of a minimum of 10 years is assumed for the precast concrete vault.

3.3.2 BMP 2—Grading Facility Areas

This involves earthwork cut, fill, import, export, and final grading to insure the working surfaces are smooth enough to allow machinery operation without irregularities that might cause material spillage from loader buckets or puddling or ponding of stormwater. It is assumed the site is relatively flat and only minimal grading is required. For this cost assessment it is assumed that a ten acre site requires 3,000 cubic yards of imported material to repair localized unsuitable soil conditions (for example, a clay lense or pocket of organic material). This BMP includes the cost of grading and compaction, but not the installation of pavement or a similar wearing surface. No demolition, clearing, or grubbing is assumed. Repair or regrade site annually (or as needed) to maintain optimal slope and grade integrity.

3.3.3 BMP 3—Appropriate Site Vegetation

Appropriate site vegetation includes protection of buffer areas from erosion caused by wind, rain, and vehicular traffic (minimum width of 10 feet). Costs are assumed for general soil amendment, hydroseeding, and irrigation to insure survival. Perimeter treatment may range from 10 to 50 feet in width. No costs for special buffer treatment, trees, or other plantings are included in this BMP cost assessment.

3.3.4 BMP 4—Graveling or Paving

Graveling is lowest cost treatment under this BMP. It involves the application of 4 inches (assumed) of crushed rock, that is placed and compacted. Pavement can be designed a number of ways. Three are described herein. One involves the structural stabilization of the subgrade with cement, plus a 4" layer of class B asphalt wearing course. Alternatively this could be crushed rock subgrade with 6-8" inches of asphalt treated base or class B asphalt, or 8-10" inches of reinforced Portland cement concrete pavement. In all cases the subgrade is assumed already graded. The cost of these treatments varies from as little as \$2.00 per sq ft to as much as \$6.00 per sq ft. A median value was used for this cost assessment. It includes replacement or repair of surfaces annually and a service life for pavement of no less than 10 years. Graveling costs less to install (assumed at \$.70 per sq ft) but substantially increases the annual operating costs (assumed to require full replacement of a five year period). For this cost assessment a median value was assumed for pavement (not graveling) and no annual costs.

3.3.5 BMP 5—Sediment Basins or Traps

This involves purchase, preparation of the site, and installation of a catchment at the low point of a graded site to allow stormwater to collect and be retained. The retention is intended to allow settleable solids and potentially floating solids to be captured and removed from the drainage system. For this cost assessment, it is assumed the catchment is designed as a pit or well that can be cleaned with a wheel loader, vactor truck, or septic tank pump truck. The pit is constructed of cast-in-place concrete and includes at least one partition to allow settling, an overflow and manual gravity drain. For example, a ten acre facility might generate 1200 cubic feet of runoff if the rainfall enters the pit at 1" of rain in 30 minutes. Five minutes of settling would require 200 cubic feet of volume. This represents a water volume of 3 feet x 8 feet x 8 feet in the pit. The solids removed on a quarterly basis from this basin are assumed to be recirculated into the compost feedstock of the facility for

composting. Other monthly maintenance, repair, and inspection is assumed to average 2 person-hours per month. The service life of the concrete catchment is no less than 10 years.

3.3.6 BMP 6—Bioswale or Grassy Swales

Bioswales or grassy swales are assumed to be equal in cost. Costs are assumed to be equivalent to estimates made in 2001 in Washington State for residential infiltration basins. This cost assessment assumes construction with engineered drawings, soils investigation, excavation, liner, overflow structure, spillway, seeding, access road, and observation wells. It is assumed each acre would require 1,870 sq ft of bioswale. Annual operating costs are assumed to be ten percent of the initial cost.

3.3.7 BMP 7—Soil Filter

Soil filters and mounds are assumed to be similar to Bioswales but involve slightly more complexity and depth of construction. Many of the same elements are present. The relative size per acre is assumed to be the same as bioswales for this cost assessment. The construction costs are assumed to be slightly higher than bioswales (due to more elaborate excavation, backfill, and liner material) and the annual costs are assumed to be ten percent of the initial cost.

3.3.8 BMP 8—Wetland

Wetlands or wet detention ponds are assumed to be equal in cost. Costs are assumed to be equivalent to estimates made in 2001 in Washington State for residential wet detention ponds. This cost assessment assumes construction with engineered drawings, excavation, liner, overflow structure, spillway, seeding, and access road. It is assumed each acre would require 1,960 sq ft of wetland. Annual costs are assumed to be ten percent of the initial cost.

3.3.9 BMP 9—Holding Pond or Detention Facility

Holding ponds are assumed to be sized at 1 million gallons per 3 acres of facility. In a western Oregon climate this might retain and reuse 10 to 40 percent of the total wet weather runoff in a yearly cycle. Holding ponds are assumed to have surface aeration to prevent nuisance odors. It would also include a pump to retrieve stored water for re-use, and a hydraulic overflow to protect the integrity of the pond in high water events. The cost assessment also includes excavation of site, installation of liner, periodic inspection and repair, and regular removal of sediment and debris from the holding pond.

3.3.10 BMP 10—Sediment Control Using Compost Filter Berms, Wattles, Bales, or Fences

Short term sediment control is assumed to cover 200 lineal feet, which is equivalent to one side of a one acre square, or two 100 foot lengths forming the lower corner of the topography. The measures are considered temporary with a service life of 4 months.

3.3.11 BMP 11—Sediment/Debris Control Using Centrifugal Devices, Weirs, or Baffles

This BMP assumes a precast centrifugal device that captures floating debris and sediment. The cost assessment includes purchase, preparation of the site, and installation of the precast centrifugal device. It also assumes two programmed cleanouts per year. The service life of these devices is assumed to be a minimum of 10 years.

3.3.12 BMP 12—Granular Filtration Tanks

This BMP assumes a wet pond to accumulate and equalize flow into the device. The device is assumed to be a precast vault with 260 cubic yards of sand media. The cost assessment includes purchase, preparation of the site and installation of the precast vault. The device is assumed to serve 2.5 acres of compost facility, which is equivalent to 10 acres of residential development. Annual operating costs are assumed to be fifteen percent of capital costs to service and replace filtration media. The service life of these devices is assumed to be a minimum of 10 years.

3.3.13 BMP 13—Soil and Plant Systems

This BMP assumes the upper eight inches of soil are amended and that the 4 inches below the amended region are broken up and loosened so that the upper 12 inches (the 8 inches of amended soil plus the 4 inches of scarified soil) is uncompacted. The plantings are assumed to preserve the permeability and regenerative qualities of the soil and plant system. Planting costs are assumed at \$5,000 per acre. Annual costs are only for selected plant replacement and addition of mulch and organic matter to the surface every three years, at five percent of the capital cost per year.

3.3.14 BMP 14—Chemical Treatment

Chemical treatment is assumed to involve a precast dosing chamber and dosing systems. Capital costs include purchase, preparation of the site, and installation of the precast chamber, tanks, pumps and controls. Chemical consumption is part of the operating costs. The overall operating costs are assumed to be \$0.025 per gallon. Each acre is assumed to produce one million gallons of runoff per year. Any capital costs for chambers and dosing equipment is assumed to be provided by the chemical treatment vendor and charged on a per-gallon basis. Service life is assumed to be a minimum of 10 years.

3.3.15 BMP 15—Coagulation and Sedimentation

This BMP is similar to chemical treatment except that more tankage and water storage or detention is assumed necessary since it may require multiple and sequential steps. The overall operating costs are assumed to be \$0.035 per gallon. Each acre is assumed to produce one million gallons of runoff per year. Any capital costs for chambers and dosing equipment is assumed to be provided by the chemical treatment vendor and charged on a per-gallon basis. Service life is assumed to be a minimum of 10 years.

3.3.16 BMP 16—Aeration and Ozonation

This BMP is assumed to require less storage but more aeration equipment than holding ponds or detention facilities (BMP 9). The overall storage is assumed to be 500,000 gallons

per 3 acres of facility. The operating costs are assumed to be equal to storage even though the water volume is half as much. This means the horsepower input per gallon is twice the rate for simple holding and detention ponds.

3.3.17 BMP 17—Underground Injection

This is assumed to be similar to infiltration or groundwater recharge systems (more details in Table 3-1, BMP 17). No pretreatment for sediment and solids removal is assumed in this cost. The cost is based on similar costs for residential infiltration systems. Pretreatment for solids and sediment are in addition to costs for this BMP. Annual maintenance would be for periodic sediment removal (residual solids that deposit in the basin) and for vegetation repair and mowing.

3.3.18 BMP 18—Diversion with Containment Barriers, Curbs, Berms, or Gutters

This BMP assumes a 200 foot by 10 foot wide gutter along one side of a one acre area. The gutter would include the forming and installation of a concrete flow line and either concrete or grassy swale side slopes. The average installed cost is assumed to be \$12 per square foot. Annual maintenance would be for periodic sediment removal (residual solids that deposit in the gutter) and/or for vegetation repair and mowing.

3.3.19 BMP 19—Liner Systems

This BMP assumes a 40 mil liner in the subgrade at \$0.60 per sq ft. Installation, bedding (i.e. sand), and top protection are also assumed at \$0.60 per sq ft. No annual maintenance is assumed. Service life is assumed to be a minimum of 10 years.

3.3.20 BMP 20—Collection and Reuse of Stormwater, Compost Leachate, or Washwater

No costs calculated for this BMP. See costs associated with BMPs 5 through 9. A combination of these BMPs will be required to implement this BMP.

3.3.21 BMP 21—Minimize Runoff by Practicing Specific Operating Procedures

No costs calculated for this BMP.

3.3.22 BMP 22—Roof Structure

This BMP assumes a pole structure and associated pavement underneath. The roof has a gutter and downspout system but no walls. The structure is assumed to be a pole-type post and beam or post and truss arrangement. The roof is assumed to be galvanized or enameled sheet metal. The downspout system includes a gravity collection line that is assumed to be discharged away from and separately from other contaminated runoff. Annual costs are assumed at one percent of capital cost to facilitate simple maintenance and repair. Service life is assumed to be a minimum of 10 years.

3.3.23 BMP 23—Membrane, Tarp, or Cover System

This BMP assumes a simple \$2.00 per square foot membrane cost. The service life is assumed to be 3 years. The range of costs may vary widely due to the range of materials,

vendors, and technologies. \$2.00 is assumed to be a relatively simple system with relative low costs. The cost is expressed on a per-acre basis for consistency although it would actually be less since the cover would only be used for the piles themselves. Operating costs are assumed to be relatively high due to weather (wind and frost damage) and machinery (pulling from machinery) stress.

3.3.24 BMP 24—Indoor Operations

This BMP assumes \$70 per square foot for complete enclosure. The cost is assumed to include pavement. It is assumed to be \$35 per square foot for the structure and \$35 per square foot for ventilation, fire protection, lighting, and other appurtenances. Annual costs are assumed at one percent of capital cost to facilitate simple maintenance and repair. Service life is assumed to be a minimum of 10 years.

3.3.25 BMP 25—Elimination of Standing Surface Water

This has no capital costs. Annual operating costs are assumed to be 5 hours at \$95 per hour per acre per year for machinery and labor.

3.3.26 BMP 26—Prompt Processing of Incoming Feedstocks

No extra costs are associated with this BMP. Management skills are required to maintain this BMP.

3.3.27 BMP 27—Shaping of Piles

This has no capital costs. Annual operating costs are assumed for just the area being used for product storage (no the entire facility acreage). Annual costs are assumed to be 20 hours at \$95 per hour per acre per year for machinery and labor.

TABLE 3-2
Costs Associated with BMPs

BMP Number	BMP Name	Capital Cost (\$/acre)	Operating Cost (\$/acre per year)
1	Oil Water Separator	\$8,700	\$1,400
2	Grading Facility Areas	\$11,200	\$3,000
3	Appropriate Site Vegetation	\$13,700	\$1,400
4	Graveling or Paving	\$174,200	\$0***
5	Sediment Basins or Traps	\$52,300	\$1,600
6	Bioswale or Grassy Swales	\$26,400	\$2,600
7	Soil Filter	\$30,000	\$3,000
8	Wetland	\$28,800	\$2,900
9	Holding Pond or Detention Facility	\$238,100	\$11,900
10	Sediment Control with Compost Filter Berms,	\$1,600	\$4,800

TABLE 3-2
Costs Associated with BMPs

BMP Number	BMP Name	Capital Cost (\$/acre)	Operating Cost (\$/acre per year)
	Wattles, Bales, or Fences		
11	Sediment Control with Centrifugal Devices, Weirs, or Baffles	\$ 13,100	\$ 800
12	Granular Filtration Tanks	\$ 16,125	\$ 2,400
13	Soil and Plant Systems	\$ 26,300	\$1,300
14	Chemical Treatment	\$187,000	\$187,000
15	Coagulation and Sedimentation	\$261,800	\$261,800
16	Aeration and Ozonation	\$119,000	\$11,900
17	Underground Injection with Pretreatment (pretreatment not included in this cost)	\$35,200	\$ 6,400
18	Diversion with Containment Barriers, Curbing, Berms, or Gutter	\$24,000	\$6,400
19	Liner Systems	\$52,300	\$0
20	Collection and Reuse of Stormwater, Compost Leachate, or Washwater	See BMPs 5-9	NA
21	Minimize Runoff by Practicing Specific Operating Procedures	NA	NA
22	Roof Structure	\$479,200	\$4,800
23	Membrane, Tarp, or Cover	Up to \$87,100	\$29,000
24	Indoor Operations	\$ 3,049,000	\$30,500
25	Elimination of Standing Surface Water	\$0	\$500
26	Prompt Processing of Incoming Compost Feedstocks	\$0	\$0
27	Shaping of Finished Product Piles	\$0	\$1,900

Note: Costs assuming that the minimum facility size is 3 acres and that the maximum facility size is 100 acres.

3.4 Ranking of BMPs

If technically and economically feasible, each site should employ some type of each of the BMP categories described in Section 3.1. Due to the vast differences between site location, types of incoming compost feedstocks, compost operation size, and method of composting used, the specific BMPs most applicable to a site will vary. In order to help a site determine which BMP is most applicable, each of the BMPs shown in Table 3-1 have been ranked based on the following categories: space efficiency, odor control, cost, level of complexity,

number of benchmark constituents potentially controlled, beneficial for E. Coli, lead, and nitrate control. The results of this ranking are shown in Table 3-3. Each of these ranking categories are briefly discussed below.

3.4.1 Space Efficiency

This ranking is based on the amount of real property that might be devoted to the BMP. Low means low efficiency, or that the BMP requires substantial space or land. High means high efficiency, or that the BMP is highly space efficient and can be implemented in a relatively small space (small percentage of the overall site).

3.4.2 Odor Control

This ranking is based on the BMP's potential to prevent, capture, remove, or otherwise control odors. Yes means the BMP has some potential benefit. *N/A* means the BMP is not applicable and there is likely no relationship between the subject BMP and odor control.

3.4.3 Cost

Cost is a ranking that weighs capital cost and annual costs proportionately. The weighing is comprised of the sum of capital cost x 1 and the annual cost x 10. Then the BMPs were grouped arbitrarily into three groups. The threshold for low cost was approximately computed as $60 \times (\text{cap cost} / 1000 + \text{annual cost} / 100)$. Any BMP below this threshold received a low cost ranking. Threshold for high cost was approximately computed as $600 \times (\text{cap cost} / 1000 + \text{annual cost} / 100)$. Any BMP above this threshold received a high cost ranking. The values between the two thresholds received a medium ranking. Estimated conceptual costs for each BMP are shown on Table 3-2 in the report.

3.4.4 Level of Complexity

Level of complexity is a ranking that approximates the risk of design, construction, or operation problems. Generally more sophisticated practices and those that are subject to more precise construction and more regular or detailed maintenance are judged more complex. High means more complex and therefore more sensitive to design, construction, and/or operational problems. Low means less complex and more robust with regard to these same potential problems.

3.4.5 Number of Benchmark Constituents Potentially Controlled

This ranking shows the approximate number of stormwater pollutant constituents that might be controlled by this BMP. This is only a guide and it is hypothetical. It is not a predictor of any specific system or facility design. There are a total of twelve benchmarks proposed for composting facilities. The number of constituents shown for each BMP were identified based on information provided on Table 3-1 in the report. The twelve benchmarks are shown on Table 5-3 of the report.

3.4.6 Beneficial for E. Coli, Lead, and Nitrate Control

This ranking shows how each BMP might control these three constituents. These three constituents are selected because they represent key benchmarks and common challenges for composting facilities. A good preliminary design concept will provide some control of

these three constituents. After these have been addressed the full list of twelve can be reviewed in final design. Yes means all three constituents might be controlled by this BMP. N/A means the BMP is not applicable. EC means E. Coli. Pb means total lead (not TCLP method). NO₃ means nitrate.

Table 3-3
BMP ranking matrix

BMP Number	BMP (By Type)	Space Efficiency	Odor Control	Cost ¹	Level of Complexity	Number of Benchmark Constituents Controlled ²	E. Coli, Lead, and Nitrate Control (EC Pb NO3)
Oil and Grease							
1	Oil Water Separator	HIGH	N/A	LOW	LOW	7	Pb ONLY
Erosion, Sediment Control, and Debris Control							
2	Grading Facility Areas	N/A	YES	LOW	LOW	5	N/A
3	Appropriate Site Vegetation	MED	N/A	LOW	MED	5	YES
4	Graveling or Paving	N/A	YES	MED	LOW	5	N/A
5	Sediment Basins, or Traps	HIGH	YES	MED	LOW	5	YES
6	Bioswale or Grassy Swale	LOW	YES	LOW	MED	12	YES
7	Soil filter	MED	YES	LOW	MED	12	YES
8	Wetland	LOW	YES	LOW	MED	12	YES
9	Holding pond or detention facility	LOW	N/A	MED	MED	4	Pb NO3 ONLY
10	Sediment Control with Compost Filter Berms, Wattles, Bales, or Fences	MED	YES	LOW	HIGH	5	Pb ONLY
11	Sediment Control with Centrifugal Devices, Weirs, or Baffles	HIGH	YES	LOW	MED	5	Pb ONLY
12	Granular Filtration Tanks	HIGH	YES	LOW	HIGH	12	EC Pb ONLY
13	Soil and Plant Systems	MED	YES	LOW	HIGH	12	YES
14	Chemical Treatment	LOW	YES	HIGH	HIGH	12	YES
15	Coagulation and Sedimentation	LOW	N/A	HIGH	HIGH	12	YES
16	Aeration and Ozonation	LOW	YES	HIGH	MED	12	N/A
17	Underground Injection with Pretreatment	LOW	YES	HIGH	HIGH	9	N/A
Stormwater and Composte Leachate Diversion							
2	Grading Facility Areas	N/A	YES	LOW	LOW	5	N/A
3	Paving	N/A	YES	MED	LOW	5	N/A
18	Diversion with Containment Barriers, Curbing, Berms, Gutters	HIGH	YES	HIGH	LOW	5	N/A
19	Liner systems	N/A	N/A	MED	LOW	5	N/A
20	Collection and Reuse of Stormwater, Compost Leachate, or Washwater	LOW	N/A	MED	HIGH	12	N/A
21	Minimize Runoff by Practicing Specific Operating Procedures	N/A	YES	LOW	LOW	12	YES
Covering Activities							
22	Roof Structure	HIGH	YES	MED	LOW	12	YES
23	Membrane, Tarp, or Cover	HIGH	YES	MED	MED	12	YES
24	Indoor Operations	HIGH	YES	HIGH	HIGH	12	YES
Housekeeping							
25	Elimination of Standing Surface Water	N/A	YES	LOW	LOW	8	YES
26	Prompt Processing of Incoming Compost Feedstocks	N/A	YES	LOW	LOW	4	N/A
27	Shaping of Piles	HIGH	YES	LOW	LOW	6	YES

Notes:

1. See Table 3-2, Costs Associated with BMPs for details on cost. For ranking, cost is computed as capital cost/1000 + operating cost/100 and cost breakpoints are at 60 and 600.
2. See Table 3-1 for the list of specific constituents controlled and Table 5-2 for the list of benchmark constituents.

<p>TABLE 3-1 Best Management Practices</p>	
<p>BMP BY CATEGORY</p>	
<p>BMP Description and Design Purpose</p>	<p>Design and Operational Considerations</p>
<p>CONTAINMENT No recommended changes, refer to requirements in 1200-Z.</p>	
<p>OIL AND GREASE</p>	
<p>BMP – 1 Oil/Water Separator</p>	
<p>BMP Description: Oil/water separators are multi-chambered devices that can be used to remove hydrocarbons from various water streams. For composting operations these devices are most applicable for use with washwater from vehicle washing areas and stormwater from shops or parking lots. Oil/water separators may not be needed for all compost sites if other treatment methods (e.g., bioswales) are effective at removing pollutants. If not, a separator may be needed to meet benchmarks.</p> <p>Design Purpose: Removal of oil and grease, oil sheen, floating solids, and trace metals. Does not remove dissolved substances.</p> <p>Source: http://www.deq.state.id.us/water/stormwater_catalog/doc_bmp52.asp</p>	<p>Design Considerations: Provide pavement. Ensure grading is sufficient to separate water associated with activities such as equipment washing, vehicle service, or truck parking from other water streams on the site and direct water from these areas to the oil/water separator.</p> <p>Operational Considerations: Repair the area annually (or as needed) to maintain sufficient separation of “oily” water from “non-oily” water and for proper operation of the device. Washwater can contain oil, grease, sediments and other fluids. These harmful contaminants can migrate into stormwater drains after rainfall from areas where vehicles or equipment are stored and/or maintained outside. Use biodegradable detergents that contain no phosphates. Wash vehicles in designated areas that are diked and graded so that wash water will flow into a treatment facility. Recycle and/or reuse washwater if possible.</p>
<p>WASTE CHEMICAL AND MATERIAL DISPOSAL No recommended changes, refer to requirements in 1200-Z.</p>	
<p>EROSION, SEDIMENT, AND DEBRIS CONTROL</p>	
<p>BMP – 2 Grading Facility Areas</p>	
<p>BMP Description: Grading of select portions of the site (focusing on areas that may collect/contact potentially contaminated water) can facilitate proper drainage and efficient composting and help prevent soil erosion. Standing water on working surfaces is the leading cause of stormwater contamination and pavement deterioration and can create odor problems.</p> <p>Design Purpose: Prevention of soil erosion and prevention of standing water or puddles. Puddling often leads to pavement failures and mud accumulation.</p> <p>Source: U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003 Natural Resource, Agriculture, and Engineering</p>	<p>Design Considerations: Typically the slope should be a minimum of 2 percent, except for cement concrete which can be sloped as low as 1 percent. Optimally 3 to 4 percent is best to prevent puddling and mud accumulation.</p> <p>Operational Considerations: Re-grade and repair the site annually (or as needed) to maintain the optimal slope and grade integrity</p>

TABLE 3-1 Best Management Practices	
BMP BY CATEGORY	
BMP Description and Design Purpose	Design and Operational Considerations
Service (NRAES) Cooperative Extension. June 1992. On-Farm Composting Handbook. NRAES-54.	
EROSION, SEDIMENT CONTROL, AND DEBRIS CONTROL (continued)	
BMP- 3 Appropriate Site Vegetation	
<p>BMP Description: Preservation of natural vegetation provides buffer zones and stabilized areas that help control erosion, protects water quality, and enhances site aesthetics. Natural vegetation should be retained as much as possible during construction. After construction, other exposed surface areas should be re-vegetated (as applicable). Buffer zones also provide an important visual buffer for facilities (minimum width of 10 feet).</p> <p>Design Purpose: Stabilization of soil and protection of water quality. Prevention of runoff to the facility and prevention of uncontrolled runoff.</p> <p>Source: U.S. Environmental Protection Agency (EPA). August 1999. <i>Preliminary Data Summary of Urban Stormwater Best Management Practices</i>. EPA-821-R-99-012 and http://www.deq.state.id.us/water/stormwater_catalog/doc_bmp03.asp</p>	<p>Design Considerations: Retain existing vegetation (as much as possible) during the construction of a site.</p> <p>Operational Considerations: Re-seed and mulch exposed surface areas (as applicable and as necessary). Maintain an effective visual screen on the facility perimeter.</p>
BMP- 4 Graveling or Paving	
<p>BMP Description: Compact surfaces work best for the portion of the site used for active composting (the composting pad). Poorly structured soils should be supplemented with compacted sand, or gravel. This area does not have to be paved (for most composting applications). However it should have moderately-to-well drained soils to avoid water retention and surface deterioration due to repetitive motion. The need for well drained or paved surfaces will vary according to the soil types, intensity of activity, compost feedstocks used, and the associated risk of pathogen release. The surface must maintain the grading and drainage of the site and be able to withstand repetitive vehicle loads in wet weather conditions.</p> <p>Design Purpose: Prevention of ponding or puddling of water, erosion from runoff, and muddy conditions. Rough surfaces contribute to compost spillage from material handling. This then contributes to mud accumulation and water accumulation. Wet surfaces often</p>	<p>Design Considerations: Design for the frequency and maximum induced stress caused by the largest material handling equipment used. Design for the compost feedstocks in the permit for the facility. Design to avoid rutting, hole formation, puddling, and mud accumulation. Although more expensive and more effective (due to less deterioration and pot-holing), paved surfaces help minimize ponding of water, erosion from runoff, and muddy conditions. Muddy conditions can create serious operational problems and are a particular problem for compost operations located in wet regions of the state (i.e. Western Oregon).</p> <p>Operational Considerations: Replace and/or repair surfaces every 10 years during dry weather (if sub-grade is prepared correctly the pavement should last for 10 years).</p>

TABLE 3-1
Best Management Practices

BMP BY CATEGORY

BMP Description and Design Purpose	Design and Operational Considerations
<p>deteriorate more quickly (can be rutted or develop holes) under heavy traffic.</p> <p>Source: Natural Resource, Agriculture, and Engineering Service (NRAES) Cooperative Extension. June 1992. On-Farm Composting Handbook. NRAES-54.</p>	

EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)

BMP- 5 Sediment Basins or Traps

BMP Description:	Design Considerations:
<p>Sediment basins or traps are flow devices located at points where one or more surface runoff flows converge at a common point. These flow devices are used to collect, trap, and store sediment produced by site activities, and as a flow detention facility for reducing peak runoff rates. Sediment basins can be designed to maintain a permanent pool or to drain completely dry. Either way, the basin detains sediment-laden runoff long enough to allow most of the sediment to settle out and be removed.</p> <p>Because composting includes a significant amount of incidental mineral soil (silts and sand) in the mixture, sediment is typically found on traffic areas and compost spillage from material handling activities. Mature compost also has a specific gravity of more than one which means it will settle and become sediment as well when stormwater is flowing across facility surfaces.</p> <p>Design Purpose: Removal of sediment, suspended solids, and trace metals from runoff flows</p> <p>Source: http://www.deq.state.id.us/water/stormwater_catalog/doc_bmp27.asp</p>	<p>Sediment basins or traps should be sized for the maximum runoff rate. Additionally, they should be designed for convenient and regular clean-out or removal of the sediment (typically front end loaders or excavators are used at compost facilities to remove sediment from these devices). The design should also incorporate an overflow or other device to prevent sediment from being washed downstream. A manual or automatic drain helps de-water or drain any retained water.</p> <p>Sediment can be processed as a compost feedstock if it does not cause contamination of the finished compost. Otherwise disposal at an appropriate and permitted facility is recommended.</p> <p>Operational Considerations: These devices must be regularly maintained. If sediment is not removed it will be washed downstream of the device.</p>

BMP- 6 Bioswale or Grassy Swales

BMP Description:	Design Considerations:
<p>Bioswales or grassy swales are broad, shallow, vegetated channels designed to slowly convey stormwater runoff, and in the process trap pollutants, promote infiltration and reduce flow velocities.</p> <p>Grassy swales can be either wet or dry. However, dry swales are used in areas where standing water is not desired, and therefore are more applicable to compost operations than wet swales.</p> <p>A Bioswale is responsible for moving stormwater runoff as slowly as possible along a slight decline of soil and plants. Suspended solids have a chance to settle into the soil.</p>	<p>As a general rule, the total surface area of the swale should be approximately 1% of the total drainage area and the soils at the site must support a dense growth of vegetation. Vegetated swales work best when used for pretreatment or when used in combination with other BMPs. If the site has significant erosion problems, some type of pre-settling device will be needed.</p> <p>Generally, the criteria for Biofiltration swales are:</p> <ul style="list-style-type: none"> • Length should be at least 200 ft. • Trapezoidal cross section. • Maximum bottom width of 10 feet.

TABLE 3-1
Best Management Practices

BMP BY CATEGORY

BMP Description and Design Purpose	Design and Operational Considerations
<p>Most of the pollutants from the water stay in the Bioswale which is good for containment purposes and the reduction of chemicals into the larger waterways.</p> <p>Design Purpose: Removal of BOD, nutrients, sediment, suspended solids, trace metals, bacteria, oil sheen, TDS and flow control.</p> <p>Source: U.S. Environmental Protection Agency (EPA). August 1999. <i>Preliminary Data Summary of Urban Stormwater Best Management Practices</i>. EPA-821-R-99-012 and http://www.deq.state.id.us/water/stormwater_catalog/doc_bmp03.asp and http://www.deq.state.id.us/water/stormwater_catalog/doc_bmp38.asp www.wsdot.wa.gov/.../Stormshed/Eastern%20Wa%20Intermediate/StormSHED%20(EW)%20Inter.%20Bioswale.DOC</p>	<ul style="list-style-type: none"> • Maximum depth of 4 inches for 6 month flow. • Must be able to convey 100 year event with 1 foot of freeboard. • Travel Velocity must be 1 fps or less. • Mannings “n” value should be 0.20. <p>Operational Considerations: Inspect bioswales periodically, especially after periods of heavy runoff. Remove sediments, fertilize, and reseed as necessary. Be careful to avoid introducing fertilizer to receiving waters or groundwater. Sediment removal can be done by removal and replacement of the plants and root zone in intermittent strips, or other suitable practice. Removal should be directly after wet weather season to allow the surface to re-establish.</p> <p>Remove and replace accumulated soil and vegetation if necessary.</p> <p>Replace plants and vegetation whenever necessary.</p> <p>Monitor discharge for suspended solids and bioswale washout.</p>
EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)	
BMP- 7 Soil Filter	
<p>BMP Description: Soil filters are filters that are designed to remove sediment and other potential pollutants as runoff travels through the soil. This can be designed for discharge to groundwater or surface water or both. Oxygen inside the soil filter aerates the water stream and fuels the microbes that break down pollutants. This BMP is not recommended where high sediment loads are expected, unless pretreatment (e.g., bioswale or sedimentation) is provided. There are two types of soil filters: sand filters and mounds. Mounds have more surface area for air infiltration and are therefore more applicable to composting operations. They also can be used in areas of high groundwater where soil infiltration is not adequate or reliable.</p> <p>Mounds are small hills of soil and gravel. Water is pumped intermittently into the top of the mound, allowing for dry periods. This makes oxygen plentiful for removal of Biochemical Oxygen Demand (BOD), sediment and the first step of nitrogen treatment. Phosphorus removal depends on sand chemistry.</p> <p>Design Purpose: Removal of floating debris, BOD, nutrients, some sediment, suspended solids, metals, bacteria, oil sheen, and TDS.</p>	<p>Design Considerations: Mound systems are designed to overcome site restrictions such as surface water discharges, slow or fast permeability soils, shallow soil cover over creviced or porous bedrock, and a high water table.</p> <p>The three components of a mound system are a pretreatment unit(s), dosing chamber, and the elevated mound. A pretreatment unit is used to remove solids from the water. The dosing chamber uses pressure to evenly distribute the wastewater over the infiltration surface of the mound. The mound is made up of a soil cover that can support vegetation and a fabric-covered coarse gravel aggregate in which a network of small diameter perforated pipe is placed. The network of perforated pipe is designed to distribute the effluent evenly through the gravel from where it trickles down to the sand media and hence, into the pavement or plowed basal area (natural soil) below. Treatment occurs through physical, biological, and chemical means as the wastewater filters down through the sand and the natural soil.</p> <p>Sand filtration trenches are used for smaller drainage areas than sand filtration basins. A typical use of a trench is along the perimeter of a pavement area. To improve the effectiveness of sand filtration basins and to protect the media from clogging, basins should be located off-line from the primary conveyance/detention system and must be preceded by a pretreatment solids removal system. Smaller filters, such as a sand filtration trench at the edge of pavement can be</p>

TABLE 3-1
Best Management Practices

BMP BY CATEGORY

BMP Description and Design Purpose	Design and Operational Considerations
<p>Source: http://agnr.osu.edu/ohioswcs/Education/soil_Resource.pdf and http://www.waterrecycling.com/soilfilt.htm http://www.septic-info.com/doc/display/1.html</p>	<p>installed on-line.</p> <p>Because of the potential for clogging, sand filtration BMPs should never be used as sediment basins during construction.</p> <p>Operational Considerations:</p> <p>In general, the maintenance required for mounds is minimal. Possible problems that can occur in a mound system include:</p> <ul style="list-style-type: none"> • Ponding in the absorption area of the mound; • Seepage out of the side or toe of the mound; • Spongy area developing on the side, top, or toe of the mound; and • Clogging of the distribution system. <p>The solids pretreatment system and dosing chamber should be checked for sludge and scum buildup and pumped as needed to avoid carryover of solids into the mound. The dosing chamber, pump, and floats should be checked annually and replaced or repaired as necessary. In addition, electrical parts and conduits must be checked for corrosion.</p> <p>A routine O&M schedule should be developed and followed for any mound system.</p> <p>Trenches and basins must also be checked annually for solids accumulation. Solids must be removed and any repair to piping and vegetation should occur during dry weather.</p>

EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)

BMP- 8 Wetland

<p>BMP Description:</p> <p>Wetlands are essentially land areas that have extended high water tables that incorporate physical, biological, and chemical methods for beneficial treatment of water streams. Both natural and constructed wetlands are used to remove potential pollutants from water streams.</p> <p>A constructed wetland is a designed and man-made complex of saturated substrates, emergent and submergent vegetation, animal life, and water that simulates natural wetlands for human use and benefits.</p> <p>Design Purpose:</p> <p>Removal of BOD, nutrients, sediment, suspended solids, metals, bacteria, and TDS. Wetlands can be designed to remove oil sheen and floating solids as well.</p> <p>Source:</p> <p>Oregon Department of Environmental Quality.</p>	<p>Design Considerations:</p> <p>Wetlands are suitable for sites as large as 100 acres.</p> <p>Short circuiting can be limited by designing a long, narrow, and irregular shaped wetland (preferably multi-cell). Clay loams, silty clay loams, sandy clays, silty clays and clays are the best soil types for wetlands.</p> <p>The better the design, the easier it is to manage a constructed wetland. Wastewater varies according to: the composting method used; compost feedstock; amounts, timing, and intensity of rainfall; frequency of solids removal; relationship of solids removal to timing of rainfall, etc.</p> <p>The two most important considerations in wetland design are solids removal from wastewater and total water budget. It is also important to keep the design simple. Design the system for minimal maintenance, to use gravity flow, and to fit in with the landscape. The design should also include provisions for extremes in weather and climate, such as floods and drought.</p> <p>Operational Considerations:</p> <p>Wetlands must be properly maintained. Maintenance includes</p>
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<p>TABLE 3-1 Best Management Practices</p>	
<p>BMP BY CATEGORY</p>	
<p>BMP Description and Design Purpose</p>	<p>Design and Operational Considerations</p>
<p>February 2004. Best Management Practices for Stormwater Discharge Associated with Construction Activities. Soil Conservation Service. August 1991. Constructed Wetland for Agricultural Treatment, Technical Requirements.</p> <p><i>Constructed Wetlands for Wastewater Treatment: Municipal, Industrial and Agricultural</i>, 1989, D.A. Hammer, ed. Lewis Publishers, Inc. Chelsea, Michigan.</p> <p>http://ohioline.osu.edu/a-fact/0005.html</p> <p>http://www.extension.umn.edu/distribution/naturalresources/DD7671.html</p>	<p>removal of dead vegetation (that release nutrients) prior to the winter wet season, debris removal from trash racks (coarse inlet screens that capture wood and litter), and sediment monitoring. Vegetation removal can be done by removal and replacement of the plants and root zone in intermittent strips, or other suitable practice. Removal should be directly after wet weather season to allow the surface to re-establish.</p> <p>All the routine operation and maintenance practices suggested for any onsite treatment system apply to wetlands. Constructed wetlands require more maintenance than conventional septic-tank-drainfield systems. The system may require quarterly to yearly maintenance. Maintenance includes inspecting all components and cleaning and repairing the system when needed. Plants should be inspected and, if a good stand does not exist, replanted (consider introducing a different species mix).</p>
<p>EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)</p>	
<p>BMP- 9 Holding Ponds or Detention Facility</p>	
<p>BMP Description: A holding pond or detention facility is an earthen basin that is used to temporarily store stormwater runoff and other water for later use or disposal and to keep this water from being released to surface water. Due to the frequent need for water in composting operations holding ponds are often used for storing make-up water.</p> <p>Design Purpose: Removal of BOD, suspended solids and to prevent the discharge of runoff to surface water.</p> <p>Source: Natural Resource, Agriculture, and Engineering Service (NRAES) Cooperative Extension. June 1992. On-Farm Composting Handbook. NRAES-54.</p> <p>http://www.wrd.state.or.us/publication/overview99/manage.html?dam+safety#first_hit</p> <p>http://www.wrd.state.or.us/MuniWaterSafety/index.shtml</p>	<p>Design Considerations: Structural integrity and hydraulic overflow should comply with Oregon Water Resources Department Dam Safety Rules for large facilities.</p> <p>Liner system should comply with Oregon DEQ Composting Rules.</p> <p>Aeration and debris control systems should be included to prevent nuisance odors and remove film plastic or other debris.).</p> <p>Operational Considerations: The overflow and surface condition of the impoundment should be maintained.</p> <p>Aerate and remove debris (film plastic, etc.) on a regular basis.</p>
<p>BMP – 10 Sediment/Debris Control with compost filter berms, wattles, bales, or fences</p>	
<p>BMP Description: Compost filter berms, wattles, bales, and fences are simple ways to control sediment and debris on sloped surfaces.</p> <p>Filter berms are closely specified compost materials (with specific nutrient and particle requirements) that can be used to filter surface flows and capture sediment and solids. Filter berm construction can be done manually or with automated equipment.</p>	<p>Design Considerations: Compost filter berms can be made with internal materials and can be recycled and maintained onsite. They are appropriate for low slope surfaces. They are simple and effective.</p> <p>Wattles can be installed on steep slopes and must be staked in position. A trench should be excavated in which to lay the wattles, ensuring that water does not seep underneath the wattles and that wattles are snugly fitted against one another. Wattles are placed along the contour of the slope to reduce water flows and trap sediments.</p>

TABLE 3-1
Best Management Practices

BMP BY CATEGORY

BMP Description and Design Purpose	Design and Operational Considerations
<p>Wattles are manufactured tubular black plastic netting filled with rice straw (approximately nine inches in diameter and twenty-five feet long). Wattles disperse runoff laterally and trap sediments on the up-slope.</p> <p>Straw bales can be used to filter out heavy sediments. The straw bales cause heavy soil particles to be retained both through a filtering operation and through the creation of a small settling basin up slope of the bales through restriction and retardation of the runoff flow velocity. Used straw bales can be composted.</p> <p>Sediment fencing consists of a geotextile fabric usually 30 to 36 inches in width. The weave of the fabric determines the size of the soil particle retained by the silt fence. Heavy soil particles are retained on the up slope side of the fence as a result of a filtering and through the creation of a small settling basin up slope of the fence through restriction and retardation of the runoff flow velocity. See also BMP 18.</p> <p>Design Purpose: Removal of sediment, and suspended solids.</p> <p>Source: Oregon Department of Environmental Quality. February 2004. Best Management Practices for Stormwater Discharge Associated with Construction Activities. www.ecoberm.com http://www.filtrexx.com</p>	<p>Bales can be installed in the ground as temporary erosion and sediment control so that either the straw is parallel to the ground or perpendicular to the ground (both methods are equally efficient). The installation method in which the straw bales are placed with the straw perpendicular to the ground will protect the binding from rapid deterioration. Proper ground preparation, placement and staking are necessary to provide a stable sediment barrier.</p> <p>Sediment fencing must be trenched at least 6” into the ground. In order for the fencing to be an effective sediment barrier it must be stretched tight between the posts without any sags or breaks. Sometimes more than one row of sediment fence may be required.</p> <p>Operational Considerations: Frequent removal of sediment is required for proper use of wattles, bales, and fences. Wattles should be replaced every three years or when they appear to be plugged. Bales should be replaced as often as every thirty days (and no longer than 90 days) depending on the amount of rainfall and sediment runoff.</p> <p>Regular inspection and repair is necessary, and should occur after each significant rainfall event.</p> <p>Fencing fabric should be replaced at least every six months when exposed to fine clay sediment runoff. A more proactive approach would be to replace the sediment fence at regular intervals (for example every 30 days when exposed to clay-silt-loam runoff).</p>

EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)

BMP – 11 Sediment/ Debris Control using centrifugal devices, weirs, or baffles

<p>BMP Description: Pre-cast units available in different sizes, ranging from 900 to 7200 gallon storage capacities, constructed from pre-cast concrete components and a fiberglass insert. Fine and coarse sediments settle to the floor of the chamber, while the petroleum products rise and become trapped beneath the fiberglass insert. During infrequent, high flow events (less than 10% of all storm events), peak stormwater flows pass over the diverting weir and continue into the downstream storm sewer system. This by-pass activity creates pressure equalization across the by-pass chamber, preventing scouring and resuspension of previously trapped pollutants</p> <p>Design Purpose: Removal of floating debris, oil sheen, sediment, and suspended solids.</p>	<p>Design Considerations: Under normal operating conditions (more than 90% of all storm events), stormwater flows into the upper chamber and is diverted by a u-shaped weir, into the separation holding chamber. Right angle outlets direct flow around the circular walls of the chamber.</p> <p>This device has pipe inlets and outlets so it is suitable for drainline installations.</p> <p>This device has oil/water separation features.</p> <p>The best location for these facilities is at the receiving point for stormwater flows.</p> <p>Operational Considerations: Inspect and maintain the device from the surface, without entry into the unit. Perform maintenance once the stored volume reaches 15% of the device capacity, or immediately in the</p>
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TABLE 3-1 Best Management Practices	
BMP BY CATEGORY	
BMP Description and Design Purpose	Design and Operational Considerations
<p>Source: http://www.rinkermaterials.com/stormceptor/products/inline.htm and http://www.vortechtechnics.com/products/phases.html and http://aquashieldinc.com/aquaswirl.html</p>	<p>event of a spill. Maintenance intervals vary depending on the application.</p> <p>Programmed quarterly inspections during the first year of installation is recommended to establish an appropriate maintenance schedule.</p> <p>Remove oil and sediment through the 24-inch diameter outlet riser pipe. Alternatively remove floatables and hydrocarbons through the 6-inch oil inspection port.</p>
EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)	
BMP – 12 Granular Filtration Tanks	
<p>BMP Description: Granular filtration tanks utilize different types of filters. Stormwater filters or compost stormwater filters work by percolating stormwater through a media which traps particulates and adsorbs dissolved materials such as metals and nutrients. Floating surface scums along with oil and grease are also removed. After filtering through the compost media, the filtered water is channeled into a collection pipe or discharges to an open channel drainageway.</p> <p>Filters act as mechanical filters to remove fine sediments, as ion exchangers to remove solubilized ionic pollutants such as metals, as molecular absorption sites to remove organics, and provide biological substrate to aid in microbial degradation of organic compounds such as oil and grease. They are effective at removing total suspended solids with moderate removal for total phosphorus.</p> <p>Design Purpose: Removal of floating debris, nutrients, sediment, suspended solids, metals, bacteria, pH adjustment, and oil sheen.</p> <p>Source: http://www.deg.state.id.us/water/stormwater_catalog/doc_bmp41.asp and http://www.stormwaterinc.com/ http://www.fhwa.dot.gov/environment/ultraurb/3fs9.htm</p>	<p>Design Considerations: Filters composed of a compost media are not intended for use as stormwater detention systems. There are two main configurations for compost filters. The larger is set into the surrounding soil and stormwater flows are routed across its surface, where infiltration occurs. The smaller is constructed from standard size pre-cast concrete vaults (drop-in) installed in-line with tight line storm drains. Both the Open and Drop-In units are designed with overflows.</p> <p>The flow capacity of the filter is exceeded when the flow into the filter exceeds the design level or sediment accumulation has reduced the filter's infiltration capacity.</p> <p>In general, in-vessel or modular sand filters take up little space and can be used on highly developed sites and sites with steep slopes. They can be added to retrofit existing sites. This BMP is not recommended where high sediment loads are expected, unless pretreatment (e.g., sedimentation) is provided, since sediment clogs sand filters.</p> <p>Operational Considerations: Maintenance has proved to be problematic with the open unit, therefore, only drop-in units are included in this report.</p> <p>As with other filtration systems, including sand and peat filters, sediments will accumulate on the filter surface, thus slowing the infiltration capacity of the filter. To reduce sediment loading, the compost filters are designed with sediment forebays and upstream sediment trapping facilities such as trapped catch basins and sedimentation manholes.</p> <p>Compost filters are a relatively new technology (about 3 years) and precise maintenance procedures are still being refined. The Drop-In filters are sized for an annual maintenance which involves replacing the compost and cleaning out the sediment from the inlet bay. The sediment in the inlet bay is removed and disposed of in a manner similar to street catch basin maintenance.</p>
BMP – 13 Soil and Plant Systems	
<p>BMP Description: The engineered soil/landscape system is a self-sustaining soil and plant system that simultaneously</p>	<p>Design Considerations: Provide an engineered soil/landscape system that has the following characteristics:</p>

TABLE 3-1
Best Management Practices

BMP BY CATEGORY

BMP Description and Design Purpose	Design and Operational Considerations
<p>supports plant growth, soil microbes, water infiltration, nutrient and pollutant adsorption, sediment and pollutant biofiltration, water interflow, and pollutant decomposition.</p> <p>These are different than constructed wetlands in their plant selection and absence of exposed water surfaces.</p> <p>These systems are naturally attractive and best used near visitor and receiving areas, and where privacy landscape perimeters are desired.</p> <p>Design Purpose: Removal of floating debris, BOD, nutrients, sediment, suspended solids, metals, bacteria, TDS, and oil sheen.</p> <p>Source: http://www.ecy.wa.gov/biblio/9915.html CH2M HILL, Soil Improvement Project, Prepared for Snohomish County Public Works, February, 2000 CH2M HILL, Soil Improvement Project, Prepared for Snohomish County Public Works, February 2000</p>	<ul style="list-style-type: none"> • Protected from compaction and erosion. • A plant system (landscape design) to support a sustained soil quality. • A soil depth that is equivalent to pasture and grassland in runoff curve numbers. • Permeability characteristics of not less than 6.0, 2.0, and 0.6 inches/hour for hydrologic soil groups A, B, and C, respectively (per ASTM D 3385). D is less than 0.6 inches/hour. • Minimum percent organic matter of 12, 14, 16, and 18 percent for hydrologic soil groups A, B, C, and D, respectively (per ASTM D 2974). <p>Operational Considerations: The system shall be protected from compaction and erosion. The system shall be planted or mulched after installation. Plant debris or its equivalent shall be left on the soil surface. Pesticides and herbicides shall be used infrequently or not at all. Fertilizer shall be applied in the form of organic matter, organic-based, or in a slow-release, non-water soluble form. Compaction shall be prevented</p>

EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)

BMP – 14 Chemical Treatment

<p>BMP Description: This is not widely used and considered experimental in some jurisdictions. It involves the use of caustics and certain approved polymers to precipitate and settle fine or magnetically charged particles. Typically the process requires more than one step. For example caustic treatment must be followed by acid treatment to correct the pH before discharge. The process will normally produce a sediment or sludge that must be composted or disposed of at an appropriately permitted facility (e.g. lime or alum sludges).</p> <p>Design Purpose: Removal of sediment and suspended solids as the primary goal. Some reduction in BOD, nutrients, metals, bacteria, TDS, and oil sheen. pH adjustment will also be accomplished.</p> <p>Source: http://www.ocwatersheds.com/StormWater/documents_bmp_construction.asp see bmp SE 11</p>	<p>Design Considerations: Requires chemicals, tanks, pumps, controls, and space for tankage. Each facility must be engineered for flow, pollutant load, space constraints, and discharge requirements. This type of system would normally be located adjacent to any water storage facility so the treatment flow can be carefully regulated.</p> <p>Operational Considerations: This is a treatment process that will require training, process controls, solids removal, and nearly continuous performance monitoring. Chemical safety and residual disposal practices will have to be adopted to protect workers and the environment.</p>
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<p>TABLE 3-1 Best Management Practices</p>	
<p>BMP BY CATEGORY</p>	
<p>BMP Description and Design Purpose</p>	<p>Design and Operational Considerations</p>
<p>EROSION, SEDIMENT, AND DEBRIS CONTROL (continued)</p>	
<p>BMP – 15 Coagulation and Sedimentation</p>	
<p>BMP Description: Coagulation is used in water treatment to destabilize and perform initial agitation of colloidal particles and suspended solids by adding a coagulant. Coagulation agglomerates small or fine particles into larger, settleable particles.</p> <p>Design Purpose: Removal of BOD, nutrients, sediment, suspended solids, metals, bacteria, and TDS.</p> <p>Source: http://watertectonics.com/innovations.html Reynolds/Richards. 1996. Unit Operations and Processes in Environmental Engineering. Second Edition. www.stormwater-resources.com/Library/077PBactiRemoval.DOC</p>	<p>Design Considerations: Requires chemicals, tanks, pumps, controls, and space for tankage. Each facility must be engineered for flow, pollutant load, space constraints, and discharge requirements.</p> <p>Operational Considerations: This is a treatment process that will require training, process controls, solids removal, and nearly continuous performance monitoring. Chemical safety and residual disposal practices will have to be adopted to protect workers and the environment.</p>
<p>BMP – 16 Aeration and Ozonation</p>	
<p>BMP Description: Aeration and ozonation are used to supplement the oxygen supply in the water stream artificially.</p> <p>Design Purpose: Removal of BOD and bacteria.</p> <p>Source: Reynolds/Richards. 1996. Unit Operations and Processes in Environmental Engineering. Second Edition</p>	<p>Design Considerations: Each facility must be engineered for flow, pollutant load, space constraints, and discharge requirements.</p> <p>Operational Considerations: Frequent monitoring of system.</p>
<p>BMP – 17 Underground Injection with Pretreatment</p>	
<p>BMP Description: Subsurface fluid distribution system with infiltration. This system is designed specifically to return water to the groundwater system. By definition this BMP has no regular outlet to the surface. Common underground injection systems in Oregon include:</p> <ul style="list-style-type: none"> • Stormwater systems, such as sumps, infiltration galleries, drywells, trench drains & french drains. • Domestic onsite drainfields and septic systems (serving 20 or more people or with a design capacity of 2,500 gpd). • Industrial/commercial process & wastewater disposal (includes drainfields of any size). • Cooling water return flows. 	<p>Design Considerations: Disposal practices that release wastewater directly into the ground can pollute groundwater and surface water if not properly designed, sited, and operated. The threat posed to ground water quality varies markedly, and depends mostly upon the volume and nature of the fluids injected, well construction, and the hydrogeologic setting. The federal UIC regulations and additional state requirements are based upon a protective performance standard. Must be designed so the discharge does not violate the federal safe drinking water act. Untreated stormwater discharges to natural wetlands are illegal under the Clean Water Act, and should not occur adjacent to wetlands due to the potential for groundwater contamination. Direct discharge of untreated stormwater to groundwater is prohibited by the state. All sites should provide some treatment of stormwater (see DEQ Guidelines for Stormwater</p>

TABLE 3-1
Best Management Practices

BMP BY CATEGORY

BMP Description and Design Purpose	Design and Operational Considerations
<ul style="list-style-type: none"> • Aquifer recharge and remediation systems. • Geothermal heat pump systems. • Greywater. <p>Design Purpose: Removal of sediment and suspended solids if pretreatment is used, the system may also remove BOD, nutrients, metals, bacteria, TDS, oil & grease, and oil sheen</p> <p>Source: http://yosemite.epa.gov/R10/WATER.NSF/476d8e2e8829cf19882565d400706530/51bbc02148429af1882568730082f6fa?OpenDocument http://www.deq.state.or.us/wq/groundwa/uicbmp.htm</p>	<p>Treatment Facilities). Biofiltration is one of the most environmentally effective treatments at this time.</p> <p>Operational Considerations: Load reduction has traditionally been the criteria used to evaluate the performance of BMPs and treatment designs. While it is useful to compare BMPs it is limited, because it does not track the pollutant outflow concentration. Current studies are showing that BMPs cannot reduce pollution levels beyond a certain point. Metals, in particular, have been detected in outflows exceeding state standards. Irreducible concentrations may represent a real threshold for cumulative development impacts.</p> <p>Sensitive groundwater areas include Wellhead Protection Areas (WHPA) or source water areas, wetlands, riparian areas, groundwater management areas, sole source aquifers and sites within ½ mile of water quality limited streams.</p> <p>Methods currently in use, such as direct discharge into a dry well or sumps do not provide adequate groundwater water quality protection for commercial, transportation or industrial sites.</p>

STORMWATER, COMPOST LEACHATE, AND WASHWATER DIVERSION

BMP - 2 Grading Facility Areas

<p>BMP Description: See BMP 2</p> <p>Design Purpose: Diversion of stormwater, compost leachate, and washwater to separate areas for treatment or discharge.</p> <p>Source: U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003</p>	<p>Design Considerations: See BMP 2</p> <p>Operational Considerations: See BMP 2</p>
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BMP - 4 Paving

<p>BMP Description: In addition to providing erosion control as mentioned above, paving can be used to facilitate stormwater, compost leachate, and washwater diversion. The need for pavement will vary depending on compost feedstocks used, scale of operation, and risk of pathogen/vector and nutrient release. Paving under the following areas is desirable: washing areas, traffic areas, drainage flowlines, and high frequency use areas like screening, sales, and compost feedstock areas can be particularly helpful</p> <p>Often for small, low risk facilities, an alternative pad (e.g., clay, compacted gravel, or liner) is sufficient. Pads with a lower permeability could be used to prevent groundwater contamination in facilities using</p>	<p>Design Considerations: Design according to regulatory requirements, intended service life, expected induced flexural stress of material handling equipment, and expected load frequency of the equipment.</p> <p>Operational Considerations: Repair any holes and or damage to the surface no less than annually.</p>
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TABLE 3-1
Best Management Practices

BMP BY CATEGORY

BMP Description and Design Purpose	Design and Operational Considerations
<p>high nutrient materials. There are several ways that pads could be constructed to reach low permeability: concrete, asphalt, landfill liners, geotextile liners, compacted clay soil, or soil stabilized with mixtures of fly ash, cement kiln dust, quicklime or cement.</p> <p>Design Purpose: Diversion of stormwater and compost leachate to separate areas for treatment or discharge. Prevention of compost leachate and/or other water from migrating into the subsurface soils, groundwater, or surface water.</p> <p>Source: Governor et al., October 2003. <i>The Compost White Paper Large-Scale Composting in Georgia.</i></p>	

STORMWATER, COMPOST LEACHATE, AND WASHWATER DIVERSION (continued)

BMP – 18 Diversion with Containment Barriers, Curbing, Berms, Gutters, etc.

BMP Description:	Design Considerations:
<p>Containment barriers, curbing, berms, gutters, interceptor trenches, and dikes are all simple and effective methods of intercepting and diverting stormwater, compost leachate, and washwater and ultimately preventing sediment-laden and/or potentially contaminated waters from entering a site, combining with other water streams, or leaving a site. They also can be used to guide water around unstable areas to prevent both erosion and saturation with water.</p> <p>Containment barriers/dikes/berms are among the simplest of options. They can be composed of a variety of materials such as concrete, cement treated soil, or non-encapsulated yard debris compost. Compost filter berms are closely specified compost materials (with specific nutrient and particle requirements) that can be used to filter surface flows and capture sediment and solids. Filter berm construction can be done manually or with automated equipment.</p> <p>Curbing is another type of structural barrier. It can be composed of soil, concrete, synthetic materials, or any other semi-impenetrable material built around a storage or process area.</p> <p>Gutters are used to divert runoff from roofs.</p> <p>Design Purpose: Diversion of stormwater, compost leachate, and washwater to separate areas for treatment or discharge [and to prevent cross-contamination and runoff] and removal of BOD, nutrients, sediment, suspended solids, metals, bacteria, and TDS.</p>	<p>Diversions should not be used on drainage areas exceeding 5 acres, though stream diversions may exceed this, and diversions should be designed to handle the peak runoff from a 10-year storm.</p> <p>Berms should be constructed of compacted soil, should have a minimum top width of 2 feet, should have a minimum height of 1 foot (with or without a swale), and should allow for 10% settlement.</p> <p>There are a variety of configurations that are applicable to compost sites. Optimal configuration of diversion devices is dependent on site configuration. Composting pads that are at the bottom of a slope may benefit from a dike/berm on the up slope side of the pad to keep stormwater from entering the pad area and a dike/berm and then interceptor trench on the down slope side of the pad to collect runoff from the pad area and then direct it to the appropriate holding/treatment/disposal area. Composting pads that are built on a 2-4% slope may benefit from an interceptor trench and then dike/berm on the up slope side and then an interceptor trench and then dike/berm on the down slope side.</p> <p>Operational Considerations: Permanent diversions should be checked following each rainfall until disturbed areas are stabilized. Temporary diversions should be inspected once a week and following each major rainfall event. All accumulated sediment should be removed. Berms should be inspected for settling. Any part of berm which has settled 4 inches lower than the design elevation requires repair.</p>

<p>TABLE 3-1 Best Management Practices</p>	
<p>BMP BY CATEGORY</p>	
<p>BMP Description and Design Purpose</p>	<p>Design and Operational Considerations</p>
<p>Source: Oregon Department of Environmental Quality. February 2004. Best Management Practices for Stormwater Discharge Associated with Construction Activities and U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003</p>	
<p>STORMWATER, COMPOST LEACHATE, AND WASHWATER DIVERSION (continued)</p>	
<p>BMP – 19 Liner Systems</p>	
<p>BMP Description: Liners are used to minimize compost leachate and/or potentially contaminated stormwater from migrating into subsurface soils, groundwater, or surface water. The need for liners will vary depending on compost feedstocks used, scale of operation, and risk of pathogen/vector release. Liners are used where required by specific regulation or where evaluation has shown them most cost-effective.</p> <p>Liners can be used under composting pads, compost feedstock areas, or collection ponds.</p> <p>Liners can be composed of synthetic material, such as high density polyethylene plastics, or natural soils, such as clay. Soil liners must be at least engineered and compacted to achieve a low permeability.</p> <p>Design Purpose: Prevention of compost leachate and/or other water from migrating into the subsurface soils, groundwater, or surface water.</p> <p>Source: U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003 and Governo et al.. October 2003. <i>The Compost White Paper Large-Scale Composting in Georgia</i>.</p>	<p>Design Considerations: Design must consider subgrade soils, imported material specifications, working surface design, service life, risk to groundwater, regulations, compost feedstocks, scale and intensity of operation, and weather conditions.</p> <p>Operational Considerations: Repair any holes and/or damage to the liner when damage is discovered and no less than annually.</p>
<p>BMP – 20 Collection and Reuse of Stormwater, Compost Leachate, or Washwater</p>	
<p>BMP Description: Compost facilities have the potential to generate a significant amount of stormwater, compost leachate, and/or washwater. The need for large volumes of water in the composting process presents this unique opportunity for stormwater, compost leachate, and washwater reuse. Diversion devices (BMP 18) can be used in combination with holding ponds or detention facilities (BMP 9). For example, a 20 acre western Oregon facility that receives 40" of rainfall per year might generate over 20 million</p>	<p>Design Considerations: The amount of stormwater, compost leachate, and washwater that can be used for moisture control in the compost process is dependent on the amount of precipitation received by the facility, the compost feedstocks used in the process, the compost process used, effectiveness of diversion systems, depth, shape, and exposed surface of the piles, amount of exposed pavement and traffic areas, and storage requirements.</p> <p>Depending on the set-up of the washing pad, the facility may</p>

<p>TABLE 3-1 Best Management Practices</p>	
<p>BMP BY CATEGORY</p>	
<p>BMP Description and Design Purpose</p>	<p>Design and Operational Considerations</p>
<p>gallons of runoff per year. During dry weather the facility could re-use more than 50 percent of this as makeup water on piles and for dust control.</p> <p>Design Purpose: Reduction in runoff volumes, and reduction in peak runoff rates.</p> <p>Source: U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003</p>	<p>also have the ability to recycle washwater.</p> <p>Operational Considerations: Stormwater (non-process) can be used throughout the process. Any other water (process stormwater or compost leachate) should only be introduced to piles that haven't undergone PFRP unless treated.</p>
<p>STORMWATER, COMPOST LEACHATE, AND WASHWATER DIVERSION (continued)</p>	
<p>BMP- 21 Minimize Runoff by Practicing Specific Operating Procedures</p>	
<p>BMP Description: Larger pile volumes, larger pile volumes with low rate aeration, and extended aerated static piles can all help to reduce runoff.</p> <p>Design Purpose: Reduction in runoff volumes, and reduction in peak runoff rates</p> <p>Source: U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003</p>	<p>Design Considerations: The volume of runoff reduction is dependent on the amount of precipitation received by the facility, the compost feedstocks used in the process, and the compost process used.</p> <p>Operational Considerations: Maintain adequate heat in the piles to drive moisture off as vapor. Maintain the shape of the piles to facilitate aeration and protection from precipitation.</p>
<p>COVERING ACTIVITIES</p>	
<p>BMP – 22 Roof Structure</p>	
<p>BMP Description: Roofing can be used to control the temperature and moisture levels in compost piles. In dry climates a roof over the active composting areas reduces evaporation and process water requirements. In wet climates, a roof prevents overly wet compost, anaerobic conditions, and ultimately reduces the amount of compost leachate and site runoff.</p> <p>Design Purpose: Reduction in runoff. Removal of BOD, nutrients, sediment, suspended solids, metals, bacteria, and TDS (total dissolved solids).</p> <p>Source: U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003</p>	<p>Design Considerations: Roof runoff and downspouts must be connected to a diversion channel, holding pond, or other discharge location. If roof accumulates significant organic dust then treatment BMPs may be necessary before discharge. Compost feedstock areas, active composting areas, and finished product areas can all benefit from roofing. Studies have shown that older piles leach less nitrogen than younger piles. Therefore if roofing can only be used on a limited basis, younger piles should be considered before older piles (if compost leachate is a problem for the site). This would include waste receiving and compost feedstock preparation areas and younger piles. Storage of finely textured screened product may also present more risk of erosion, sediment, and suspended solids in runoff from these areas.</p> <p>Operational Considerations: Gutters and downspouts need to be maintained and directed to the appropriate discharge location. Broken, crushed, or</p>

TABLE 3-1 Best Management Practices	
BMP BY CATEGORY	
BMP Description and Design Purpose	Design and Operational Considerations
	poorly directed downspouts will diminish the effectiveness of the roof.
COVERING ACTIVITIES (continued)	
BMP – 23 Membranes, Tarps, or Covers	
<p>BMP Description: Membranes, tarps, and covers are all relatively simple methods of providing cover for various portions of the compost facility. Similarly to roofing (BMP 22), they can be used to control the temperature and moisture levels in the piles.</p> <p>Design Purpose: Removal of BOD, nutrients, sediment, suspended solids, metals, bacteria, and TDS.</p>	<p>Design Considerations: Unlike roofs, no diversion or runoff separation is normally possible. This BMP avoids transport of elements listed but does not reduce runoff volumes. Some increase in peak runoff rates and runoff volumes may result since piles cannot absorb incidental rainfall.</p> <p>Compost feedstock areas, active composting areas, and finished product areas can all benefit from covers.</p> <p>Studies have shown that older piles leach less nitrogen than younger piles. Therefore if membranes and tarps can only be used on a limited basis, younger piles should be considered before older piles (if compost leachate is a problem for the site). This would include waste receiving and compost feedstock preparation areas and younger piles</p> <p>Storage of finely textured screened product may also present more risk of erosion, sediment, and suspended solids in runoff from these areas.</p> <p>Operational Considerations: Covers should be repaired as needed.</p>
BMP – 24 Indoor Operation	
<p>BMP Description: Indoor operations provide the ultimate level of moisture control and can eliminate the infiltration of compost leachate into the groundwater.</p> <p>Design Purpose: Reduction in runoff. Removal of BOD, nutrients, sediment, suspended solids, metals, bacteria, and TDS.</p> <p>Source: U.S. Environmental Protection Agency (EPA). May 1994. <i>Composting Yard Trimming and Municipal Solid Waste</i>. EPA530-R-94-003</p>	<p>Design Considerations: Compost feedstock areas, active composting areas, curing areas, and finished product areas can all benefit from indoor operations.</p> <p>Studies have shown that older piles leach less nitrogen than younger piles. Therefore if indoor operations can only be used on a limited basis, younger piles should be considered before older piles (if compost leachate is a problem for the site). This would include waste receiving and compost feedstock preparation areas and younger piles</p> <p>Operational Considerations: Buildings should be repaired as needed.</p>
HOUSE KEEPING	
BMP – 25 Elimination of Standing Surface Water	
<p>BMP Description: Elimination of standing surface water will help keep the separation of stormwater and process water possible.</p> <p>Standing water in combination with vehicle traffic can accelerate surface deterioration and create odors.</p> <p>Once surface deterioration begins, uneven surfaces</p>	<p>Design Considerations: Design working surfaces with proper slope and proper surface materials.</p> <p>Design drainage patterns so water is not retained behind piles, grade-changes, or structures.</p> <p>Operational Considerations: Continuously repair damaged drainage channels, manholes, basins, and other conveyance devices.</p>

TABLE 3-1 Best Management Practices	
BMP BY CATEGORY	
BMP Description and Design Purpose	Design and Operational Considerations
<p>cause material spillage and mud accumulation.</p> <p>Design Purpose: Reduction in vectors, odors, stormwater contamination, and surface damage.</p>	<p>Eliminate trapped stormwater due to piles or other obstructions</p>
HOUSE KEEPING (continued)	
BMP – 26 Prompt Processing of Incoming Compost Feedstocks	
<p>BMP Description: Prompt processing of incoming compost feedstocks will help reduce stormwater contamination. Food waste is typically a wet compost feedstock and has water-soluble nutrients, pathogens, oils, and fats. Free liquids will often drain from this type of material. Grass that is collected and compressed through curbside collection programs can also produce water-soluble nutrients and free liquids. Compost feedstocks like food waste, manures, and compressed grass should be stored and handled with care.</p> <p>Design Purpose: Reduction in stormwater contamination.</p>	<p>Design Considerations: Design a material receiving system that quickly processes and places these compost feedstocks into compost piles.</p> <p>Operational Considerations: NA</p>
BMP – 27 Shaping of Piles	
<p>BMP Description: Piles that have an irregular top surface (hills and valleys) will capture more incidental rainfall and will not create natural airflow convection that heats the pile and drives moisture off as vapor. Conical, windrow, or wedge shaped piles work best to shed heavy rainfall, convect air, produce heat, and drive off moisture naturally.</p> <p>Design Purpose: Reduction in runoff.</p>	<p>Design Considerations: Design finished product stockpiles to match these shapes. Select equipment to construct appropriate piles. High-lift buckets and stacking conveyors are examples of suitable equipment. Active Piles must have porosity (be loosely stacked) to facilitate convection. Finely textured finished product should be compacted to reduce permeability</p> <p>Operational Considerations: Avoid irregular surfaces on top of piles. Orient piles to avoid trapping runoff or puddling. Adjust each pile density according to its composition (i.e. loosely stack active materials, compact older or finished materials).</p>

SECTION 4

Current Regulations

The purpose of composting regulations is to protect human health and the environment. Ideally, composting regulations can be formulated in a manner which is protective of human health and the environment and promotes effective composting by minimizing regulatory barriers.

During the past few years, the composting industry has seen significant growth. Virtually every state located within the United States is participating in some sort of composting operation (Environmental Protection Agency, April 1999). Within those states, the compost regulations vary significantly. A study performed by the University of Georgia's Department of Biological and Agricultural Engineering (BAE) (published in October 2003) compared the composting regulations of thirteen different states (California, Florida, Georgia, Kentucky, Louisiana, Maine, Mississippi, North Carolina, Oregon, South Carolina, Tennessee, Washington, and Virginia). In general, this study found that regulatory approaches varied widely from state to state. States with active compost programs (such as California, Maine, Oregon, and Washington) tended to incorporate some type of tiered system (which supports proportionate requirements with the risks associated with facilities) but had less specific end use standards and fewer zoning requirements; while states with less active compost programs had the reverse. (Governo et al., October 2003)

Oregon has one of the more active composting programs. The commercial composting industry in Oregon has diversified and grown substantially since the rules were developed. New information regarding the presence of constituents in the various stages of composting and the potential for those constituents to migrate in ways including groundwater and surface water and ultimately impact human health and the environment has been discovered in the past few years. As a result, the Oregon Department of Environmental Quality is currently in the process of examining and revising existing rules for the operation of commercial composting facilities.

This section includes a comparison of compost regulations for Oregon, California, Washington, and Maine. The focus of this comparison was on the regulations which impact the management of stormwater and compost leachate at compost facilities in those states. The results of this comparison are discussed below. Fact sheets highlighting some of the regulatory features of each state are included in Appendix B.

4.1 Oregon

Oregon has a tiered regulatory framework for composting facilities. Within the framework are three levels of regulatory permitting by DEQ: composting registration, composting general permit, and a composting full permit. Facilities are permitted based on compost feedstock type, and facility size (described as volume of incoming compost feedstocks).

There are approximately 42 registered or permitted composting facilities in the state (Oregon Department of Environmental Quality, March 2004). Agricultural facilities (that are

unregulated by rule or regulated by the Oregon Department of Agriculture), home composting systems, biosolids facilities, and on-site institutional composting systems are not covered under the State registration and permitting system, and therefore are not addressed in this document.

There is a separate Oregon Department of Agriculture (ODA) program to regulate all livestock and confined animal feeding operations (CAFOs) to satisfy both state water quality laws and the federal Clean Water Act.² There are approximately 545 CAFOs in the state.

DEQ is responsible for water pollution control in all waters of the state. Oregon Law has effluent limitations, in relation to the waters of the state. The Environmental Quality Commission by rule may establish effluent limitations.³ Any water released from a facility will be discharged to surface water, groundwater, or a sewer system.

Under the DEQ Land Quality Division compost rules, there are not any specific design requirements for the management of stormwater. Stormwater discharges from composting facilities in Oregon are regulated under a National Pollutant Discharge Elimination System (NPDES) 1200-Z Industrial General permit issued by DEQ's Water Quality Division. The 1200-Z Permit is issued for 5 years and requires the development and implementation of a Stormwater Pollution Control Plan (SWPCP). Under the permit, facilities are required to collect grab samples from each stormwater discharge point twice a year (preferably once in the fall and once in the spring). Samples must be analyzed for total copper, total lead, total zinc, pH, total suspended solids, oil and grease. Monthly visual monitoring must also be performed for oil and grease sheen and floating solids (when discharging).

Some design requirements for the management of compost leachate and washwater are included in the compost rules (see Appendix B). If there is a discharge of leachate or washwater (from vehicle and equipment washing) to surface water or ground water, a wastewater permit from the DEQ is required(OAR 340-096-0028(2)(c)). Agricultural composters must meet water quality requirements pursuant Oregon Revised Statute 468B.050 (1)(b), administered by the Oregon Department of Agriculture

Some groundwater discharges are regulated by DEQ's "Underground Injection Control Program" as part of the Safe Drinking Water Act (Oregon Department of Environmental Quality, March 2004). Underground injection is any system, structure or activity that is created to discharge fluid below the ground or sub-surface. Common underground injection systems in Oregon include:

² DEQ chose not to issue NPDES permits for CAFO wastes because the state Water Pollution Control Facilities (WPCF) permit program was deemed to be more restrictive. The WPCF permit program prohibits the discharge of CAFO wastes to surface waters, whereas NPDES permits allow such discharges to surface water during large storm events. EPA has since directed DEQ and ODA to issue NPDES permits to CAFOs that fit the federal definition of a *concentrated* animal feeding operation. In addition, the 2001 Oregon legislature authorized and directed the transfer of the NPDES permit program for CAFOs from DEQ to ODA upon approval by EPA.

³ Rule 468B, as defined in Section 502 of the Federal Water Pollution Control Act, as amended by Public Law 92-500, October 18, 1972, and other minimum requirements for disposal of wastes, minimum requirements for operation and maintenance of disposal systems, and all other matters pertaining to standards of quality for the waters of the state. The commission may perform or cause to be performed any and all acts necessary to be performed by the state to implement within the jurisdiction of the state the provisions of the Federal Water Pollution Control Act of October 18, 1972, and Acts amendatory thereof or supplementary thereto, and federal regulations and guidelines issued pursuant thereto

- Stormwater systems, such as sumps, infiltration galleries, drywells, trench drains & french drains
- Domestic onsite drainfields and septic systems (serving 20 or more people or with a design capacity of 2,500 gpd)
- Industrial/commercial process & wastewater disposal (includes drainfields of any size)
- Cooling water return flows
- Aquifer recharge and remediation systems
- Geothermal heat pump systems
- Greywater

“Rule authorized” systems do not require a permit. For an injection system to qualify as “rule authorized”, the following requirements must be met: facilities must be registered, have no impact on water quality, and meet DEQ siting requirements. Sites that do not qualify as rule authorized need to either be closed, modified to meet rule requirements, or submit a Water Pollution Control Facility (WPCF) permit application to the appropriate regional DEQ office. At this time, some DEQ offices have large water quality permit backlogs.

The state has some sensitive aquifers, some high-value agricultural land, and various watersheds for surface water management. Each watershed has a certain water quality profile. As the composting industry grows in number and size of each facility, location will become more of a key consideration. The location of a facility could be affected by any one of these considerations. For example, a composting facility with a full permit (nongreen compost feedstocks) could be affected by a designation that it resides over a sensitive aquifer.

The state maintains a website that shows the 303(d) list of stream segments that do not meet water quality standards (Oregon Department of Environmental Quality, March 2004). This list is called the 303(d) List because of the section of the Clean Water Act that makes the requirement. The link below shows the state map with overlays for each water quality parameter.

<http://deq12.deq.state.or.us/scripts/esrimap.dll?name=lasar&cmd=map>

This website of the 303(d) lists includes those surface water bodies that are impaired. Each constituent of concern has its own list. This includes, but is not limited to E. Coli, Fecal coliform, Nitrate, and Phosphorus. The lists show each water body by name, as well as sub-basin, river mile, constituent of concern or impairment, season of impairment, and the date it was added to the impairment list. Copies of the statewide lists for E. Coli, Fecal coliform, Nitrate, and Phosphorus are shown in Appendix C, as they appeared at the time this report was prepared.

DEQ's Water Quality Division also maintains a map of each surface water sub-basin, and prioritizes them according to streams that are water quality limited. This map is shown in Appendix D (last updated in July 1996).

<http://www.deq.state.or.us/nwr/stormwater.htm>

4.2 California

California has a tiered regulatory framework for the regulation of solid waste facilities. The regulations establish five (5) tiers of regulatory placement for solid waste facilities. From the highest level of regulation to the lowest, the tiers are: full, standardized, registration, enforcement agency notification, and excluded. California revised their compost regulations in April of 2003 and under the new regulations all composting facilities fall under either excluded activities, enforcement agency notification, or full permit tiers with the exception of some chipping and grinding operations. Chipping and grinding operations handling more than 200 tons per day and up to 500 tons per day of material are required to obtain a registration permit. There are approximately 170 facilities in the state (California Integrated Waste Board, May 2004).

Under these rules, there are not any specific design criteria for the management of stormwater. Stormwater discharges from composting facilities in California are regulated under a National Pollutant Discharge Elimination System (NPDES) General permit. (No. CAS000001; General permit for Non-Construction Industrial Activities). The NPDES Industrial General Permit is issued for 5 years and requires the following:

- Elimination of unauthorized non-stormwater discharges
- Monitoring of stormwater discharges and authorized non-stormwater discharges
- Development and implementation of a Stormwater Pollution Prevention Plan (SWPPP).

Permitted composting facilities are required to collect and analyze samples of stormwater discharges twice per year. Analysis must include pH, total suspended solids (TSS), total organic carbon (TOC), total iron, nitrate/nitrite (as N), total lead, total zinc, phosphorus, and specific conductance.

California's composting rules provide no specific requirements for compost leachate management beyond that compost leachate shall be controlled to prevent contact with the public (Title 14 CCR, Division , Chapter 3.1, Article 5., Section 17867(a)(12)).

4.3 Maine

The Maine Department of Environmental Protection (DEP) regulates composting facilities under Maine Solid Waste Management Rules (06-096 Code of Maine Rule [CMR] Chapters 400, 405 and 409). Maine uses a tiered system to separate composting facilities into different regulatory levels. Facilities are permitted based on residual type and facility size (described as volume composted). Residuals that have been approved for composting include food, fiber, vegetable and fish processing wastes; dredge materials; biosolids; sewage sludge; short paper fiber; dewatered septage; and ash from wood, sludge or other fuels.

Maine has three levels of permitting for solid waste facilities listed from most stringent to least stringent: Full Facility Licensing, Reduced Procedures Licensing, and Permit by Rule Notifications. Most composting facilities are subject to Reduced Procedures Licensing or Permit by Rule Notifications.

Maine's Solid Waste Management Rules include extensive design and operating requirements for the management of stormwater and compost leachate. There are approximately 75 active facilities in the state (Maine Department of Environmental Protection, May 2004). These rules require that surface water drainage be diverted away from receiving, processing, composting and curing areas. Composting facilities must also be designed to manage stormwater runoff to prevent contamination of surface water or groundwater. Water falling on a composting facility during a 25-year, 24-hour storm event must infiltrate or be detained such that the stormwater rate of flow from the facility after construction does not exceed the rate prior to construction (06-096 CMR Chapter 409(9)(B)(3)). In addition, surfaces on which composting takes place must be designed to have a slope between 2 percent and 6 percent and where necessary, be graded to prevent ponding of water.

If stormwater is discharged to a municipal separate stormwater system or directly to surface waters a National Pollutant Discharge Elimination System (NPDES) permit is required. The federal Environmental Protection Agency administers the NPDES permitting program for industrial sources (40 CFR 122.26). A composting facility is covered under the NPDES Multi-Sector General Permit (MSGP). All facilities with a MSGP are required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP). The permit provides specific SWPP requirements for each industry sector. Composting facilities fall under Industry Sector C (standard industry code [SIC] 2873-2879 Agricultural Chemicals). Sector C industries are required to conduct benchmark monitoring for nitrate plus nitrite nitrogen, total lead, total iron, total zinc, and phosphorus. Benchmark monitoring periods are October 1, 2001 to September 30, 2002 (year two of the permit) and October 1, 2003 to September 30, 2004 (year four of the permit). Composting facilities are required to conduct benchmark monitoring, quarterly (4 times a year) during at least one, and potentially both, monitoring periods.

Compost facilities in Maine must be designed to contain, collect and treat any compost leachate generated at the facility (06-096 CMR Chapter 409(9)(B)(3)). All facilities that have a compost leachate collection and/or detection system must implement a program of periodic monitoring of compost leachate quality and volume, leak detection system (LDS) fluid quality, volume and flow rate, and compost leachate treatment residue composition and generation rate. A compost leachate sampling and analytical work plan must be submitted to the DEP for review and approval (06-096 CMR, Chapter 405(4)).

4.4 Washington

Washington regulates composting facilities under the Solid Waste Handling Rules (Chapter 173-350-220 Washington Administrative Code [WAC]). Washington solid waste rules provide requirements for composting facility design, operating standards, closure, financial assurance, permitting, construction records and designation of composted materials. All composting facilities in Washington, unless exempted under the regulation, are required to

obtain a solid waste permit from the jurisdictional health department. Washington uses a tiered system to divide composting facilities into different types. Facilities are permitted based on compost feedstock type, and facility size (described as volume of composted material). There are approximately 40 compost facilities in the state (Washington Department of Ecology, 2003).

Composting facilities in Washington are required to separate stormwater from compost leachate by designing stormwater runoff prevention systems. Systems may include covered areas (roofs), diversion swales, ditches or other designs to divert stormwater from composting areas (Chapter 173-350-220(3)(b)). All runoff from active composting areas, including waste receiving and processing areas is classified as compost leachate. Runoff from other facility areas such as roads and finished product storage areas is considered to be stormwater. If stormwater is discharged to a stormwater treatment facility or surface water an Industrial General Stormwater Permit is required.

Coverage under the Industrial General Stormwater Permit depends on the Standard Industrial Classification (SIC) of individual facilities. However, the Washington Department of Ecology (Ecology) can require permit coverage of any facility on a case-by-case basis in order to protect waters of the state. The following SIC codes should be used when a compost facility applies for a permit:

- SIC code 2879, Pesticides and Agricultural Chemicals, Not Elsewhere Classified: This classification includes facilities that are primarily engaged in manufacturing or formulation of soil conditioners. Normal composting operations, which produce a final product that is considered a soil conditioner will fall under this SIC code.
- SIC code 2875, Fertilizers, Mixing Only: Compost facilities that mix fertilizers into the compost and produce final product, which is considered fertilizer, will be classified under this SIC code.

The main purpose of the Industrial General Stormwater Permit is to incorporate a Stormwater Pollution Prevention Plan (SWPPP) into the design of the facility.

All Washington permitted facilities must conduct quarterly monitoring of authorized discharges of stormwater. Permitted composting facilities must sample for the following parameters: total zinc, nitrate/nitrite as nitrogen, phosphorus (TP), BOD₅, pH, turbidity, and petroleum (oil and grease). If the value for total zinc exceeds the benchmark value for two consecutive quarters beginning with the next sampling quarter the Permittee must include a quarterly analysis for copper and lead.

In Washington all runoff from active composting areas, including waste receiving and processing areas is considered compost leachate. Runoff from other facility areas such as roads and finished product storage areas is considered to be stormwater.

Composting facilities in Washington are required to collect all compost leachate generated from compost feedstock preparation, active composting, and curing. Compost leachate must be conveyed to a compost leachate holding pond, tank or other containment structure (Chapter 173-350-220 (3) (c)WAC). Washington's solid waste handling standards specify design requirements for ponds (Chapter 173-350-220(3)(c)(ii) WAC) and tanks (173-350-220(3)(c)(iii) WAC).

Washington also requires that all incoming compost feedstocks, active composting and curing materials are placed on compost pads. All compost pads must be curbed or graded so as to prevent ponding, and stormwater runoff and runoff, and be designed to direct all compost leachate to collection devices (173-350-220(3)(e) WAC).

4.5 Summary

Oregon, California, Maine, and Washington all have active composting programs. All four states incorporate some type of tiered regulatory framework. This allows for proportionate levels of control depending on the compost feedstock type and potential level of risk. Maine and Washington incorporate the most extensive design and operating requirements for the management of stormwater and compost leachate. Maine requires the fewest number of analytes to be tested (although the list is more applicable to composting than Oregon's list) and Washington requires the greatest number of analytes to be tested. California, Maine, and Washington all use the benchmark values that are contained in the U.S. EPA Multi-Sector Permit.

Recommendations

As a result of the unique characteristics and potential risks associated with commercial composting, changes to the existing Oregon DEQ composting rules are desired. This report focuses on changes that should be made to the existing 1200-Z permit to develop a new, compost-specific stormwater/compost leachate/washwater permit. This report also recommends some changes to the existing definitions for incoming compost feedstock types. Although not covered in this report, the new compost rules should also include facility siting and design requirements for the management of stormwater, compost leachate, and washwater in the permit itself.

This section provides recommendations for changing the definitions for incoming compost feedstock types, BMPs, and monitoring requirements to better fit the specific issues associated with commercial composting facilities.

5.1 Definitions for Incoming Feedstock Types

As shown in Appendix B, Oregon Compost Rules currently have two categories of incoming feedstocks (excluding biosolids, home composting, and agricultural composting that is either unregulated or regulated by ODA): Green Feedstock and Nongreen Feedstock. Currently, green feedstocks include, but are not limited to: yard debris, animal manure, wood waste, vegetative food waste, produce waste, vegetative restaurant waste, vegetative food processor by-products, and crop residue (OAR 340-093-0030). Nongreen feedstocks currently include, but are not limited to: animal parts and by-products, mixed materials containing animal parts or by-products, dead animals and municipal solid waste (OAR 340-093-0030).

As discussed in Section 2, manure and wastes containing vegetable matter pose some special challenges. Even though different levels of risk are associated with the different types of manures and vegetable wastes, they all pose some increased risk of water soluble nutrient mobility. It is important to remember that one of the best methods to reduce nutrient mobility and solubility (e.g. nitrates and ammonia) is to compost the waste and convert the nitrogen into slow release forms (humic structure). Likewise many of the experiences with E. Coli 0157:H7 have been associated with cattle manure in particular. Therefore, raw manure is considered a higher risk feedstock than “green feedstocks” in general.

Due to the higher level of risk associated with raw manure (especially during rainfall events and the wet season in western Oregon), it is advisable to limit exposure of raw manure and vegetable wastes to less than 24 hours (for example: must be processed and placed indoors or in a well managed compost pile by the end of the day). If a green feedstocks compost facility is accepting manure and vegetable waste, and regularly fails the benchmark values, that facility should be considered non-conforming and should be required to prepare a mitigation plan to continue operating as a “green feedstock” facility.

In order to address these issues the definitions for green feedstock and nongreen feedstock should be modified. Table 5-1 summarizes the recommended changes.

TABLE 5-1
Modifications to Definitions of Incoming Compost Feedstocks

Incoming Compost Feedstocks	Proposed Revisions Current definitions from OAR 340-093-0030 (underlined text is recommended by CH2M HILL)
Green Feedstock	(38) "Green Feedstocks" are materials used to produce a compost. Green feedstocks are low in a) substances that pose a present or future hazard to human health or the environment and b) low in and unlikely to support human pathogens <u>and c) effectively managed to prevent pollution to groundwater and surface water.</u> Green feedstocks include but are not limited to: yard debris, animal manures, wood waste (as defined in OAR 340-093-0030(95)), vegetative food waste, produce waste, vegetative restaurant waste, vegetative food processor by-products and crop residue. Green feedstocks may also include other materials that can be shown to DEQ by the composter to be low in substances that pose a present or future hazard to human health or the environment and low in and unlikely to support human pathogens. <u>Manures and vegetable wastes must be processed and placed in an properly managed compost pile within 24 hours of receipt, or be considered nongreen feedstocks.</u> This term is not intended to include materials fed to animals and not used for composting.
Nongreen Feedstock	(64) "Nongreen Feedstocks" are materials used to produce a compost. Nongreen feedstocks are high in a) substances that pose a present or future hazard to human health or the environment and b) high in and likely to support human pathogens. Nongreen feedstocks include but are not limited to: animal parts and by-products, mixed materials containing animal parts or by-products, dead animals, <u>post-consumer food wastes, waste containing significant amounts of proteins, fats, and oils,</u> and municipal solid waste. This term is not intended to include materials fed to animals and not used for composting.

5.2 Best Management Practices

In Oregon, facilities permitted under the 1200-Z or 1200-COLS permits are required to maintain existing controls and/or develop new controls appropriate for the site in order to eliminate or minimize the exposure of pollutants to stormwater. As part of this requirement facilities are required to employ the following categories of BMPs (if technically and economically feasible): containment, oil and grease, waste chemicals and material disposal, erosion and sediment control, debris control, stormwater diversion, covering activities, and housekeeping. To make these categories applicable to composting facilities, the definitions need some modifications. Table 5-2 summarizes the current definition and recommended revised definition for each BMP category.

TABLE 5-2
Modifications to BMP Categories

BMP Category	Current Definition	Recommended Revised Definition
Containment	All hazardous substances must be stored within berms or other secondary containment devices to prevent leaks and spills from contaminating stormwater. If the use of berms or secondary containment devices is not possible, then hazardous substances must be stored in areas that do not drain to the storm sewer system.	Leave definition as stands.
Oil and Grease	Oil/water separators, booms, skimmers or other methods must be employed to eliminate or minimize oil and grease contamination of stormwater discharges.	Leave definition as stands. Oil/water separators are recommended for use at compost facilities.
Waste Chemicals and Material Disposal	Wastes must be recycled or properly disposed of in a manner to eliminate or minimize exposure of pollutants to stormwater. All waste contained in bins or dumpsters where there is a potential for drainage of stormwater through the waste must be covered to prevent exposure of stormwater to these pollutants. Acceptable covers include, but are not limited to, storage of bins or dumpsters under roofed areas and use of lids or temporary covers such as tarps.	Leave definition as stands.
Erosion and Sediment Control	Erosion control methods such as vegetating exposed areas, graveling or paving must be employed to minimize erosion of soil at the site. Sediment control methods such as detention facilities, sediment control fences, vegetated filter strips, bioswales, or grassy swales must be employed to minimize sediment loads in stormwater discharges. For activities that involve land disturbance, the permittee must contact the local municipality to determine if there are other applicable requirements.	Leave definition as stands. However recommend combining with debris control, and renaming the category Erosion, Sediment, and Debris Control. BMP options include: grading facility areas, appropriate site vegetation, graveling or paving, sediment basins or traps, bioswales or grassy swales, soil filters, wetlands, holding ponds or detention facilities, sediment/debris control (with wattles, bales, or fences), sediment/debris control with centrifugal or weir and baffle solids traps, granular filtration tanks, soil and plant systems, chemical treatment, coagulation and sedimentation, aeration and ozonation, and underground injection.
Debris Control	Screens, booms, settling ponds, or other methods must be employed to eliminate or minimize debris in stormwater discharges.	Leave definition as stands. However recommend combining with erosion and sediment control, and renaming the category Erosion, Sediment, and Debris Control. See above for BMP options.

TABLE 5-2
Modifications to BMP Categories

BMP Category	Current Definition	Recommended Revised Definition
Stormwater Diversion	Stormwater must be diverted away from fueling, manufacturing, treatment, storage, and disposal areas to prevent exposure of uncontaminated stormwater to potential pollutants.	<p>Stormwater must be kept from running onto the site and must be diverted away from fueling, storage (of oil, gas, and chemicals), compost feedstock, active composting, curing, finished product, and disposal areas to prevent exposure of uncontaminated stormwater to potential pollutants, where technically and economically feasible. Stormwater, process stormwater, compost leachate, and washwater must be kept from commingling with each other. All streams except stormwater should be kept from running off site. Recommend renaming Stormwater, Compost Leachate, and Washwater Diversion.</p> <p>BMP options include: grading facility areas, paving, diversion with containment (using barriers, curbing, berms, gutters, interceptor trenches, or dikes), liner systems, collection and reuse of stormwater or compost leachate, and minimizing runoff by practicing specific operating procedures.</p>
Covering Activities	Fueling, manufacturing, treatment, storage, and disposal areas must be covered to prevent exposure of stormwater to potential pollutants. Acceptable covers include, but are not limited to, permanent structures such as roofs or buildings and temporary covers such as tarps.	<p>Fueling, storage (of oil, gas, and chemicals), compost feedstock, active composting, curing, finished product, and disposal areas (that have the potential to discharge to waters of the State) should be covered to reduce exposure of stormwater to potential pollutants.</p> <p>Studies have shown that older piles leach less nitrogen than younger piles. Therefore if covers can only be used on a limited basis, younger piles should be considered before older piles (if compost leachate is a problem for the site). This would include waste recovery and compost feedstock preparation areas and younger piles.</p> <p>Acceptable covers include, but are not limited to, permanent structures such as roofs or buildings and temporary covers such as tarps, covers, or membranes.</p>

TABLE 5-2
Modifications to BMP Categories

BMP Category	Current Definition	Recommended Revised Definition
Housekeeping	Areas that may contribute pollutants to stormwater must be kept clean. Sweeping, prompt clean up of spills and leaks, and proper maintenance of vehicles must be employed to eliminate or minimize exposure of stormwater to pollutants.	Areas that may contribute pollutants to stormwater must be kept clean (including areas between piles). Sweeping, prompt clean up of spills and leaks, proper maintenance of vehicles, elimination of standing surface water, prompt processing of incoming compost feedstocks, and proper shaping of the piles must be employed to eliminate or minimize exposure of stormwater to pollutants.

Owing to the nature of composting operations, the majority of BMPs for compost facilities fall either in the category of Erosion, Sediment, and Debris Control or Stormwater, Compost Leachate, and Washwater Diversion. As a result, compost facilities should first try and focus on prevention of stormwater contamination and then on treatment.

5.3 Benchmarks and Monitoring

In Oregon, stormwater benchmarks are currently in place for both the 1200-Z and 1200-COLS permits. Currently, Oregon composting facilities with stormwater discharges are required to collect grab samples twice a year and analyze them for the constituents shown in Table 5-3. Most western Oregon compost facilities must achieve the benchmarks in the 1200-Z permit while those in the Columbia Slough area in Portland must achieve more stringent benchmarks in the 1200-COLS permit. Facilities that are located in low rainfall areas and can manage stormwater so there's no anticipated point source discharge are not required to get a stormwater permit. Table 5-3 also shows the benchmarks that are used for regulating stormwater from compost facilities in Washington, California, and Maine. Of the four states compared, Washington requires the most extensive list of analytes. Washington, California, and Maine all use the benchmarks values that are listed in the U.S. EPA Multi-Sector Permit. These values are generally more conservative than the benchmarks used in Oregon (excluding those listed the 1200-COLS). Oregon is the only state of the four that has a benchmark for E. Coli. None of these require testing for additional pathogens or pesticides.

TABLE 5-3
Current Benchmarks for Stormwater in Oregon, Washington, California, and Maine

Constituent	Oregon 1200-Z Benchmarks (mg/L)	Oregon 1200-COLS Benchmarks (mg/L)	Washington Industrial General Benchmarks (mg/L)	California Benchmarks (mg/L)	Maine Multi-Sector General Permit Benchmarks (mg/L)
Total Copper	0.1	0.036	0.0636**	NA	NA
Total Iron	NA	NA	NA	1.0	1.0
Total Lead	0.4	0.006	0.0816**	0.0816	0.0816
Total Zinc	0.6	0.24	0.117	0.117	0.117
pH	5.5 - 9.0 S.U.	6.5-8.5 S.U.	6.0-9.0 SU	6.0-9.0 SU	NA
Turbidity	NA	NA	25 NTU	NA	NA
Total Suspended Solids	130	50	NA	100	NA
Total Oil and Grease	10	10	15	15	15
E. Coli*	406 counts/100 ml	406 counts/100 ml	NA	NA	NA
BOD ₅	NA	33	30	NA	NA
Nitrate/Nitrite as N	NA	NA	0.68	0.68	0.68
Total Phosphorus	NA	0.16	2.0	2.0	2.0
Floating solids (associated with industrial activity)	No visible discharge	No visible discharge	NA	NA	NA
Oil & grease sheen	No visible sheen	No visible sheen	NA	NA	NA

*The benchmark for E. coli applies only to landfills, if septage and sewage biosolids are disposed at the site, and sewage treatment plants.

**Only required if the Zn benchmark is exceeded for 2 consecutive quarters.

In Oregon, effluent limitations are currently in place for the 1700-A permit which covers vehicle, equipment, building, and pavement washing activities that result in a discharge to surface water or a stormwater sewer system. The permit contains effluent limitation for any discharges from washing activities. For engine washing, acid/caustic metal brightener washing, and steam/heated water washing, washwater must be collected and treated to meet the limitations shown in Table 5-4 below. Table 5-4 also shows the limitations that

must be met for all other washing activities (except those exempted under the permit). The permit requires that grab samples for each of these parameters are collected once per month.

TABLE 5-4
Oregon 1700-A NPDES General Permit: Wastewater Discharge Limitations

Parameter	Limitations (Daily Maximum)
Engine Washing, Acid/Caustic/Metal Brightener Washing, or Steam/Heater Water Washing	
Oil and Grease	15 mg/l
Copper	0.1 mg/l
Lead	0.1 mg/l
Zinc	0.5 mg/l
pH	Shall be within 6.0 – 9.0 S.U.
All other washing activities	
Total Suspended Solids	60 mg/l
Oil and Grease	15 mg/l
pH	Shall be within 6.0 – 9.0 S.U.

Based on the comparison of stormwater regulations imposed in Oregon and other states and the existing washwater limitations, Oregon should make the following changes to benchmarks and limitations to create a new water quality permit that covers stormwater, compost leachate, and washwater.

Benchmarks:

- Keep the existing 1200-Z benchmarks for total copper, total lead, total zinc, pH, total suspended solids, and total oil and grease. These existing benchmarks are based on water quality criteria, with an allowance for downstream mixing, and therefore will be considered appropriately protective of receiving water quality. Also, consistency for the benchmarks for these pollutants with the 1200-Z permit benchmarks will minimize confusion.
- Keep the existing 1200-Z floating solids and oil and grease sheen visual monitoring requirements. Again, consistency with the 1200-Z benchmarks makes sense.
- Add benchmarks for BOD₅, nitrate/nitrite as nitrogen, and total phosphorus. The addition of benchmarks for these constituents will help minimize the introduction of excess nutrients and high oxygen demand to surface waters (as discussed in Section 2). Use of the Washington benchmarks (based on the U.S. EPA Multi-Sector Permit) for these parameters is recommended, with the exception that the nitrate/nitrite as nitrogen benchmark should be expressed as 0.7 mg/L (one significant figure is generally more

appropriate). These benchmarks are established levels that have been approved by EPA and are considered protective of receiving water quality.

- Add benchmark for E. Coli, based on the existing 1200-Z benchmark that applies for landfills (if septage and sewage biosolids are disposed at the site) and sewage treatment plants. This benchmark is recommended to only apply to those facilities that are processing green compost feedstock mixed with animal manure, and/or nongreen compost feedstock. There has been some concern that the addition of a bacteria benchmark for composting facilities would result in false positives due to plant-borne organisms being counted as coliforms due to the broad nature of the standard method used for total or Fecal coliform analyses. For example organisms such as Klebsiella and Citrobacter can be counted as Fecal coliform but they often reside on the tissue of leaves and bark, not inside animals. The recommended benchmark would be for E. Coli, which is the indicator organism used in the Oregon DEQ water quality standards for bacteria. It is also recommended that the permit include a section listing the approved procedures for E. Coli testing. These procedures, including the popular Colilert procedure (see table below), are specific for E. coli, and do not result in false positives because of the nonpathogenic plant derived organisms mentioned above.

Bacteria monitoring language to be included in the permit is as follows:

E. coli monitoring must be conducted according to any of the following test procedures as specified in **Standard Methods for the Examination of Water and Wastewater, 20th Edition**, (American Public Health Association, 2002) or according to any test procedure that has been authorized and approved in writing by the Director or his authorized representative:

Method	Reference	Page	Method Number
MTEC agar, MF	Standard Methods, 18 th Edition	9-28	9213 D
NA-MUG, MF	Standard Methods, 19 th Edition	9-63	9222 G
Chromogenic Substrate, MPN	Standard Methods, 19 th Edition	9-65	9223 B
Colilert QT	Idexx Laboratories, Inc. http://www.idexx.com/water/products/colilert/science.cfm		

- No benchmarks are recommended for pesticides however PFRP temperatures are beneficial for decomposing chemical residues. Concentrations of pesticides and herbicides should be minimal. See Section 2.2.1 for details. Chlordane and pentachlorophenol were the two constituents most frequently present in the test results on finished compost and should be controlled by not allowing the acceptance of treated wood into the compost facility.

Limitations:

- Keep the existing 1700-A limitations. Washwater should be kept segregated and contained from all other onsite streams and therefore does not require modifications specific to compost facilities. If streams are allowed to commingle with washwater, the

entire stream will be subject to the limitations in the 1700-A. This should encourage diversion of stormwater, compost leachate, and washwater.

Monitoring:

- Maintain the twice per year monitoring requirements from the 1200-Z permit for all numerical benchmarks, and the once per month (when discharging) frequency for the visual observations for floating solids and oil and grease sheen.
- Eliminate the option for monitoring reduction that is in Schedule B.2 of the 1200-Z permit. Composting facilities have a greater likelihood of potential changes to stormwater and other discharges due to factors such as changing compost feedstocks, and the more direct impact of weather conditions, and the monitoring waiver is not recommended.
- Maintain the monthly monitoring requirement from the 1700-A permit for washwater discharge.

The new recommended composting facility benchmarks and monitoring frequency are summarized in Table 5-5.

TABLE 5-5
Recommended Composting Facility Benchmarks and Monitoring Frequency

Constituent	Benchmarks	Monitoring Frequency
Total Copper	0.1 mg/L	Twice per Year
Total Lead	0.4 mg/L	Twice per Year
Total Zinc	0.6 mg/L	Twice per Year
pH	5.5 - 9.0 S.U.	Twice per Year
Total Suspended Solids	130 mg/L	Twice per Year
Total Oil and Grease	10 mg/L	Twice per Year
E. coli*	406 counts/100 ml	Twice per Year
BOD ₅	30 mg/L	Twice per Year
Nitrate/Nitrite as N	0.7 mg/L	Twice per Year
Total Phosphorus	2.0 mg/L	Twice per Year
Floating solids (associated with industrial activity)	No visible discharge	Once per Month (when discharging)
Oil & grease sheen	No visible sheen	Once per Month (when discharging)

* The benchmark for E. coli applies only to composting facilities processing green compost feedstock mixed with animal manure, and/or nongreen compost feedstock.

These new benchmarks and monitoring requirements are intended to more adequately control the water quality at composting facilities. In addition, these benchmarks are

considered to be reasonable benchmarks that the facilities should be able to meet with proper controls. If a facility is having difficulty meeting these benchmarks, they should revise their stormwater pollution control plan and should be required to prepare a mitigation plan. This process will promote continuous improvement. However, it is advisable that the permit acknowledge ongoing changes in the composting industry as new information regarding human health and the environment becomes available. Such changes may result in the need for additional modifications.

SECTION 6

Conclusions

Stormwater and related liquid discharges such as process water, compost leachate, and washwater from composting may contain a variety of constituents that are potentially harmful to the environment. Some are transient (such as suspended solids, oxygen demand, and bacteria) and can be reduced in the natural environment using BMPs. Others are more accumulative (such as metals and petroleum products) and their discharge is best prevented using BMPs. Because outdoor composting operations are prevalent in Oregon, these facilities have the potential to affect a variety of water streams, including process and nonprocess stormwater, compost leachate, and washwater. Without appropriate controls, the combination of potentially harmful constituents and uncontrolled water streams may result in releases to surface waters and groundwater.

A variety of controls can be incorporated into the design and operating requirements for compost facilities. Comparison of the composting regulations in California, Maine, Oregon, and Washington indicates that Maine and Washington have stricter design requirements for the management of stormwater and compost leachate than Oregon. This report recommends BMPs that are specifically applicable to Oregon compost facilities, based on a review of potential BMPs used by Oregon and other states. In addition, recommendations are made for modifications to the monitoring requirements of the stormwater permit for compost facilities, including adaptation of benchmarks currently used in Oregon and Washington. These modifications will enhance the relevance and protective quality of the stormwater permit. However, it is advisable that the permit acknowledge ongoing changes in the composting industry as new information regarding human health and the environment becomes available. Such changes may result in the need for additional modifications.

Commercial composting operations are expected to grow in size and number over the next few years. Yard debris, food waste, biosolids, manure, and specialty organics are all growth areas as wastesheds strive to achieve high recovery rates. Furthermore, composters will find they can make money by making quality compost as disposal and land application options are restricted. The existing permitting process for green compost feedstock composters is simple and low cost allowing for rapid expansion since 1999. Land use limitations and requirements tend to create pressure for existing facilities to expand and new facilities to locate in industrial areas near urban centers, on established agricultural operation or on low value farmland which is usually far from urban centers. Hence Oregon will need more composting operations capable of handling diverse compost feedstocks and this is likely to occur through expansion of existing facilities and applications for some new facilities.

A general water quality permit will have to address an effective strategy for the control of potentially harmful constituents, storage of winter runoff water for reuse and operation of treatment systems to achieve effective control.

SECTION 7

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APPENDIX A

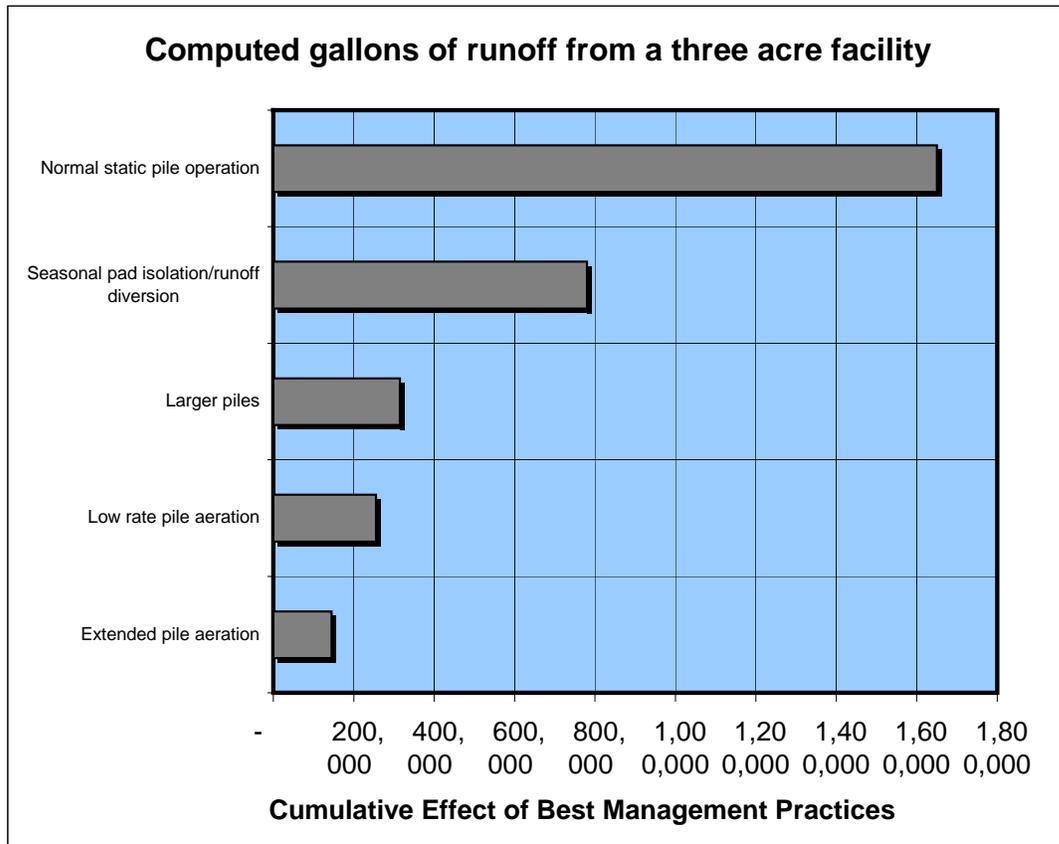
Case Study—Operation and Management Options

A study was published in Washington State in 2000 which evaluated the effect that operating techniques had on runoff generation. Different techniques were tested on a medium-sized yard debris composting facility in western Washington. According to this study, modifications of operating techniques and procedures can potentially eliminate up to 90 percent of the runoff generated from a facility.¹ The modifications that were proposed in this study address energy and water needs of the composting system by:

1. Managing moisture and heat release in each pile
2. Managing the process so evaporated moisture is released to the atmosphere
3. Forcing or controlling air flow through the piles to remove heat and moisture
4. Reducing pad space and pile configuration
5. Covering the compost processing areas
6. Diverting pavement or pad runoff away from active process and storage areas

The affects of these operational modifications are shown in the below figure.

FIGURE A-1
 Effect of Operational Changes on Runoff Generation
 Source: (E&A Environmental Consultant, Inc., 2000)



¹ E&A Environmental Consultant, Inc. January 2000. *Evaluation and Prioritization of Compost Facility Runoff Management Methods*. Report no. CM-00-2.

APPENDIX B

**Regulatory Fact Sheets for Oregon,
California, Maine, and Washington**

Oregon

Compost Regulations

Oregon has a tiered regulatory framework for the regulation of composting facilities. Within the framework are three levels of regulatory permitting, composting registration, composting general permit, and a composting full permit. Facilities are permitted based on feedstock type, and facility size (described as volume of incoming feedstocks).

Definitions

<i>Green Feedstocks</i>	<p>Are materials low in:</p> <ul style="list-style-type: none">a) Substances that pose a present or future hazard to human health or the environment; and,b) Substances that are low-in, and unlikely to support human pathogens. <p>Green feedstock include, but are not limited to: yard debris, animal manure, wood waste, vegetative food waste, produce waste, vegetative restaurant waste, vegetative food processor by-products, and crop residue. (OAR 340-093-0030)</p>
<i>Nongreen Feedstocks</i>	<p>Are materials high in:</p> <ul style="list-style-type: none">a) Substances that pose a present or future hazard to human health or the environment; and,b) Substances that are high in, and likely to support, human pathogens. <p>Nongreen feedstocks include, but are not limited to: Animal parts and by-products, mixed materials containing animal parts or by-products, dead animals and municipal solid waste. (OAR 340-093-0030)</p>
<i>Agricultural Composting</i>	<p>Means composting as an agricultural operation conducted on lands employed for farm use. (OAR 340-093-0030)</p>
<i>Institutional Composting</i>	<p>Means the composting of green feedstocks generated from the facility's own activities. It may also include supplemental feedstocks. Feedstocks must be composted on-site and the compost produced must be used on-site and not offered for sale or use off-site. Institutional composting includes, but is not limited to: parks, apartments, universities, schools, hospitals, golf courses, and industrial</p>

	parks. (OAR 340-093-0030)
<i>Leachate</i>	Means liquid that has come into contact with solid waste and contains dissolved, miscible and/or suspended contaminants as a result of such contact. (OAR 340-093-0030)
<i>Reload Facility</i>	Means a facility or a site that accepts and reloads only yard debris and wood waste for transport to another location. (OAR 340-093-0030)
<i>Stormwater</i>	Means water from rain or snow melt.

Composting Registration (Oregon Administrative Code [OAR] 340-096-0024(1) and OAR 340-096-0028(1)(d), (2)(c), (3)(b), (3)(c) and (4))

Composting registration is required for facilities utilizing as feedstocks for composting:

- More than 20 tons of green feedstocks in a calendar year; or
- More than 20 tons and less than or equal to 5,000 tons of feedstocks, which are exclusively yard debris and wood waste, in a calendar year.

Composting General Permit (OAR 340-096-0024(2) and OAR 340-093-0070(3))

A composting general permit is required for facilities utilizing as feedstocks for composting:

- More than 2,000 tons of green feedstocks in a calendar year; or
- More than 5,000 tons of green feedstocks, which are exclusively yard debris or wood waste, in a calendar year.

Composting Full Permit (OAR 340-096-0024(3))

A composting full permit is required for facilities utilizing more than 20 tons of feedstocks for composting during a calendar year, that include ANY amount of nongreen feedstocks.

Exempt Activities (OAR 340-093-0050(3)(d))

- Agricultural operations composting green feedstocks generated and composted at the same agricultural operation and all the compost is used on-site at an agronomic rate;
- Agricultural composting operations that are following a compost management plan approved by the Oregon Department of Agriculture;
- Production of silage on a farm for animal feed;
- Home composting;
- Institutional composting;
- Reload facilities; and,

- Composting facilities utilizing sewage sludge or biosolids under a valid Oregon Department of Environmental Quality (DEQ) water quality permit.

Stormwater Management

The DEQ Solid Waste Special Rules for Selected Solid Waste Disposal Sites mandates that composting facilities will have no discharge of stormwater or wash water (from vehicle and equipment washing) to the ground, or surface waters, except in accordance with permits issued by the DEQ Water Quality Division (OAR 340-096-0028(2)(C)). In addition, the Composting General Permit requires that a permittee must apply to the DEQ Water Quality Division for a stormwater permit if there is a point source discharge of stormwater from the facility (Solid Waste General Permit for Composting Facilities. Permit Number C2; Section 9.1). Stormwater and wash water discharges from composting facilities in Oregon are regulated under National Pollutant Discharge Elimination System (NPDES) General permits.

1200-Z General Permit, National Pollutant Discharge Elimination System Stormwater Discharge Permit (OAR 340-041 and OAR 340-045)

The NPDES Industrial General Permit is issued for 5 years. The permit stipulate the following basin requirements:

- Monitor stormwater by taking a grab sample twice a year for contaminants specified in the permit.
- Strive to meet stormwater benchmarks in the permit (see Tables 1 and 2 below)
- Submit and implement a Stormwater Pollution Control Plan (SWPCP). The SWPCP must include the following:
 - Site description
 - Stormwater best management practices (BMPs)
 - Spill prevention and response procedures
 - Preventative maintenance
 - Employee education
 - Record keeping and internal reporting procedures

For further information on developing a SWPCP see *DEQ's Guidance Document for Preparation of the NPDES Stormwater Pollution Control Plan and Recommended Best Practices for Stormwater Discharges* (<http://www.deq.state.or.us/wq/wqpermit/wqpermit.htm>).

- Review and update SWPCP when benchmarks are exceeded.

1200-COLS General Permit, National Pollutant Discharge Elimination System Stormwater Discharge Permit (OAR 340-041 and OAR 340-045)

This NPDES General Permit was developed for facilities draining to the Columbia Slough. The permit contains the same general requirements for SWPCP development and BMPs and the 1200-Z NPDES General Permit. However, the stormwater discharge benchmarks

are different, as they are based on the pollutants of concern and the Columbia Slough total maximum daily load (TMDL) limits.

Stormwater BMPs

If economically and technically feasible the following BMPs must be employed at a permitted site:

- Containment
- Oil and grease elimination or minimization
- Waste chemical and material disposal
- Erosion and sediment control
- Debris control
- Stormwater diversion
- Covering of activities
- Housekeeping

Stormwater Discharge Benchmarks

Under the 1200-Z permit all permittees must take stormwater grab samples twice per year for all constituents listed in Table 1 with the exceptions of Floating Solids and Oil and Grease Sheen which must be sampled for monthly when a facility is discharging.

TABLE 1
Oregon 1200-Z NPDES General Permit: Stormwater Discharge Benchmarks

Parameter	Benchmark
Total Copper	0.1 mg/l
Total Lead	0.4mg/l
Total Zinc	0.6 mg/l
pH	5.5-9.0 SU
Total Suspended Solids	130 mg/l
Total Oil and Grease	10 mg/l
E. Coli **	406 counts/100 ml
Floating Solids (associated with industrial activities)	No visible discharge
Oil and Grease Sheen	No visible sheen

** The benchmark for E. coli applies only to landfills, if septage and sewage biosolids are disposed at the site, and at sewage treatment plant.

Under the 1200-COLS permit, all permittees must take stormwater grab samples twice per year for all constituents listed in Table 1 with the exceptions of Temperature, Floating Solids, and Oil and Grease Sheen which must be sampled for monthly when a facility is discharging.

TABLE 2
Oregon 1200-COLS NPDES General Permit: Stormwater Discharge Benchmarks

Parameter	Benchmark	Benchmark (Optional)
Total Copper	0.036 mg/l	0.036 mg/l
Total Lead	0.006 mg/l	0.006 mg/l
Total Zinc	0.24 mg/l	0.24 mg/l
pH	6.5-8.5 SU	6.5-8.5 SU
Total Suspended Solids	50 mg/l	130 mg/l
Total Oil and Grease	10 mg/l	10 mg/l
E. Coli	406 counts/100 ml	406 counts/100 ml
BOD ₅	33 mg/l	33 mg/l
Total Phosphorus	0/16 mg/l	0/16 mg/l
Dieldrin	NA	0.0000000584 mg/l
DDT/DDE	NA	0.0000000197 mg/l
PCB	NA	0.0000000322 mg/l
Dioxin	NA	0.0000000000797 mg/l
Temperature	Report	Report
Floating Solids (associated with industrial activities)	No visible discharge	No visible discharge
Oil and Grease Sheen	No visible sheen	No visible sheen

1700-A General Permit, National Pollutant Discharge Elimination System Permit (OAR 340-041 and OAR 340-045)

This NPDES General Permit covers discharges related to vehicle, equipment, building, and pavement washing activities that result in a discharge to surface water or a stormwater sewer system. The permit prohibits the use of organic solvents or nonbiodegradable soaps or detergents. In addition, all chemical, soaps, and detergents are required to be phosphate-free. The permit contains effluent limitation for any discharges from washing activities. For engine washing, acid/caustic metal brightner washing, and steam/heated water washing, washwater must be collected and treated to meet the limitations shown in Table 3 below. For all other washing activities (except those exempted under the permit), the limitations shown in Table 4 must be met. The permit requires that grab samples for each of these parameters are collected once per month.

TABLE 3

Oregon 1700-A NPDES General Permit: Wastewater Discharge Limitations (Engine Washing, Acid/Caustic/Metal Brightener Washing, or Steam/Heater Water Washing)

Parameter	Limitations (Daily Maximum)
Oil and Grease	15 mg/l
Copper	0.1 mg/l
Lead	0.1 mg/l
Zinc	0.5 mg/l
pH	Shall be within 6.0 – 9.0 S.U.

TABLE 4

Oregon 1700-A NPDES General Permit: Wastewater Discharge Limitations

Parameter	Limitations (Daily Maximum)
Total Suspended Solids	60 mg/l
Oil and Grease	15 mg/l
pH	Shall be within 6.0 – 9.0 S.U.

The permit also requires that the permittee implement the best management practices listed in the DEQ's guidance document titled *Recommended Best Management Practices for Washing Activities*, whenever economically and technically feasible.

Leachate Management

If leachate is present, a composter must provide a protective layer beneath compost processing and feedstock areas, and leachate sumps and storage basins to prevent the release of leachate to surface water or ground water. Facility operators must monitor all water releases and document that there is no release to groundwater (OAR 340-096-0028(2)(b)).

The Composting General Permit requires that the facilities develop and implement a written inspection and maintenance plan that provides procedures for washing equipment and maintaining leachate management systems to ensure no adverse impacts from facility operations on waters of the state (Solid Waste General Permit for Composting Facilities. Permit Number C2; Section 7.3). The permit also states that facilities which generate leachate may need to install leachate monitoring devices (Solid Waste General Permit for Composting Facilities. Permit Number C2; Section 9.2).

If there is a discharge of leachate or wash water (from vehicle and equipment washing) to surface water or ground water, a wastewater permit from the DEQ is required (OAR 340-096-0028(2)(c)). Agricultural composters must meet water quality requirements pursuant Oregon Revised Statute 468B.050 (1)(b), administered by the Oregon Department of Agriculture.

Resources:

- <http://www.deq.state.or.us/wmc/solwaste/composting.html>

California

Compost Regulations

California has a tiered regulatory framework for the regulation of solid waste facilities. The regulations establish five (5) tiers of regulatory placement for solid waste facilities. From the highest level of regulation to the lowest, the tiers are full, standardized, registration, enforcement agency notification, and excluded. California revised their compost regulations in April of 2003 and under the new regulations all composting facilities fall under either excluded activities, enforcement agency notification, or full permit tiers with the exception of some chipping and grinding operations. Chipping and grinding operations handling more than 200 tons per day and up to 500 tons per day of material are required to obtain a registration permit.

Definitions

<i>Agricultural Material</i>	Means material of plant or animal origin, which result from the production and processing of farm, ranch agricultural, horticultural, aquacultural, silvicultural, floricultural, vermicultural, or viticultural products, including manures, orchard and vineyard prunings, and crop residues (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(5)).
<i>Agricultural Material Composting Operation</i>	Means an operation that produces compost from green or agricultural additives, and/or amendments (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(6)).
<i>Biosolids</i>	Means solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Biosolids includes, but is not limited to, treated domestic septage and scum or solids removed in primary, secondary, or advanced wastewater treatment processes. Biosolids does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screenings generated during the preliminary treatment of domestic sewage in a treatment works (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(9)).

<p><i>Chipping and Grinding Operation</i></p>	<p>Means an operation or facility, that does not produce compost, that mechanically reduces the size or otherwise engages in the handling, of compostable material and the site does the following:</p> <ol style="list-style-type: none"> 1. The site handles only material, excluding manure, allowed at a green material composting operation; and 2. Each load of green material is removed from the site within 48 hours of receipt. <p>(Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(10)).</p>
<p><i>Feedstock</i></p>	<p>Means any compostable material used in the production of compost or chipped and ground material including, but not limited to, agricultural material, green material, food material, biosolids, and mixed solid waste. Feedstocks shall not be considered as either additives or amendments (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(19)).</p>
<p><i>Green Material</i></p>	<p>Means any plant material that is separated at the point of generation contains no greater than 1.0 percent of physical contaminants by weight. Green material includes, but is not limited to, yard trimmings, untreated wood wastes, natural fiber products, and construction and demolition wood waste. Green material does not include food material, biosolids, mixed solid waste, material processes from commingled collection, wood containing lead-based paint or wood preservative, mixed construction or mixed demolition debris (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(21)).</p>
<p><i>Green Material Composting Operation</i></p>	<p>Is an operation or facility that composts green material, additives, and/or amendments. A green material composting operation or facility may also handle manure and paper products. An operation or facility that handles a feedstock that is not green material, manure, or paper products, shall not be considered a green material composting operation or facility (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(22)).</p>

<i>Mushroom Farming</i>	Means an activity that produces mushrooms. The handling of compostable material at a mushroom farm prior to and after use as a growth medium is subject to regulation pursuant to this chapter and is not considered mushroom farming (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(27)).
<i>Process Water</i>	means liquid that is generated during or used in the production of compost or chipped and ground materials.
<i>Research Composting Operation</i>	Means a composting operation, that is operated for the purpose of gathering research information on composting (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(34)).
<i>Stormwater</i>	Means stormwater runoff, snow melt runoff, and stormwater surface runoff and drainage. It excludes infiltration and runoff from agricultural land (State Water Resources Control Board Water Quality Order No. 97-03-DWQ NPDES General Permit No. CAS000001. Attachment 4 Definitions).
<i>Vermicomposting</i>	Means an activity that produces worm castings through worm activity. The EA may determine whether an activity is or is not vermicomposting. The handling of compostable material prior to and after use as a growth medium is subject to regulation pursuant to this chapter and is not considered vermicomposting (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1, Section 17852(a)(39)).

Compostable Materials Handling Operations and Facilities Regulatory Requirements (Title 14 California Code of Regulations [CCR], Division 7, Chapter 3.1, Article 1-4)

Enforcement Agency (EA) Notification

The following composting operations are required to provide *EA Notification* (Title 14, CCR, Division 7, Chapter 5, Article 3.0 (commencing with section 18100)):

- All agricultural material composting operations (Title 14 CCR, Section 17856)
- Green material composting operations with up to 12,500 cubic yards of feedstock, compost or chipped and ground material on-site at any one time (Title 14 CCR, Section 17857.1)
- All biosolids composting operations at Publicly Owned Treatment Works (POTWs) (Title 14 CCR, Section 17859.1)
- Research composting operations with less than 5,000 cubic yards of material on-site (more material may be allowable onsite in a vessel with EA approval) (Title 14 CCR, Section 17862)

- Chipping and grinding operations handling less than 200 tons per day of material (Title 14 CCR, Section 17855.4)

Registration Permit

The following operations are required to obtain a *Registration Permit* (Title 14, CCR, Division 7, Chapter 3.1, Article 2, Section 17862.1(b), pursuant to Title 14 CCR, Division 7, Chapter 5, Article 3):

- Chipping and grinding facilities that receive more than 200 tons per day, and up to 500 tons per day of material that may be handled by a green material composting operation (Title 14 CCR, Section 17862.1(b))

Full Facility Permit

The following composting operations are required to obtain a *Compostable Materials Handling Facility Permit* (Title 14, CCR, Division 7, Chapter 3.1, Article 2 pursuant to Title 27, CCR, Division 2, Subdivision 1, Chapter 4, Subchapter 1 and Subchapter 3, Articles 1, 2, 3, and 3.1 (commencing with Section 21450)):

- All compost facilities with feedstock other than green material (Title 14 CCR, Section 17854)
- Green material composting facilities with more than 12,500 cubic yards of feedstock, compost or chipped and ground material on-site at any one time (Title 14 CCR, Section 17857.1)
- Chipping and grinding operations handling more than 500 tons per day of material (14 CCR, Section 17862.1)²

Excluded Activities

The following activities are excluded from permit requirements (Title 14, CCR, Division 7, Chapter 3.1, Section 17855):

- Agricultural composting if no more than 1,000 cubic yards of compost is sold or given away annually
- Vermicomposting (Note: the handling of compostable materials used as a growth medium is not excluded)
- Mushroom farming (Note: the handling of compostable materials used as a growth medium is not excluded)
- On-site generation of green material if there is no more than 500 cubic yards on-site and no more than 1,000 cubic yards is sold or given away annually)
- Non-commercial composting with less than one cubic yard of food material is excluded provided that all compostable material is generated and used on-site

² Chipping and grinding operations handling between 200 tons per day and 500 tons per day of material require and Registration Permit (Title 14, CCR, Division 7, Chapter 5.0, Article 3.0 (commencing with Section 18100))

- Storage of bagged products from compostable material is an excluded activity provided that bags are no greater than 5 cubic yards
- Within-vessel composting process activities with less than 50 cubic yard capacity
- Beneficial use of compostable materials. Beneficial uses includes, but is not limited to slope stabilization, weed suppression, alternative daily cover, and similar uses, as determined by the EA; land application in accordance with California Department of Food and Agriculture requirements; and reclamation projects in accordance with requirements set by the Office of Mine Reclamation of the Department of Conservation
- The handling of compostable materials is an excluded activity if:
 - The activity is located at a facility (i.e. landfill or transfer/processing facility) that has a tiered or full permit; that has a Report of Facility Information which is completed and submitted to the EA that identifies and describes the activity and meets the composting regulatory requirement; and will only use the material on the facility site
 - The activity is solely for temporary storage of biosolids sludge at a POTW
 - The activity is located at the site of biomass conversion and is for use in biomass conversion
 - The activity is part of a silvicultural operation or a wood, paper, or wood product manufacturing operation
 - The activity is part of an agricultural operation and is used to temporarily store or process agricultural material not used in the production of compost or mulch
 - The activity is part of an operation used to chip and grind material derived from and applied to lands owned or leased by the owner, parent, or subsidiary of the operation
 - The activity is part an animal food manufacturing or rendering operation
 - The activity is the storage of yard trimmings at a publicly designated site for the collection of lot clearing necessary for fire protection provided that the public agency designating the site has notified the fire protection agency
 - The materials are handled in such a way to preclude the reaching of temperatures at or above 122 degrees Fahrenheit as determined by the EA

Resources:

- <http://www.ciwmb.ca.gov/Regulations/Title14/ch31.htm>
- <http://www.ciwmb.ca.gov/Regulations/Title14/ch5a3.htm>

Stormwater Management

Stormwater discharges from composting facilities in California are regulated under a National Pollutant Discharge Elimination System (NPDES) General permit for Non-

Construction Industrial Activities. The California Regional Water Quality Boards (Regional WQCB) administer the California NPDES program.

National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000001 (General permit for Non-Construction Industrial Activities)

The NPDES Industrial General Permit is issued for 5 year and requires the following:

- Eliminate unauthorized nonstormwater discharges
- Perform monitoring of stormwater discharges and authorized nonstormwater discharges
- Develop and implement a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must include:
 - Site map
 - List of significant materials
 - Description of potential pollutant sources
 - Assessment of potential pollutant sources
 - Stormwater Best Management Practices (BMPs)

Stormwater BMPs

The following BMPs must be considered for implementation:

- Good Housekeeping
- Preventive Maintenance
- Spill Response
- Material Handling and Storage
- Employee Training
- Waste Handling/Recycling
- Recordkeeping and Internal Reporting
- Erosion Control and Site Stabilization
- Inspections
- Quality Assurance
- Overhead Coverage
- Retention Ponds
- Control Devices
- Secondary Containment Structures
- Treatment

Stormwater Sampling and Benchmarks

Permitted composting facilities are required to collect and analyze samples of stormwater discharges. Stormwater samples must be collected during the first hour of discharge from (1) the first storm event of the wet season, and (2) at least one other storm event in the wet season (NPDES General Permit No. CAS000001). Samples must be analyzed for the following:

- pH

- Total suspended solids (TSS)
- Total organic carbon (TOC) (Oil and Grease may be substituted for TOC)
- Total iron
- Nitrate/nitrite (as N)
- Total lead
- Total zinc
- Phosphorus
- Specific conductance

California uses the stormwater benchmarks provided in the federal NPDES Multi-Sector General Permit (see table below).

Parameter name	Benchmark level
Biochemical Oxygen Demand (5 day)	30 mg/L
Chemical Oxygen Demand	120 mg/L
Total Suspended Solids	100 mg/L
Oil and Grease	15 mg/L
Nitrate + Nitrite Nitrogen	0.68 mg/L
Total Phosphorus	2.0 mg/L
pH	6.0–9.0 s.u.
Acrylonitrile (c)	7.55 mg/L
Aluminum, Total (pH 6.5–9)	0.75 mg/L
Ammonia	19 mg/L
Antimony, Total	0.636 mg/L
Arsenic, Total (c)	0.16854 mg/L
Benzene	0.01 mg/L
Beryllium, Total (c)	0.13 mg/L
Butylbenzyl Phthalate	3 mg/L
Cadmium, Total (H)	0.0159 mg/L
Chloride	860 mg/L
Copper, Total (H)	0.0636 mg/L
Cyanide, Total	0.0636 mg/l
Dimethyl Phthalate	1.0 mg/L
Ethylbenzene	3.1 mg/L
Fluoranthene	0.042 mg/L
Fluoride	1.8 mg/L
Iron, Total	1.0 mg/L
Lead, Total (H)	0.0816 mg/L
Magnesium, Total	0.0636 mg/l
Manganese	1.0 mg/L
Mercury, Total	0.0024 mg/L
Nickel, Total (H)	1.417 mg/L
PCB–1016 (c)	0.000127 mg/L
PCB–1221 (c)	0.10 mg/L
PCB–1232 (c)	0.000318 mg/L
PCB–1242 (c)	0.00020 mg/L
PCB–1248 (c)	0.002544 mg/L
PCB–1254 (c)	0.10 mg/L
PCB–1260 (c)	0.000477 mg/L
Phenols, Total	1.0 mg/L
Pyrene (PAH,c)	0.01 mg/L
Selenium, Total (*)	0.2385 mg/L
Silver, Total (H)	0.0318 mg/L
Toluene	10.0 mg/L
Trichloroethylene (c)	0.0027 mg/L
Zinc, Total (H)	0.117 mg/L

Resources:

<http://www.cabmphandbooks.com/Industrial.asp>

Process Waste (Leachate) Water Management

California's composting rules provide no specific requirements for leachate management beyond that leachate shall be controlled to prevent contact with the public (Title 14 CCR, Division , Chapter 3.1, Article 5., Section 17867(a)(12)).

Resources:

- <http://www.ciwmb.ca.gov/Regulations/Title14/ch31a5.htm#article5>

Maine

Compost Regulations

The Maine Department of Environmental Protection (DEP) regulates composting facilities under Maine Solid Waste Management Rules (06-096 Code of Maine Rule [CMR] Chapters 400, 405 and 409). Maine uses a tiering system to separate composting facilities into different regulatory levels. Facilities are permitted based on residual type and facility size (described as volume composted). Residuals that have been approved for composting include food, fiber, vegetable and fish processing wastes; dredge materials; biosolids; sewage sludge; short paper fiber; dewatered septage; and ash from wood, sludge or other fuels.

Maine has three levels of permitting for solid waste facilities listed from most stringent to least stringent: Full Facility Licensing, Reduced Procedures Licensing, and Permit by Rule Notifications. Most composting facilities are subject to Reduced Procedures Licensing or Permit by Rule Notifications.

Definitions

<i>Compost</i>	Means a residual that has undergone a composting process (06-096 CMR, Chapter 400(1)(DD))
<i>Leachate</i>	Means liquid that has passed through or emerged from solid waste and contains dissolved, suspended or miscible materials removed from that waste (06-096 CMR, Chapter 400(1)(ZZZ))
<i>Residual</i>	Means solid wastes generated from municipal, commercial, or industrial facilities that may be suitable for agronomic utilization. These materials may include: food, fiber, vegetable and fish processing wastes; dredge materials; sludges; dewatered septage; and ash from wood or sludge fired boilers (06-096 CMR, Chapter 400(1)(Ss))
<i>Type IA Residuals</i>	Are leaf, vegetative and other residuals with an available ratio of carbon to nitrogen (C:N ratios) of greater than 25:1 (06-096 CMR, Chapter 400(1)(Www))
<i>Type IB Residuals</i>	Are food and other residuals with a C:N ratio of between 25:1 to 15:1 (06-096 CMR, Chapter 400(1)(Xxx))
<i>Type IC Residuals</i>	Are fish and other residuals with a C:N ratio of less than 15:1 (06-096 CMR, Chapter 400(1)(Yyy))
<i>Type II residuals</i>	Are sewage sludge, septage, and other residuals that may contain human pathogens (06-096 CMR, Chapter 400(1)(Zzz))

<i>Type III residuals</i>	Are petroleum contaminated soils and other residuals that may contain hazardous substances (06-096 CMR, Chapter 400(1)(Aaaa))
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Full Facility Licensing (06-096, CMR Chapter 409, Sections 2-4)

A composting facility may be required to obtain a full facility license and comply with the application, siting, design, and operating requirements set forth in 06-096 CMR, Chapter 409, Sections 2 through 4 and 06-096 CMR, Chapter 400, Section 4; or if a facility meets the requirements for reduced procedure licensing they need only comply with the requirements set forth in 06-096 CMR, Chapter 409, Section 9 (see below).

Reduced Procedure Licensing (06-096 CMR, Chapter 409, Section 9)

The following composting facilities are subject to Reduced Procedures if they follow all applicable siting, design and operational procedures:

- Facilities composting any amount of Type IA residuals; and/or
- Up to 400 cubic yards monthly of Type IB residuals; and/or
- Up to 200 cubic yards monthly of Type IC residuals; or up to 200 cubic yards monthly of Type II residuals.

Siting and Design Standards and Operating Requirements Include, But Are Not Limited To:

Design

- The facility must include processing systems and storage areas of sufficient capacity to accommodate seasonal throughput of all materials that are delivered and generated by the facility (06-096 CMR, Chapter 409, Section 2(B)(2))
- If determined by the DEP an environmental monitoring program must be implemented (06-096 CMR, Chapter 409, Section 2(B)(3))
- Composting activities can only be conducted on (06-096 CMR, Chapter 409, Section 9(B)(1)):
 - Well drained soils that are at least 24 inches above the seasonal high water table, bedrock, and sand or gravel lenses;
 - A pad constructed 2 feet above seasonal high water table (either glacial till and gravel, or soil covered with asphalt or concrete);
 - A covered land area; or
 - A area determined to be suitable by a qualified individual.
- Facilities handling type IC residuals, must have a receiving and mixing pad covered with asphalt, concrete, or other impervious material. Facilities processing type II residuals, or more than 750 cubic yards of type IC residuals annually, must have a pad covered with asphalt, concrete, or other impervious material (06-096 CMR, Chapter 409, Section 9 (B)(2))

- Surface water drainage must be diverted away from receiving, processing, composting, curing, and storage areas and leachate and runoff mixed with leachate must be collected and treated (06-096 CMR, Chapter 409, Section 4(B)(12) and 06-096 CMR, Chapter 409, Section 9 (B)(3)) (see Stormwater Management and Leachate Management below)

Operation

- Facility must be operated and maintained in a manner that will not contaminate ground or surface water, contaminate the ambient air, constitute a hazard to health and welfare, or create a nuisance (06-096 CMR, Chapter 409, Section 4(B)(1))
- Facility design must include provisions to contain, collect and treat any leachate and wash waters generated at the facility (06-096 CMR, Chapter 409, Section 2(B)(4))
- Facility must include provisions for regular wash down or dry clean-up of the facility (06-096 CMR, Chapter 409, Section 2(B)(5))
- The onsite population of disease vectors must be minimized to protect public health (06-096 CMR, Chapter 409, Section 4(B)(6))
- A compost facility must contain, collect and treat leachate and runoff mixed leachate (06-096 CMR, Chapter 409, Section 4(B)(12))
- All soil surfaces that are used for residuals mixing and composting must annually be graded clean and re-compacted. All concrete and asphalt pads must annually be scraped clean and inspected for cracks or other deformities, and repaired as needed (06-096 CMR, Chapter 409, Section 9 (C)(1))
- Requirements for pathogen treatment and vector attraction reduction must be met (06-096 CMR, Chapter 409, Section 9 (C)(3)(b)):
- Requirements for static pile composting must be met (06-096 CMR, Chapter 409, Section 9 (C)(4))
- Residuals must be handled on approved surfaces. Type IC and type II residuals must be offloaded and mixed on a receiving pad meeting the standards listed in seventh bullet of this subsection (06-096 CMR, Chapter 409, Section 9 (C)(8))

Permit by Rule (06-096 CMR, Chapter 409, Section 8)

The permit by rule licensing provisions apply to facilities that compost type IA residuals and grass clippings and that meet all conditions of the regulation. If any conditions of the regulation are not met or an applicant chooses to site, design or operate a composting facility in a manner that would not meet the standards required in the regulation, then the applicant must obtain a Full Facility License to develop and operate a solid waste processing facility.

Siting and Design Standards and Operating Requirements Include, But Are Not Limited To:

- The composting facility may only receive Type IA residuals and grass clipping. It may not accept painted wood, treated wood, plywood, chipboard, plastic, wood with

fasteners, nails, glue, adhesives, resins, paint or coatings, or wood that is otherwise contaminated.

- The total waste handling area cannot exceed 3 acres, onsite storage cannot exceed 1 acre, and individual storage piles cannot exceed 10,000 square feet.
- Minimum setbacks from aquatic environments and protected natural resources must be maintained (06-096 CMR, Chapter 409, Section 8(B)(3)).
- Composting activities can only be conducted on:
 - Well drained soils that are at least 24 inches above the seasonal high water table, bedrock, and sand or gravel lenses;
 - A pad constructed 2 feet above seasonal high water table (either glacial till and gravel, or soil covered with asphalt or concrete);
 - A covered land area; or
 - A area determined to be suitable by a qualified individual.
- Surface water drainage must be diverted away from processing, composting curing, and storage areas.
- The facility must be operated so that it does not contaminate water, land or air from the handling, storage or composting of wood, leaf, and yard debris.

Exempt Activities (06-096 CMR, Chapter 409, Section 1(B))

- Facilities that process solid waste generated at the same facility prior to reuse in that facility.
- Mobile chippers for the chipping of bark, brush, stumps, slabs, edgings and slash when the chipper is used on a site for less than 30 days, and material is removed from site within 30 days.
- Facilities that, each month, compost less than:
 - Ten (10) cubic yards of type IA residuals;
 - Five (5) cubic yards of type IB residuals;
 - Three (3) cubic yards of type IC residuals; or
 - Twenty (20) cubic yards of animal carcasses from routine animal mortalities at the site of generation
- Facilities that compost 10,000 cubic yards or less of animal manure per year;
- with the normal operation of a transfer station.
- Disposal of livestock, poultry, and pet carcasses provided that the carcasses are handled in a manner approved by the Maine Department of Agriculture.

Resources:

- <http://www.maine.gov/dep/rwm/rules/index.htm#rulesadmbbrwm>
- <http://www.maine.gov/dep/rwm/residuals/index.htm>

Stormwater Management

Maine's Solid Waste Management Rules require that surface water drainage be diverted away from receiving, processing, composting and curing areas. Composting facilities must be designed to manage stormwater runoff to prevent contamination of surface water or groundwater. Water falling on a composting facility during a 25-year, 24-hour storm event must infiltrate or be detained such that the stormwater rate of flow from the facility after construction does not exceed the rate prior to construction (06-096 CMR Chapter 409(9)(B)(3)). In addition, surfaces on which composting takes place must be designed to have a slope between 2 percent and 6 percent and where necessary, be graded to prevent ponding of water.

If stormwater is discharged to a municipal separate stormwater system or directly to surface waters a National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit is required. The federal Environmental Protection Agency (EPA) currently administers the NPDES permitting program for industrial sources in Maine. However, the federal EPA has delegated authority to the Maine Department of Environmental Protection (DEP) for the federal NPDES program in 2001. DEP is in the process of developing general permits. The federal Multi-Sector General Permit will continue to be administered by the federal EPA until the Maine Department of Environmental Protection (DEP) issues a state general permit.

National Pollutant Discharge Multi-Sector General Permit (MSGP) (40 CFR 122.26)

A composting facility is covered under the NPDES Multi-Sector General Permit (MSGP). All facilities with a MSGP are required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP). The permit provides specific SWPPP requirements for each industry sector, but items that are required in all SWPPPs include:

- Site maps showing drainage and outfall locations;
- An inventory of exposed materials; and
- Pollution prevention Best Management Practices (BMPs).

Stormwater Benchmarks

Under the federal MSGP composting facilities fall under Industry Sector C (standard industry code [SIC] 2873-2879 Agricultural Chemicals). Sector C industries are required to conduct benchmark monitoring for nitrate plus nitrite nitrogen, total lead, total iron, total zinc, and phosphorus. Benchmark monitoring periods are October 1, 2001 to September 30, 2002 (year two of the permit) and October 1, 2003 to September 30, 2004 (year four of the permit). Composting facilities are required to conduct benchmark monitoring, quarterly (4 times a year) during at least one, and potentially both, monitoring periods. Table C-1 below lists the benchmark concentration for composting facilities under industry subsection of Agricultural Chemicals (2873-2879).

TABLE C-1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration ¹	Numeric limitation ²
Part of Permit Affected/Supplemental Requirements			
Phosphate Subcategory of the Fertilizer Manufacturing Point Source Category (40 CFR § 418.10)—applies to precipitation runoff, that during manufacturing or processing, comes into contact with any raw materials, intermediate product, finished product, by-products or waste product (SIC 2874).	Total Phosphorus (as P)	105.0 mg/L, daily max. 35 mg/L, 30-day avg.
	Fluoride	75.0 mg/L, daily max. 25.0 mg/L, 30-day avg.
Agricultural Chemicals (2873–2879)	Nitrate plus Nitrite Nitrogen	0.68 mg/L.	
	Total Recoverable Lead	0.0816 mg/L.	
	Total Recoverable Iron	1.0 mg/L	
	Total Recoverable Zinc	0.117 mg/L.	
Industrial Inorganic Chemicals (2812–2819)	Phosphorus	2.0 mg/L	Nitrate plus Nitrite Nitrogen
	Total Recoverable Aluminum	0.75 mg/L	
	Total Recoverable Iron.	0.68 mg/L	
Soaps, Detergents, Cosmetics, and Perfumes (SIC 2841–2844).	Nitrate plus Nitrite Nitrogen	0.68 mg/L.	
	Total Recoverable Zinc	0.117 mg/L..	
Plastics, Synthetics, and Resins (SIC 2821–2824)	Total Recoverable Zinc	0.117 mg/L.	

¹ Monitor once/quarter for the year 2 and year 4 Monitoring Years.

² Monitor once/year for each Monitoring Year.

Resources:

- <http://www.maine.gov/dep/blwq/docstand/stormwater/multisector.htm>
- <http://cfpub.epa.gov/npdes/stormwater/indust.cfm>

Leachate Management

Compost facilities in Maine must be designed to contain, collect and treat any leachate generated at the facility (06-096 CMR Chapter 409(9)(B)(3)). All facilities that have a leachate collection and/or detection system must; implement a program of periodic monitoring of leachate quality and volume, leak detection system (LDS) fluid quality, volume and flow rate, and leachate treatment residue composition and generation rate. A leachate sampling and analytical workplan must be submitted to the DEP for review and approval (06-096 CMR, Chapter 405(4)).

Washington

Compost Regulations

Washington regulates composting facilities under the Solid Waste Handling Rules (Chapter 173-350-220 Washington Administrative Code [WAC]). Washington solid waste rules provides requirements for composting facility design, operating standards, closure, financial assurance, permitting, construction records and designation of composted materials. All composting facilities in Washington, unless exempted under the regulation, are required to obtain a solid waste permit from the jurisdictional health department. Washington uses a tiered system to divide composting facilities into different types. Facilities are permitted based on feedstock type, and facility size (described as volume of composted).

Definitions

<i>Leachate</i>	Means water or other liquid within a solid waste handling unit that has been contaminated by dissolved or suspended materials due to contact with solid waste or gases (173-350-100 WAC)
<i>Type 1 Feedstocks</i>	Means source-separated yard and garden wastes, wood wastes, agricultural crop residues, wax-coated cardboard, preconsumer vegetative food wastes, or other similar source-separated materials that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances, human pathogens, and physical contaminants (173-350-100 WAC)
<i>Type 2 Feedstocks</i>	Means manure and bedding from herbivorous animals that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances, human pathogens, and physical contaminants when compared to a Type 1 feedstock (173-350-100 WAC)
<i>Type 3 Feedstock</i>	Means meat and post consumer source-separated food wastes or other similar source-separated materials that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances, and physical contaminants, but are likely to have high levels of human pathogens (173-350-100 WAC)

<i>Type 4 Feedstocks</i>	Means mixed municipal solid wastes, postcollection separated or processed solid wastes, industrial solid wastes, industrial biological treatment sludges, or other similar compostable materials that the jurisdictional health department determines to have a comparable high level of risk in hazardous substances, human pathogens and physical contaminants (173-350-100 WAC)
<i>Stormwater</i>	Means rainfall and snow melt runoff (State of Washington Industrial Stormwater General Permit, Appendix 2)
<i>Stormwater Discharge Associated with Industrial Activity</i>	Means the discharge from any conveyance that is used for collecting and conveying stormwater and that is directly related to manufacturing, processing of raw materials, or storage areas at an industrial plant (see 40 CFR 122(b)(14). It may also, on a case-by-case basis, include stormwater from any portion of an industrial site subject to pollutants of a significant amount (State of Washington Industrial Stormwater General Permit, Appendix 2)
<i>Stormwater Management Manual (SWMM) or Manual</i>	Means the technical manual prepared by Ecology for stormwater management. For BMPs implemented prior to February 2001 it is the Stormwater Management Manual for the Puget Sound Basin published in 1992. For all facilities west of the crest of the Cascade Mountains as of February 1, 2002, it is the Stormwater Management Manual for Western Washington. For facilities east of the crest of the Cascade Mountains it will be the Stormwater management Manual for Eastern Washington when it becomes available. It also applies to any future revision of the technical manual as they become available (State of Washington Industrial Stormwater General Permit, Appendix 2))

Solid Waste Permit (Chapters 173-350-220(8), 173-350-710, and 173-350-715 WAC)

A solid waste permit is required for all facilities that treat solid waste by composting.

The following activities are exempt from permitting and all other requirements of the solid waste rule (Chapter 173-350-220(1) WAC):

- Composting used as treatment for dangerous wastes.
- Composting used as a treatment for petroleum contaminated soils.
- Treatment of liquid sewage and biosolids in digesters at wastewater treatment facilities.
- Treatment of other liquid wastes in digesters.

The following activities must comply with Chapter 173-350-220(1)(c) WAC, but are not required to obtain an solid waste permit:

- Production of substrate used solely onsite to grow mushrooms.

- Vermicomposting, when used to process Type 1, 2 or 3 feedstocks onsite. Total volume of material is limited to 1,000 cubic yards on-site at any one time.
- Composting no more than 40 cubic yards of Type 1 or 2 feedstocks on-site at any one time.
- Composting of no more than 10 cubic yards of food waste on-site at any one time.
- Agricultural composting:
 - When all agricultural waste is generated onsite and all compost is used onsite;
 - When agricultural waste is generated offsite, all compost is used on-site and no more than 1,000 cubic yards is on-site at any one time;
 - When agricultural composting is part of an approved dairy nutrient management plan;
 - When agricultural waste is distributed offsite, when more than 40 cubic yards but less than 1,000 cubic yards is on-site at any one time; and
 - When agricultural composting is part of a farm management plan.
- Composting of Type 1 or 2 feedstocks when more than 40 cubic yards but less than 250 cubic yards is onsite at any one time requires notification to the county health department

Resources:

- <http://www.ecy.wa.gov/biblio/ecy040136.html>
- <http://www.ecy.wa.gov/programs/swfa/facilities/350.html>
- <http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=173-350-220>

Stormwater Management

Washington’s Solid Waste Handling Standards require composting facilities to separate stormwater from leachate by designing stormwater runoff prevention systems designed to divert stormwater from areas of feedstock preparation, active composting or curing. Systems may include covered areas (roofs), diversion swales, ditches or other designs to divert stormwater from composting areas (Chapter 173-350-220(3)(b) WAC). All runoff from active composting areas, including waste receiving and processing areas is leachate. Runoff from other facility areas such as roads and finished product storage areas is considered to be stormwater. If stormwater is discharged to a stormwater treatment facility or surface water an Industrial General Stormwater Permit is required.

Industrial General Stormwater Permit A National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit and State Waste Discharge General Permit For Stormwater Discharges Associated With Industrial Activities

Washington Solid Waste Handling Standards require that composting facilities Compost facilities that discharge stormwater to surface water or a municipal stormwater system (publicly owned treatment works [POTW]) must have a Industrial General Stormwater Permit (Chapter 173-220 WAC). Coverage under the Industrial General Stormwater Permit depends on the Standard Industrial Classification (SIC) of individual facilities. However, if the Washington Department of Ecology (Ecology) can require permit coverage of any facility on a case-by-case basis in order to protect waters of the state. The following SIC codes should be used when a compost facility applies for a permit:

- **SIC code 2879, Pesticides and Agricultural Chemicals, Not Elsewhere Classified.** This classification includes facilities that are primarily engaged in manufacturing or formulation soil conditioners. Normal composting operations, which produce a final product that is considered a soil conditioner will fall under this SIC code.
- **SIC code 2875, Fertilizers, Mixing Only.** Compost facilities that mix fertilizers into the compost and produce final product, which is considered fertilizer, will be classified under this SIC code.

The main purpose of the Industrial General Stormwater Permit is to provide benchmarks for industrial stormwater discharges and incorporate Stormwater Pollution Prevention Plan (SWPPP) into the design of the facility. The SWPPP must include the following:

- Facility assessment
- Monitoring plan
- Stormwater best management practices (BMPs)
- Erosion and sediment control BMPs

Stormwater BMPs

The permit requires that the SWPPP include the description and implementation of best management practices (BMPs). BMPs must be selected from the Ecology's Stormwater Management Manual, Volumes I through V. At a minimum the BMP categories listed below must be included in the SWPPP:

- Operational Source Control
 - Pollution Prevention Team
 - Good Housekeeping
 - Preventative Maintenance
 - Spill Prevention and Emergency Cleanup Plan
 - Employee Training
 - Inspections and Record keeping
- Structural Source Control
- Treatment

- Stormwater Peak Runoff Rate and Volume Control
- Erosion and Sediment Control

Stormwater Discharge Benchmarks

All Washington permitted facilities must conduct monitoring of authorized discharges of stormwater. Permitted composting facilities must sample quarterly for the parameters listed in the following table.

TABLE 1
Washington NPDES Industrial General Stormwater Permit: Stormwater Discharge Benchmarks

Parameter	Benchmark
Total Zinc	117 ug/l
Nitrate/Nitrite as N	0.68 mg/l
Phosphorus (TP)	2.0 mg/l
BOD5	30 mg/l
pH	6.0-9.0 SU
Turbidity	25 NTU
Petroleum - Oil and Grease	15 mg/l

If the value for total zinc exceeds the benchmark value for two consecutive quarters beginning with the next sampling quarter the Permittee must include a quarterly analysis for copper and lead as defined in Table 2.

TABLE 2
Washington NPDES Industrial General Stormwater Permit: Stormwater Discharge Benchmarks

Parameter	Benchmark
Total Copper	63.6 ug/l
Total Lead	81.6 ug/l
Hardness	NA

Resources:

- <http://www.ecy.wa.gov/biblio/wac173220.html>
- <http://www.ecy.wa.gov/programs/wq/stormwater/index.html>

Leachate Management

All runoff from active composting areas, including waste receiving and processing areas is leachate. Leachate is generated at composting facilities that compost outside without cover.

Runoff from other facility areas such as roads and finished product storage areas is considered to be stormwater.

Composting facilities in Washington are required to collect all leachate generated from feedstock preparation, active composting and curing. Leachate must be conveyed to a leachate holding pond, tank or other containment structure (Chapter 173-350-220 (3) (c)WAC). Washington's solid waste handling standards specify siting and design requirements for ponds (Chapter 173-350-220(3)(c)(ii) WAC) and tanks (173-350-220(3)(c)(iii) WAC).

There are three options for leachate management and/or disposal available to composting facilities:

- Leachate can be treated and discharged to surface waters under a Individual National Pollutant Discharge Elimination System (NPDES) Waste Discharge General Permit (Chapter 173-220 WAC). If leachate is discharged to surface waters it must be treated to a level that meets the effluent limitations set by the NPDES permit and any applicable water quality standards as set forth in WAC 173-201A-240, and in WAC 173-201A-250.
- Leachate can be applied to land under a State Waste Discharge Permit for Discharge of Industrial Wastewater to Groundwater (Chapter 173-216 WAC) or discharged to a publicly owned treatment works (POTW) under a State Waste Discharge Permit for Discharge of Industrial Wastewater to a POTW (Chapter 173-216 WAC). However, if a facility discharges to a delegated POTW (the State of Washington has delegated authority to regulate pretreatment of incoming waste) they would need a permit from the POTW not Ecology. State Waste Discharge Permits will provide specific effluent limitations, and monitoring and reporting requirements to ensure compliance with state water quality standards.
- All leachate can be contained in a pond or tank and reused for makeup water in the composting process. The Washington Solid Waste Handling Standards require that process makeup water be added to composting piles in a manner that promotes an aerobic composting process (Chapter 173-350-220(3)(iii)(d)). Washington regulations also require that facilities consider the re-use of leachate as process makeup water in their water balance calculation (Chapter 173-350-220(3)(c)). The location of the facility and annual precipitation levels will have a significant impact on the amount of leachate that can be reused as process makeup water. Specific requirements for water reuse are provided in Tables 1, 2 and 3 of the Washington Department of Ecology and Washington Department of Health's Water Reclamation and Reuse Standards document.³

Resources:

- <http://www.ecy.wa.gov/biblio/ecy040136.html>
- <http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=173-350-220>

³ Washington Department of Ecology and Washington Department of Health. Water Reclamation and Reuse Standards. September 1997. Publication #97-23. <http://www.ecy.wa.gov/programs/wq/reclaim/index.html#Standards>

APPENDIX C

**Statewide Lists for E. Coli, Fecal
Coliform, Nitrate, and Phosphorus
Impairment**

State 303 (d) Lists for Selected Constituents of Impairment

The following records match a search for E. Coli impairment:

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
8903	A-3 Drain	UPPER WILLAMETTE	0 to 0	E Coli	June 1 - September 30	2002	303(d) List
8904	A-3 Drain	UPPER WILLAMETTE	0 to 0	E Coli	October 1 - May 31	2002	303(d) List
8905	Amazon Creek	UPPER WILLAMETTE	0 to 22.6	E Coli	June 1 - September 30	2002	303(d) List
8906	Amazon Creek	UPPER WILLAMETTE	0 to 22.6	E Coli	October 1 - May 31	2002	303(d) List
8039	Antelope Creek	UPPER ROGUE	0 to 19.7	E Coli	June 1 - September 30	2002	303(d) List
9357	Bargfeld Creek	CLACKAMAS	0 to 2.3	E Coli	Summer	2002	303(d) List
4531	Beaver Creek	LOWER COLUMBIA-SANDY	0 to 8.3	E Coli	Summer	2002	303(d) List
9354	Cedar Creek	LOWER COLUMBIA-SANDY	0 to 4.3	E Coli	Summer	2002	303(d) List
8520	Clackamas River	CLACKAMAS	0 to 15	E Coli	June 1 - September 30	2002	303(d) List
7279	Clark Creek	MIDDLE WILLAMETTE	0 to 1.9	E Coli		1998	303(d) List
8570	Cow Creek	CLACKAMAS	0 to 2.6	E Coli	October 1 - May 31	2002	303(d) List
9365	Deep Creek	CLACKAMAS	1.9 to 14.1	E Coli	Summer	2002	303(d) List
7014	Fairview Creek	LOWER WILLAMETTE	0 to 1.7	E Coli	Year Around	1998	303(d) List
8580	Kellogg Creek	LOWER WILLAMETTE	0 to 5	E Coli	October 1 - May 31	2002	303(d) List
4540	Kelly Creek	LOWER COLUMBIA-SANDY	0 to 4.8	E Coli	Summer	2002	303(d) List
8056	Lake Creek	UPPER ROGUE	0 to 7.8	E Coli	June 1 - September 30	2002	303(d) List
8057	Lake Creek	UPPER ROGUE	0 to 7.8	E Coli	October 1 - May 31	2002	303(d) List
8058	Lick Creek	UPPER ROGUE	0 to 6.8	E Coli	June 1 - September 30	2002	303(d) List
8573	Mount Scott Creek	LOWER WILLAMETTE	0 to 6.1	E Coli	October 1 - May 31	2002	303(d) List
9312	Necanicum River	NECANICUM	0 to 5.9	E Coli	Summer	2002	303(d) List
8066	Nichols Branch	UPPER ROGUE	0 to 0.5	E Coli	June 1 - September 30	2002	303(d) List
9361	North Fork Deep Creek	CLACKAMAS	0 to 9	E Coli	Summer	2002	303(d) List
8091	North Fork Deer Creek	SOUTH UMPQUA	0 to 6.7	E Coli	June 1 - September 30	2002	303(d) List
8087	North Fork Little Butte Creek	UPPER ROGUE	0 to 6.5	E Coli	June 1 - September 30	2002	303(d) List
8576	Phillips Creek	LOWER WILLAMETTE	0 to 1.2	E Coli	October 1 - May 31	2002	303(d) List
9273	Prairie Creek	WALLOWA	0 to 12.5	E Coli	June 1 - September 30	2002	303(d) List
6067	Pringle Creek	MIDDLE WILLAMETTE	0 to 6.2	E Coli		1998	303(d) List
8068	Reese Creek	UPPER ROGUE	0 to 3	E Coli	June 1 - September 30	2002	303(d) List
8554	Rock Creek	CLACKAMAS	0 to 6.1	E Coli	October 1 - May 31	2002	303(d) List
8070	Salt Creek	UPPER ROGUE	0 to 9	E Coli	June 1 - September 30	2002	303(d) List
8559	Sieben Drainage Ditch	CLACKAMAS	0 to 1	E Coli	October 1 - May 31	2002	303(d) List
8563	Sieben Drainage Ditch	CLACKAMAS	1 to 1.8	E Coli	October 1 - May 31	2002	303(d) List
9362	Tickle Creek	CLACKAMAS	0 to 2.3	E Coli	Summer	2002	303(d) List
9352	Unnamed Waterbody	LOWER COLUMBIA-SANDY	0 to 2.9	E Coli	Summer	2002	303(d) List
9098	Willow Creek	LOWER MALHEUR	0 to 0.2	E Coli	October 1 - May 31	2002	303(d) List
9097	Willow Creek	LOWER MALHEUR	0 to 0.2	E Coli	June 1 - September 30	2002	303(d) List

The following records match a search for Fecal Coliform impairment:

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
8340	Alsea River	ALSEA	0 to 4.9	Fecal Coliform	Year Around	2002	303(d) List
8341	Alsea River	ALSEA	4.9 to 10	Fecal Coliform	Year Around	2002	303(d) List
7056	Amazon Diversion Canal	UPPER WILLAMETTE	0 to 1.8	Fecal Coliform	Year Around	1998	303(d) List
4085	Ashland Creek	MIDDLE ROGUE	0 to 2.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4357	Ashland Creek	MIDDLE ROGUE	0 to 2.8	Fecal Coliform	Summer	1998	303(d) List
5262	Balm Fork	WILLOW	0 to 9.5	Fecal Coliform	Summer	1998	303(d) List
6065	Bashaw Creek	MIDDLE WILLAMETTE	0 to 4.8	Fecal Coliform	Year Around	1998	303(d) List
4712	Bear Creek	COQUILLE	0 to 13.2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4086	Bear Creek	MIDDLE ROGUE	0 to 26.3	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4360	Bear Creek	MIDDLE ROGUE	0 to 26.3	Fecal Coliform	Summer	1998	303(d) List
2252	Bully Creek	BULLY	0 to 12.8	Fecal Coliform	Summer	1998	303(d) List
2253	Bully Creek	BULLY	15.9 to 57.1	Fecal Coliform	Summer/Fall	1998	303(d) List
4088	Butler Creek	MIDDLE ROGUE	0 to 5.2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6051	Calapooia River	UPPER WILLAMETTE	0 to 42.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5663	Calapooya Creek	UMPQUA	0 to 18.7	Fecal Coliform	Summer	1998	303(d) List
5429	Calapooya Creek	UMPQUA	0 to 18.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4690	Catching Slough	COOS	0 to 5.6	Fecal Coliform	Year Around	1998	303(d) List
4964	Catching Slough	COOS	0 to 5.6	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
3000	Clatskanie River	LOWER COLUMBIA-CLATSKANIE	0 to 1.9	Fecal Coliform	Summer	1998	303(d) List
4691	Coalbank Slough	COOS	0 to 0.5	Fecal Coliform	Year Around	1998	303(d) List
6048	Coast Fork Willamette River	COAST FORK WILLAMETTE	0 to 31.3	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6853	Coast Fork Willamette River	COAST FORK WILLAMETTE	0 to 31.3	Fecal Coliform	Summer	1998	303(d) List
4089	Coleman Creek	MIDDLE ROGUE	0 to 6.9	Fecal Coliform	Year Around	1998	303(d) List
4689	Coos Bay	COOS	7.8 to 12.3	Fecal Coliform	Year Around	1998	303(d) List
4718	Coquille River	COQUILLE	4.2 to 35.6	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4977	Coquille River	COQUILLE	0 to 4.2	Fecal Coliform	Year Around	1998	303(d) List
7057	Coyote Creek	UPPER WILLAMETTE	0 to 26.2	Fecal Coliform	Year Around	1998	303(d) List
4090	Crooked Creek	MIDDLE ROGUE	0 to 4.3	Fecal Coliform	Summer	1998	303(d) List
4404	Crooked Creek	MIDDLE ROGUE	0 to 4.3	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
268	Crooked River	-CROSSES SUBBASINS	0 to 51	Fecal Coliform	Summer	1998	303(d) List
4719	Cunningham Creek	COQUILLE	0 to 7.4	Fecal Coliform	Summer	1998	303(d) List
4917	Cunningham Creek	COQUILLE	0 to 7.4	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5425	Deer Creek	SOUTH UMPQUA	0 to 9.6	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5657	Deer Creek	SOUTH UMPQUA	0 to 9.6	Fecal Coliform	Summer	1998	303(d) List
6072	Deer Creek	YAMHILL	0 to 20.4	Fecal Coliform	Year Around	1998	303(d) List
6866	Deer Creek	YAMHILL	0 to 20.4	Fecal Coliform	Summer	1998	303(d) List
2743	Depot Slough	SILETZ-YAQUINA	0 to 1.3	Fecal Coliform	Year Around	1998	303(d) List
5430	Elk Creek	UMPQUA	0 to 25.9	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5667	Elk Creek	UMPQUA	0 to 25.9	Fecal Coliform	Summer	1998	303(d) List
4092	Evans Creek	MIDDLE ROGUE	0 to 19.1	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4400	Evans Creek	MIDDLE ROGUE	0 to 19.1	Fecal Coliform	Summer	1998	303(d) List
7013	Fairview Creek	LOWER WILLAMETTE	0 to 1.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6056	Fern Ridge Reservoir/Long Tom River	UPPER WILLAMETTE	24.2 to 31.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
919	Grande Ronde River	-CROSSES SUBBASINS	80.7 to 162.4	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4093	Griffin Creek	MIDDLE ROGUE	0 to 14.4	Fecal Coliform	Summer	1998	303(d) List
4405	Griffin Creek	MIDDLE ROGUE	0 to 14.4	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
4692	Haynes Inlet	COOS	0 to 3.3	Fecal Coliform	Year Around	1998	303(d) List
4967	Haynes Inlet	COOS	0 to 3.3	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
8109	Isthmus Slough	COOS	0 to 10.6	Fecal Coliform	Year Around	2002	303(d) List
4095	Jackson Creek	MIDDLE ROGUE	0 to 12.6	Fecal Coliform	Year Around	1998	303(d) List
4693	Joe Ney Slough	COOS	0 to 2.2	Fecal Coliform	Year Around	1998	303(d) List
1908	John Day River	-CROSSES SUBBASINS	182 to 265	Fecal Coliform	Summer	1998	303(d) List
1526	John Day River	-CROSSES SUBBASINS	182 to 265	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6117	Johnson Creek	LOWER WILLAMETTE	0 to 23.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6901	Johnson Creek	LOWER WILLAMETTE	0 to 23.7	Fecal Coliform	Summer	1998	303(d) List
4694	Kentuck Slough	COOS	0 to 2.2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4946	Kentuck Slough	COOS	0 to 2.2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
1999	Klamath Strait	LOST	0 to 0	Fecal Coliform	Summer	1998	303(d) List
4096	Larson Creek	MIDDLE ROGUE	0 to 6.7	Fecal Coliform	Year Around	1998	303(d) List
4695	Larson Slough	COOS	0 to 3.9	Fecal Coliform	Summer	1998	303(d) List
4929	Larson Slough	COOS	0 to 3.9	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4097	Lazy Creek	MIDDLE ROGUE	0 to 4.5	Fecal Coliform	Year Around	1998	303(d) List
4083	Little Butte Creek	UPPER ROGUE	0 to 16.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4354	Little Butte Creek	UPPER ROGUE	0 to 16.7	Fecal Coliform	Summer	1998	303(d) List
6052	Long Tom River	UPPER WILLAMETTE	0 to 24.2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2001	Lost River	LOST	0 to 59.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2149	Lost River	LOST	0 to 59.7	Fecal Coliform	Summer	1998	303(d) List
6054	Luckiamute River	UPPER WILLAMETTE	0 to 31.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2249	Malheur River	-CROSSES SUBBASINS	0 to 67	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2250	Malheur River	-CROSSES SUBBASINS	93.4 to 119.9	Fecal Coliform	Summer	1998	303(d) List
2431	Malheur River	-CROSSES SUBBASINS	0 to 67	Fecal Coliform	Summer	1998	303(d) List
6055	Marys River	UPPER WILLAMETTE	0 to 13.9	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4098	Meyer Creek	MIDDLE ROGUE	0 to 5.3	Fecal Coliform	Summer	1998	303(d) List
4406	Meyer Creek	MIDDLE ROGUE	0 to 5.3	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4713	Middle Fork Coquille River	COQUILLE	0 to 39.6	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6075	Mill Creek	YAMHILL	0 to 22.2	Fecal Coliform	Summer	1998	303(d) List
6066	Mill Creek	MIDDLE WILLAMETTE	0 to 25.7	Fecal Coliform	Year Around	1998	303(d) List
6089	Molalla River	MOLALLA-PUDDING	0 to 25	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
3006	Nehalem Bay	NEHALEM	0 to 2.1	Fecal Coliform		1998	303(d) List
3197	Nehalem Bay	NEHALEM	0 to 4.1	Fecal Coliform		1998	303(d) List
9321	Nehalem River	NEHALEM	0 to 3	Fecal Coliform	Year Around	2002	303(d) List
4715	North Fork Coquille River	COQUILLE	0 to 19	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2251	North Fork Malheur River	UPPER MALHEUR	0 to 18	Fecal Coliform	Spring/Summer	1998	303(d) List
4696	North Slough	COOS	0 to 2.4	Fecal Coliform	Year Around	1998	303(d) List
6081	North Yamhill River	YAMHILL	0 to 20.1	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6876	North Yamhill River	YAMHILL	0 to 20.1	Fecal Coliform	Summer	1998	303(d) List
2904	Nute Slough	SILETZ-YAQUINA	0 to 1.5	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2744	Olalla Creek	SILETZ-YAQUINA	0 to 3.2	Fecal Coliform	Year Around	1998	303(d) List
3346	Owyhee River	-CROSSES SUBBASINS	0 to 18	Fecal Coliform	Summer	1998	303(d) List
9322	Pacific Ocean	NECANICUM	26 to 30	Fecal Coliform	Year Around	2002	303(d) List
4100	Payne Creek	MIDDLE ROGUE	0 to 2.1	Fecal Coliform	Year Around	1998	303(d) List
4710	Pony Creek	COOS	0 to 5.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4957	Pony Slough	COOS	0 to 0.8	Fecal Coliform	Year Around	2002	303(d) List
2745	Poole Slough	SILETZ-YAQUINA	0 to 2.6	Fecal Coliform	Year Around	1998	303(d) List
3550	Powder River	POWDER	71.9 to 115.6	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
3551	Powder River	POWDER	115.6 to 130	Fecal Coliform	Summer	1998	303(d) List
3839	Powder River	POWDER	0 to 69	Fecal Coliform	Summer	1998	303(d) List
3841	Powder River	POWDER	71.9 to 115.6	Fecal Coliform	Summer	1998	303(d) List
3843	Powder River	POWDER	115.6 to 130	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
3549	Powder River	POWDER	0 to 69	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
924	Prairie Creek	WALLOWA	0 to 12.5	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6091	Pudding River	MOLALLA-PUDDING	0 to 35.4	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6884	Pudding River	MOLALLA-PUDDING	0 to 35.4	Fecal Coliform	Summer	1998	303(d) List
4081	Rogue River	-CROSSES SUBBASINS	94.9 to 110.7	Fecal Coliform	Summer	1998	303(d) List
4322	Rogue River	-CROSSES SUBBASINS	110.7 to 132.2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4372	Rogue River	-CROSSES SUBBASINS	68.3 to 94.9	Fecal Coliform	Summer	1998	303(d) List
6077	Salt Creek	YAMHILL	0 to 32.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5652	Scholfield Creek	UMPQUA	0 to 5	Fecal Coliform	Year Around	1998	303(d) List
2256	Shepherd Gulch	MIDDLE SNAKE-PAYETTE	0 to 3.6	Fecal Coliform	Spring/Summer	1998	303(d) List
6094	Silver Creek	MOLALLA-PUDDING	0 to 5.9	Fecal Coliform	Summer	1998	303(d) List
4931	South Fork Coquille River	COQUILLE	0 to 18.9	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2255	South Fork Jacobsen Gulch	MIDDLE SNAKE-PAYETTE	0 to 3	Fecal Coliform	Spring/Summer	1998	303(d) List
4700	South Slough	COOS	0 to 5.3	Fecal Coliform	Year Around	1998	303(d) List
5426	South Umpqua River	SOUTH UMPQUA	0 to 15.9	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5427	South Umpqua River	SOUTH UMPQUA	15.9 to 57.7	Fecal Coliform	Summer	1998	303(d) List
5428	South Umpqua River	SOUTH UMPQUA	15.9 to 57.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6084	South Yamhill River	YAMHILL	0 to 18.1	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6085	South Yamhill River	YAMHILL	18.1 to 42.6	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6086	South Yamhill River	YAMHILL	42.6 to 61.7	Fecal Coliform	Summer	1998	303(d) List
6878	South Yamhill River	YAMHILL	18.1 to 42.6	Fecal Coliform	Summer	1998	303(d) List
6118	Spring Brook Creek	LOWER WILLAMETTE	0 to 2.3	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
7051	Spring Brook Creek	LOWER WILLAMETTE	0 to 2.3	Fecal Coliform	Summer	1998	303(d) List
925	Spring Creek	WALLOWA	0 to 4.5	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4701	Stock Slough	COOS	0 to 1.1	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4947	Stock Slough	COOS	0 to 1.1	Fecal Coliform	Summer	1998	303(d) List
2749	Thompson Creek	SILETZ-YAQUINA	0 to 2	Fecal Coliform	Summer	1998	303(d) List
2911	Thompson Creek	SILETZ-YAQUINA	0 to 2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5433	Umpqua River	UMPQUA	25.9 to 109.3	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
5649	Umpqua River	UMPQUA	7.7 to 11.8	Fecal Coliform	Year Around	1998	303(d) List
5650	Umpqua River	UMPQUA	1 to 6.7	Fecal Coliform	Year Around	1998	303(d) List
926	Wallowa River	WALLOWA	0 to 50	Fecal Coliform	Summer	1998	303(d) List
927	Wallowa River	WALLOWA	0 to 50	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6037	Willamette River	-CROSSES SUBBASINS	0 to 24.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6038	Willamette River	-CROSSES SUBBASINS	24.8 to 54.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6040	Willamette River	-CROSSES SUBBASINS	54.8 to 108	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6042	Willamette River	-CROSSES SUBBASINS	108 to 119.7	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6043	Willamette River	-CROSSES SUBBASINS	119.7 to 148.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6078	Willamina Creek	YAMHILL	0 to 9.9	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
4702	Willanch Slough	COOS	0.7 to 2.8	Fecal Coliform	Summer	1998	303(d) List
4948	Willanch Slough	COOS	0.7 to 2.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2434	Willow Creek	WILLOW	0 to 27.4	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
2254	Willow Creek	WILLOW	0 to 27.4	Fecal Coliform	Summer	1998	303(d) List
6079	Yamhill River	YAMHILL	0 to 11.2	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
2885	Yaquina River	SILETZ-YAQUINA	5.1 to 15.4	Fecal Coliform	Year Around	1998	303(d) List
2883	Yaquina River	SILETZ-YAQUINA	0 to 6.3	Fecal Coliform	Year Around	2002	303(d) List
6095	Zollner Creek	MOLALLA-PUDDING	0 to 7.8	Fecal Coliform	Winter/Spring/Fall	1998	303(d) List
6886	Zollner Creek	MOLALLA-PUDDING	0 to 7.8	Fecal Coliform	Summer	1998	303(d) List

The following records match a search for nitrate impairment:

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
9271	Unnamed Waterbody	UMATILLA	0 to 3.1	Nitrates	Year Around	2002	303(d) List
8394	Zollner Creek	MOLALLA-PUDDING	0 to 7.8	Nitrates	Year Around	2002	303(d) List

The following records match a search for phosphorus impairment:

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
5552	South Umpqua River	SOUTH UMPQUA	0 to 15.9	Phosphorus	Summer	1998	303(d) List

APPENDIX D

Water Quality-Limited Streams
