Water Environment Services Biosolids Management Plan

June 25, 2012

Prepared for

Clackamas County
Water Environment Services
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Oregon City, OR 97045

By Kennedy/Jenks Consultants

K/J Project No. 1091004.00

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List of Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
ADWF	average dry weather flow
BMP	Best Management Practice
BSMP	Biosolids Management Plan
CCSD #1	Clackamas County Service District No. 1
CFR	Code of Federal Regulations
CFU	Colony Forming Units
DAFT	Diffused Air Flotation Thickener
DEQ	Oregon Department of Environmental Quality
EPA	United States Environmental Protection Agency
ft	feet
GIS	Geographic Information System
gpm	gallons per minute
GPS	Global Positioning System
IMD	Internal Management Directive
kW	kilowatts
MBR	membrane bioreactor
MGD	million gallons per day
mm	millimeter
MPN	Most Probable Number
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rules
OERS	Oregon Emergency Response System
OSU	Oregon State University
PAN	plant available nitrogen
Plants	WES wastewater treatment plants
RAS	return activated sludge
RBC	rotating biological contactor
RM	river mile
RST	Rotating Screen Thickener
scfm	standard cubic feet per minute
STP	Sewage Treatment Plant
TCSD	Tri-City Service District
TS	total solids
UV	ultraviolet
WAS	waste activated sludge
WES	Water Environment Services
WPCP	Water Pollution Control Plant

Executive Summary

Clackamas County Water Environment Services (WES) provides wastewater management services to over 150,000 people in two wastewater treatment Districts in Clackamas County, Oregon and operates four wastewater treatment plants; three of these plants produce biosolids.

The Tri-City Service District (TCSD) includes the Tri-City Water Pollution Control Plant (WPCP) located in Oregon City, serving the cities of Gladstone, Oregon City, and West Linn.

Clackamas County Service District No. 1 (CCSD #1) includes the Kellogg Creek WPCP located in Milwaukie, serving Happy Valley, unincorporated North Clackamas County and wholesale customers in the City of Milwaukie and Johnson City, as well as the Hoodland Sewage Treatment Plant (STP), located in Welches serving the Mt. Hood Recreational Corridor of Clackamas County. The Boring STP serves the small community of Boring.

Clackamas County WES operates the plants on behalf of the two districts, including a biosolids management program that produces a Class B biosolids product. Biosolids stored in the plants' digesters are hauled and land applied on agricultural lands in Clackamas and Sherman Counties. Pathogen and vector attraction reduction of the Class B biosolids are accomplished through aerobic and anaerobic digestion.

This Biosolids Management Plan (BSMP) provides information about how the Class B program is operated, as well as monitoring and testing data to document product quality. The BSMP addresses the requirements set forth in Oregon Administrative Rules (OAR) Chapter 340, Division 50 and Title 40 Code of Federal Regulations (CFR) Part 503.

Section 1: Introduction

Biosolids are the nutrient-rich organic materials resulting from the treatment of domestic sewage at wastewater treatment plants. Through biosolids management, solids from the wastewater treatment process are treated to reduce or eliminate pathogens and minimize odors, forming a safe, beneficial product. Biosolids can be applied as a soil amendment to improve and maintain productive soils and stimulate plant growth. Biosolids are classified into two general categories Class A and Class B. Water Environment Services (WES) currently operates a Class B biosolids beneficial use program via agricultural land application.

Class B regulatory requirements ensure pathogens in biosolids have been reduced to levels that protect public health and the environment and include certain restrictions for crop harvesting, grazing animals and public contact for all forms of Class B biosolids. As is true of their Class A counterpart, Class B biosolids are treated in a wastewater treatment facility and undergo heating, digestion or increased pH processes before leaving the wastewater treatment plant. Unlike Class A, Class B biosolids cannot be bagged or marketed to the public for application to gardens, landscapes or other public uses. Rather, Class B biosolids are typically land applied to agricultural sites under permits and with restricted public access. When managed in this way, biosolids land application provides beneficial reuse or recycling of nutrients and organic matter. This is one of the many ways wastewater treatment plant staff contributes to a better environment for Oregon. WES anticipates continuing to manage its Class B biosolids by hauling to approved sites for land application in western and eastern Oregon.

Biosolids are regulated by both the United States Environmental Protection Agency (EPA) and Oregon Department of Environmental Quality (DEQ) to ensure quality standards are met. EPA’s regulations can be found in Title 40 Code of Federal Regulations (CFR) Part 503 and are adopted by reference in the Oregon Administrative Rules (OAR) Chapter 340 Division 50. The regulations address pollutant concentrations, pathogen content, odor potential and basic operational practices. Beneficial reuse of biosolids has long been preferred over historical disposal practices such as incineration or landfilling. Land application practices and marketable biosolids products are encouraged by state and federal regulatory authorities as an alternative to disposal. Numerous publications from the EPA and regional academic institutions such as Oregon State University (OSU), Washington State University, and University of Washington provide valuable information regarding biosolids management practices. DEQ’s December 2005 biosolids guidance entitled, “Implementing Oregon’s Biosolids Program Internal Management Directive” (Biosolids IMD) provides very useful information for permit writers and the public regarding how Oregon administers the biosolids regulations.

This Biosolids Management Plan (BSMP) outlines treatment practices, monitoring, beneficial use practices (land application) and methods of operation for WES’ biosolids program following DEQ’s BSMP template contained within the December 2005 Biosolids IMD. The BSMP addresses the requirements set forth in Oregon’s OAR Chapter 340 Division 50 and EPA’s Title 40 CFR Part 503. The BSMP, as well as Site Authorizations, are considered to be components of

WES' National Pollutant Discharge Elimination System (NPDES) permits and subject to approval and enforcement by DEQ.

Any BSMP modifications require DEQ approval in accordance with OAR 340-0031(3) and are subject to public notice if any land application elements are modified. Modifications may include, but are not limited to changes in biosolids quality, treatment processes, and beneficial use or disposal practices.

The BSMP is intended to satisfy NPDES requirements for the following four WES wastewater treatment plants:

- NPDES Permit for the Tri-City WPCP
    - NPDES Permit Number: 101168
    - File Number: 89700
    - Contact Title: Michael Trent
    - Contact Phone: (503) 557-2804
    - Plant Telephone Number: (503) 557-2802

- NPDES Permit for the Kellogg Creek WPCP
    - NPDES Permit Number: 100983
    - File Number: 16590
    - Contact Title: Doug Rumpel
    - Contact Phone: (503) 975-1363
    - Plant Telephone Number: (503) 794-8050

- NPDES Permit for the Hoodland STP
    - NPDES Permit Number: 100962
    - File Number: 39750
    - Contact Title: Doug Rumpel
    - Contact Phone: (503) 975-1363
    - Plant Telephone Number: (503) 622-5350

- NPDES Permit for the Boring STP
    - NPDES Permit Number: 100968
    - File Number: 16592
    - Contact Title: Doug Rumpel
    - Contact Phone: (503) 975-1363
    - Plant Telephone Number: (503) 622-5350

Section 2: Biosolids Program Contact Information

The following table describes the WES biosolids program contact information including position title, responsibilities, and phone numbers.

Table 1: Biosolids Program Contact Information

Title	Role	Contact Phone Numbers
Biosolids Program Manager	Overall direction and responsibility for program; Questions regarding the BSMP	(503) 742-4608
Environmental Monitoring Manager	Monitoring and data support	(503) 557-2830
Biosolids Supervisor	Management of daily land application operations	(503) 557-2810
Biosolids Application Technician 2	Haul and land apply biosolids; Fleet management; Supports Management of daily land application operations; back-up centrifuge operation	(503) 557-2815
Biosolids Application Technicians 1	Haul and land apply biosolids; back-up centrifuge operation	(503) 557-2810
Operations Supervisor, Tri-City Wastewater Treatment Plant	Produce biosolids that meet permit requirements; Signatory authority for NPDES permit	(503) 557-2804
Operations Supervisor, Kellogg Creek Wastewater Treatment Plant and Hoodland Sewage Treatment Plant	Signatory authority for NPDES permit; produce biosolids that meet permit requirements	(503) 794-8050

Section 3: Wastewater Treatment Facilities

The following sections describe the standard operating processes at the four WES wastewater treatment plants (Plants).

3.1 Tri-City WPCP

3.1.1 Liquids Processing

WES operates an activated sludge and Membrane Bioreactor (MBR) facility at the Tri-City WPCP located at 15941 S. Agnes Avenue, Oregon City, OR 97045 in Clackamas County. The Tri-City WPCP became operational in 1986. The MBR portion of the WPCP became operational in 2011. Treated effluent is discharged year round to the Willamette River at river mile (RM) 25.5. The designed average dry weather flow (ADWF) for the WPCP is 8.4 million gallons per day (MGD). Actual dry season flows during the year 2009 averaged 9.2 MGD and during the wet season averaged 11.9 MGD. The peak design flow capacity is 50 MGD, although at that flow, approximately 36.5 MGD would receive secondary treatment and the remainder would receive primary treatment and disinfection. The ADWF for the MBR is 4.0 MGD with a peak hour of 10.0 MGD. The origin of the wastewater processed is 94.5 percent domestic and commercial sources, and 5.5 percent industrial sources.

The basic components of the current plant consist of an influent pump station, intermediate pump station, bar screens, aerated grit chambers, fine screens, hollow fiber membrane cassettes, primary clarifiers, aeration basins, secondary clarifiers, ultraviolet (UV) disinfection and chlorine contact chambers. The liquid stream treatment process with the new MBR is illustrated in Figure 1.

3.1.1.1 Influent Pump Station

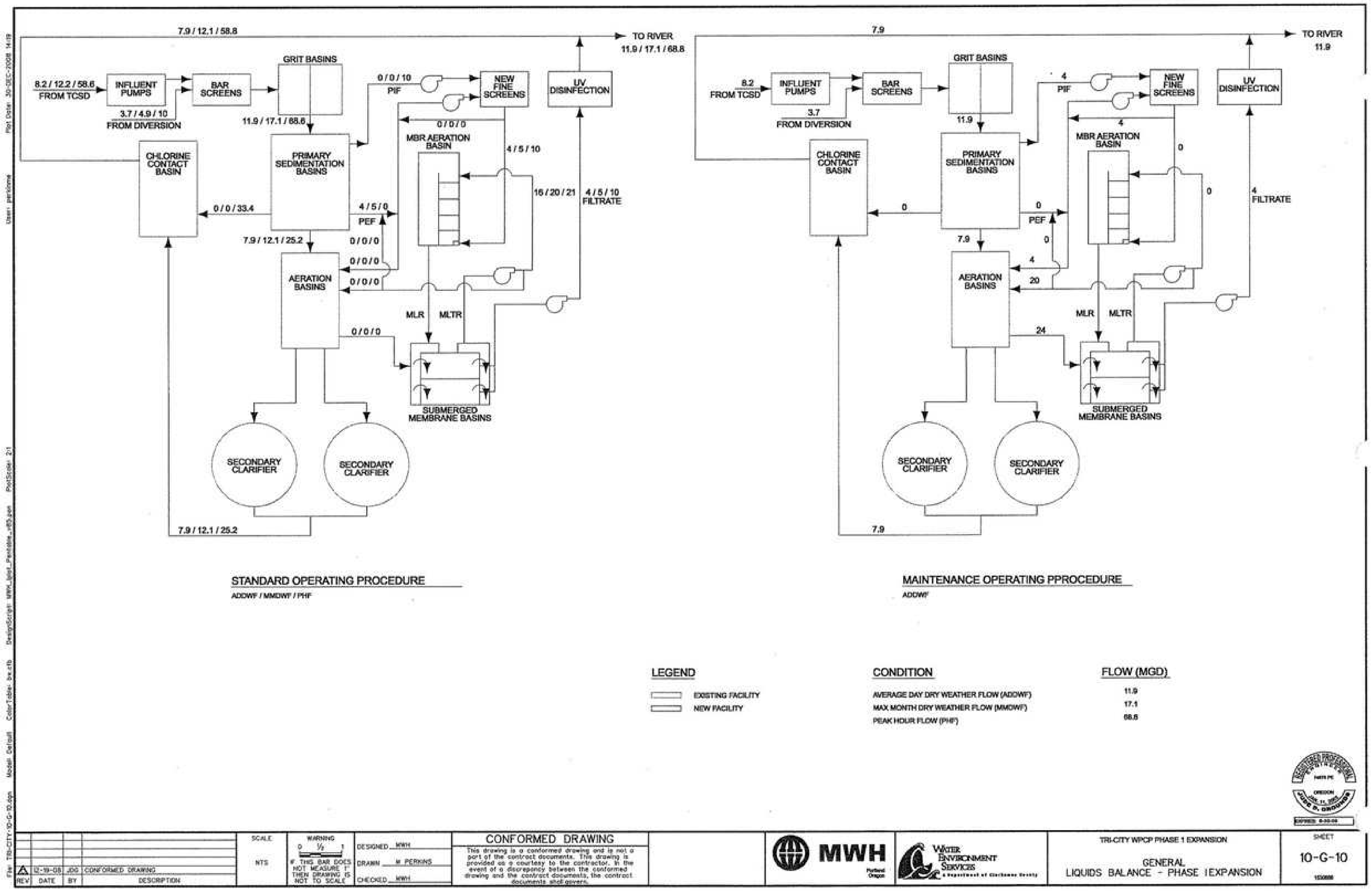
The wastewater enters the Tri-City WPCP through the influent pump station, where two 5,000-gallon per minute (gpm) (7.2 MGD) variable speed pumps and three 12,500-gpm (18 MGD) variable speed pumps are operated.

3.1.1.2 Pretreatment and Primary Treatment

Pretreatment is accomplished by the headworks and primary clarifiers. The headworks provide screening and grit removal. The influent is screened to remove materials such as rags, plastic and large debris with four bar screens: one 4-feet wide (10.4 MGD) mechanically-cleaned bar screen, two 7-feet wide (25 MGD) mechanically cleaned bar screens and one 7-foot wide (25 MGD) manually cleaned bar screen. The screened material is conveyed to a hopper, where the material is transferred to trucks and transported to a solid waste landfill approved to receive this material.

Parshall flumes monitor the amount of influent flow that passes from the screens to the aerated grit basins. Two 55,023-gallon aerated grit chambers operate with three minute detention times each.

Figure 1. Tri-City WPCP Liquids Balance for Phase I Expansion



Settled grit is pumped as slurry to hydrocyclone degritters and classifiers for dewatering. The grit is washed in grit washers and removed for disposal to a solid waste landfill.

After grit removal, the influent flows to six 125-ft by 20-ft primary clarifiers with average side water depth of 11 ft. Flow to the clarifiers is mitigated by sluice gates. Primary solids are pumped to anaerobic digesters and scum is skimmed from the clarifier surface and pumped to the anaerobic digesters.

3.1.1.3 MBR Intermediate Pump Station and Pretreatment

Primary effluent is pumped from the WPCP activated sludge primary effluent channel to the MBR bandscreens for additional pretreatment. Three pumps are available for operation. One pump is 3500 gpm (5.0 MGD) and two are 6950 gpm (9.9 MGD).

Two bandscreens have 2 millimeter (mm) perforated screen panels which can process up to 15 MGD each. The bandscreens are a self-contained screening system which effectively captures and transports undesirable materials to a sluice conveyor for disposal. The primary effluent enters the center of the bandscreen and exits out the two sides, and then flows by gravity to the aeration basin.

3.1.1.4 Activated Sludge Secondary Treatment

The activated sludge secondary treatment system consists of four aeration basins and two secondary clarifiers. The four aeration basins are 639,000 gallons each and the two secondary clarifiers are 1,938,000 gallons per unit. In 2001, three anoxic zones and an automated dissolved oxygen control system were installed in the aeration basins. In 2010-2011, new high-speed Turbo-blowers and fine pore dome diffusers were installed to make the air system more efficient. Internal pumping re-circulation capacity in the aeration basins was increased by a factor of four by installing the new pumps. Motorized gates were installed in the anoxic zone walls to restore step-feed capabilities to the aeration basins.

Flows then proceed to two 120-ft diameter secondary clarifiers with side water depths of 18 feet. Secondary solids are thickened and sent to the primary digester. Scum is pumped to the dissolved air flotation thickener and then pumped to the primary digester.

3.1.1.5 MBR Secondary Treatment

The MBR secondary treatment system consists of one aeration basin and four trains of General Electric/Zenon hollow fiber cassettes. The aeration basin has one deox zone, three anoxic zones and three aerobic zones. The aerobic zones are equipped with dome diffusers. Mixed liquor flows by gravity to the MBR cassettes. The MBR cassettes are divided into four trains. Each train has nine cassettes with space for one more cassette. The cassettes are submerged in the mixed liquor. Pumps create a slight vacuum on the hollow fibers of each cassette which allows clean water to pass through, but not soluble or particulate biodegradable material including bacteria. The hollow fibers are kept clean by air scouring and periodic chemical cleans. The permeate is then pumped to the UV disinfection channel.

3.1.1.6 Activated Sludge Effluent Disinfection

The secondary effluent undergoes chlorination prior to discharge. Contact time is provided by two 274,500-gallon chlorine contact basins. In 1995, a dechlorination system using sodium bisulfite was added.

3.1.1.7 MBR Effluent Disinfection

Permeate from the MBR process passes through the UV bulb array before being discharged.

3.1.2 Solids Processing

Anaerobic digesters receive and digest the waste solids generated at the Tri-City WPCP. Primary and secondary sludge and primary scum are pumped directly to the digesters for stabilization. A more detailed description of the biosolids production process is described below.

Primary sludge is pumped from the sludge hoppers at the primary clarifiers to the anaerobic digesters through a common sludge line by air-operated diaphragm pumps. This maximizes the primary sludge solids concentration to between four and six percent. Waste activated sludge (WAS) is pumped from the secondary clarifiers or MBR process to the gravity belt thickeners, thickened to between five and six percent, and then pumped into the primary anaerobic digester. The sludge is then further processed in a secondary digester.

The two heated digesters each have a treatment capacity of about 1,017,000 gallons (136,000 cubic feet). The active digestion volume is about 508,500 gallons (68,000 cubic feet) with the other half of the volume dedicated to sludge storage and grit and scum accumulation. The hydraulic detention time is 19 days based on active digestion volume at design with both digesters in operation. The digesters are mixed with Vaughn chopper pump mixers. Each digester is equipped with a sludge grinder which shreds material in both feed and recirculated sludge. Operating temperature ranges from 95 to 101 degrees Fahrenheit (°F). Some of the digester gas produced is utilized in an engine generator producing up to 250 kilowatts (kW) of electrical power per day. The remainder of the digester gas is either used in the boiler or flared.

Following digestion the biosolids are dewatered in a centrifuge to 21-24 percent solids content. The biosolids are then loaded into haul trucks with approximately 15 yd^3 capacity. Truck loading is accomplished via an auger conveyor system. It takes approximately 2.5 hours to load one truck. The loaded trucks transport biosolids to DEQ authorized land application sites for beneficial use or are placed in temporary storage at the Tri-City Plant.

Figure 2 is a solids flow diagram for the Tri-City WPCP illustrating how solids move through the thickening process, digestion, centrifugation and beneficial use or storage.

In 2012, WES plans on commencing a strategic planning process to evaluate long-term biosolids management options that may involve modifications to one or more of the wastewater treatment facilities. Any modifications to the biosolids beneficial use program would be reflected in a revised BSMP.

3.1.3 Septage Processing

A septage receiving station is located in the headworks screening building. Septage haulers discharge septage into a receiving vault equipped with a bar rack. Septage is contained in a storage tank with a 10,000 gallon capacity. The septage storage tank is located by the screenings building complex. Septage enters the treatment stream after the influent pump station and prior to screening.

3.1.4 Pre-Treatment Program

The Tri-City WPCP receives 5.5 percent of its flow from industrial dischargers. TCSD has an industrial pretreatment program in place to address these flows. Federal and State industrial pretreatment requirements (e.g. industrial user permitting and pollutant monitoring) help to ensure the quality of biosolids that are land applied meet federal and state biosolids regulations.

3.1.5 Biosolids Dewatering and Temporary Storage Building

In 2011, a 6,000-square feet biosolids storage facility was completed. A skid-mounted centrifuge dewatering system adjacent to the storage facility was completed in February 2012. This will allow WES to optimize wastewater and biosolids treatment efficiencies, and provide contained storage and dewatering in the event of equipment breakdowns, operational constraints, treatment process upsets, or inclement weather conditions that arise at the facilities or the authorized land application sites. WES is evaluating uncovered emergency storage at the TC facility in the event trucks are unable to leave the plant.

3.1.5.1 Temporary Storage Building

Construction of the biosolids storage building was completed in 2011. The building is designed for storage of dewatered biosolids, as needed, to optimize biosolids management and ensure that site authorization requirements for land application are maintained.

The biosolids storage building is a fabricated metal building approximately 100 feet by 60 feet by 17 feet with a concrete floor, a roof with access doors for truck loading and floor drains that direct runoff and wash water back into the WPCP. A front-end loader is used for moving biosolids within the building, moving separation barriers, and loading trucks destined for land application sites. The building is not equipped with a mechanical odor control system but is designed to accept retrofitting with an odor control system if needed. Figure 3 is the ground floor plan and Figure 4 shows elevations for the temporary biosolids storage building.

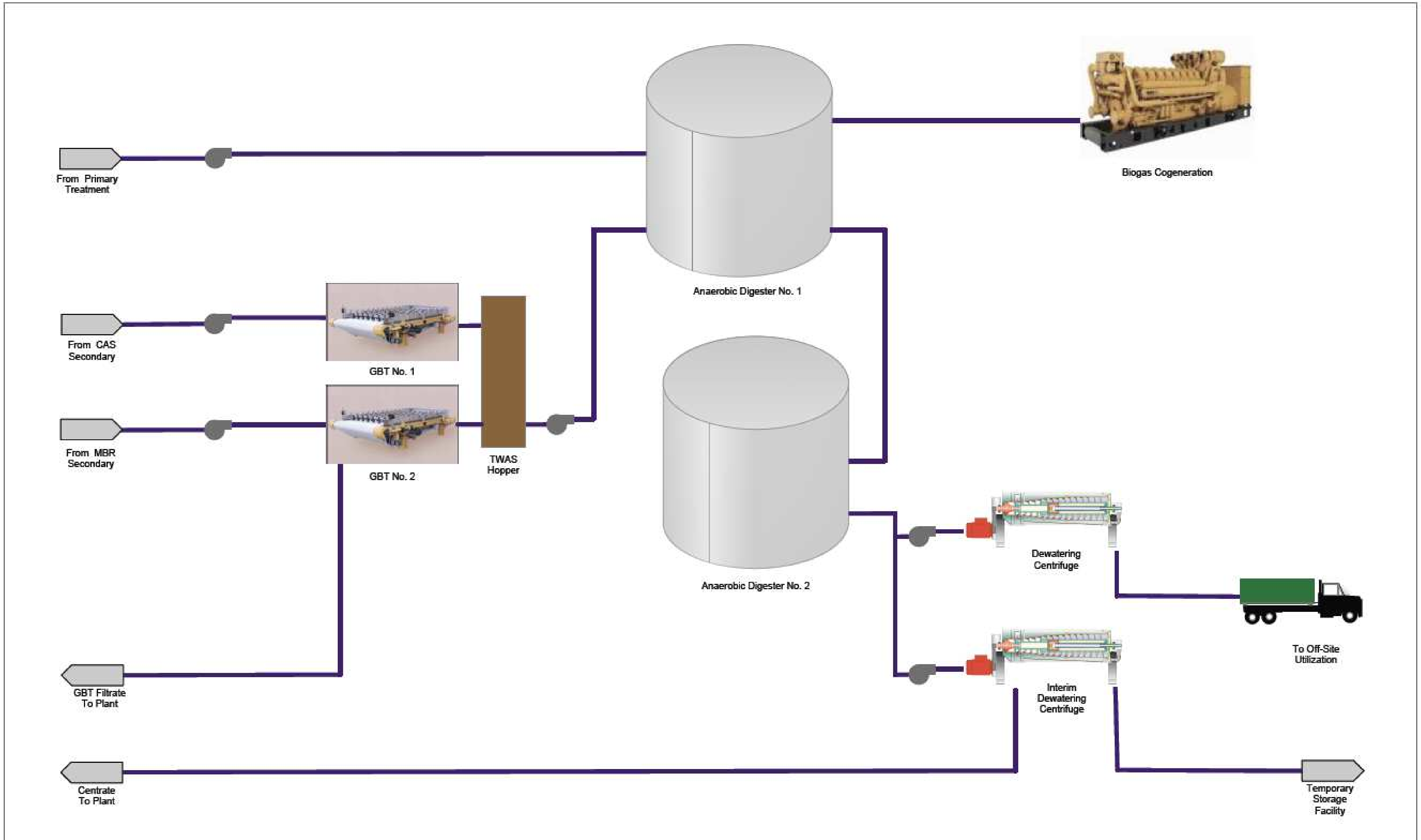
Kellogg Creek WPCP and Tri-City WPCP dewatered biosolids that are not transported directly to DEQ authorized land application sites are placed in the storage building where moveable barriers are used as needed to assure separation of Kellogg Creek WPCP and Tri-City WPCP biosolids kept in storage. The storage building design is intended to provide up to 3 months of storage capacity for dewatered biosolids. When empty, the building will be cleaned by hosing-out the bays and/or other methods as needed to assure good housekeeping.

3.1.5.2 Centrifuge and Day Tanks

The skid-mounted centrifuge system is designed to provide the Tri-City WPCP with redundancy for their existing centrifuge dewatering facility. As needed, the skid-mounted centrifuge will also dewater biosolids from Kellogg Creek WPCP.

Two 35,000 gallon day tanks support the skid-mounted centrifuge system. Liquid biosolids are placed into these tanks and gradually fed into the skid-mounted centrifuge. Each day tank can receive biosolids from either the Tri-City WPCP or the Kellogg Creek WPCP. Contents are identified by signage and other operational controls. Sources will be processed separately. At no time will biosolids from Kellogg Creek WPCP be processed with biosolids from the Tri-City WPCP.

Figure 2. Tri-City WPCP Solids Flow Diagram



NOTES	REVISED	SCALE		DRAWN BY	DESCRIPTION	PAGE
1. Interim centrifuge and solids handling facility to be constructed Summer 2011	03.21.11	NTS	Water Environment Services	REI	Tri-City WPCP Solids Handling Process Diagram	

Figure 3 Temporary Storage Building Ground Floor Plan

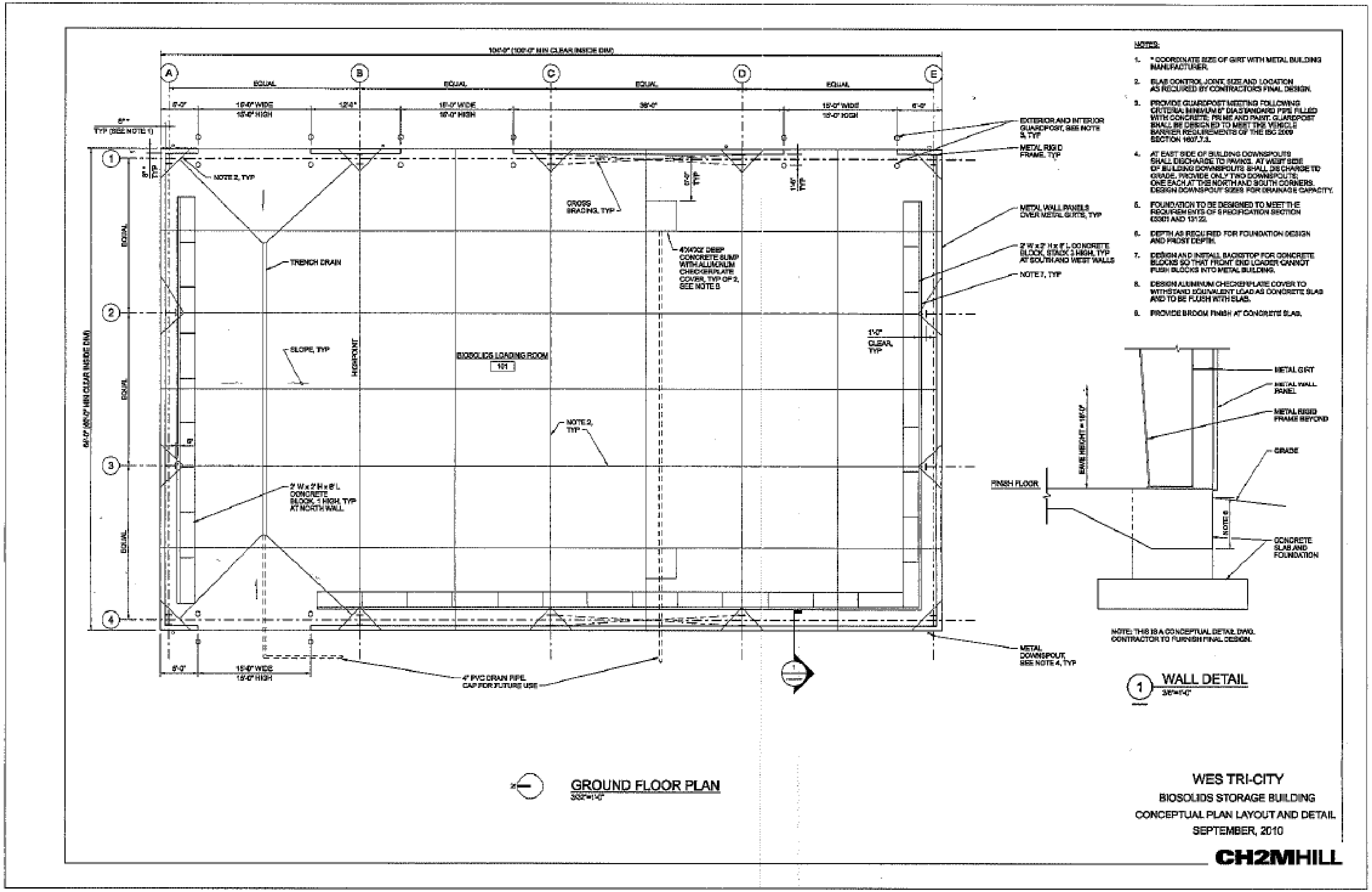
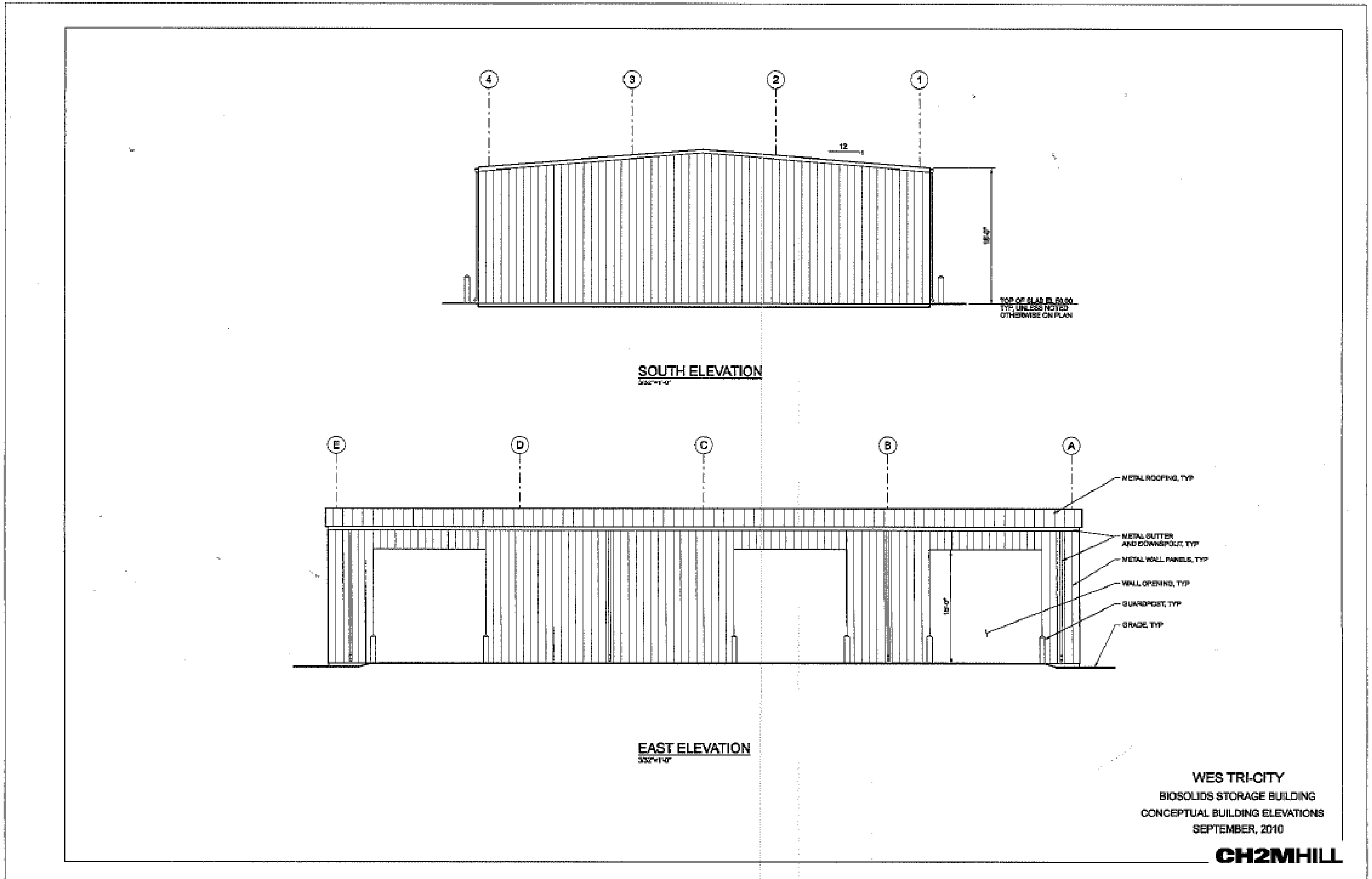


Figure 4. Temporary Storage Building Elevations



3.2 Kellogg Creek WPCP

3.2.1 Liquids Processing

WES operates the Kellogg Creek WPCP, an activated sludge treatment facility located at 11525 SE McLoughlin Blvd., Milwaukie, OR in Clackamas County. Treated effluent is discharged year round to the Willamette River at river mile 18.5. The designed ADWF is 10.0 MGD. Actual flows during the year 2009 dry season averaged 6.47 MGD and the average wet weather averaged 8.82 MGD. The origin of the wastewater processed is 97.0 percent domestic and commercial sources, and 3.0 percent industrial sources.

The plant was constructed in 1973-1974 and became operational in August 1974. The Kellogg Creek WPCP site plan is shown in Figure 5. Incoming raw sewage is lifted 40 feet from the main interceptor in the influent pump station consisting of four pumps (three at 200 horsepower and one at 125 horsepower) to the headworks. From the headworks, the sewage flows through two 3/8 inch bar screens and a non-aerated grit chamber. The flow splits between two primary clarifiers and continues to four aeration basins. From there, the flow travels to two secondary clarifiers. Waste activated sludge is pumped from the secondary clarifiers to the Diffused Aeration Flotation Thickener (DAFT) in the solids building to thicken and remove the solids. The liquid from there is returned to the headworks. Return activated sludge (RAS) is also pumped (approximately 40 percent of flow) from the two secondary clarifiers back to the beginning of the aeration basins. The flow from the secondary clarifiers then travels to the chlorine contact chamber and out through two UV disinfection channels. From there, it enters an outfall pipe that discharges to the Willamette River at a depth of approximately 40 feet.

3.2.2 Solids Processing

The anaerobic digestion facilities at the Kellogg Creek WPCP were constructed in 1986-1987 and became operational in March 1987. The digestion facilities are nearly identical to the current facilities at the Tri-City WPCP.

Primary sludge is pumped from the bottom of each primary clarifier to the anaerobic digesters. WAS is pumped from the secondary clarifier to the DAFT. This unit concentrates solids in the sludge and recycles the discharge back to the plant wastewater influent. The thickened WAS is pumped to the anaerobic digesters. Scum from the primary clarifiers is pumped to the anaerobic digesters and scum from the secondary clarifiers is pumped directly to the dissolved air flotation thickener.

Two heated anaerobic digesters, each having an inside diameter of 65 feet and a maximum side water depth of 41 feet, are provided for digestion and storage. The volume of each digester is about 1,017,000 gallons. The active digestion volume is about 508,500 gallons with the other half of the volume dedicated to sludge storage and grit and scum accumulation. Hydraulic detention time is 19 days based on active digestion volume at design with both digesters in operation, and 10 days with one digester out of service. Sludge storage detention time at design conditions is approximately 17 days. Digester mixing is done with a large bubble and draft tube gas mix system and sludge is also recirculated with pumps. Each digester is equipped with a sludge grinder which shreds material in both feed and re-circulated sludge. Anaerobic digestion is done in the mesophilic treatment range, of approximately 96-101^{o}F.

Anaerobically digested biosolids can be recuperatively thickened by the use of a Rotary Screen Thickener (RST). The use of this thickening is dependent upon digester levels. Once the biosolids have been thickened, they are returned to the digester. The unit is located within the thickener building. The average feed rate is 40 gpm. The solids being fed have an average concentration of 1 to 2 percent solids dry weight. The dewatered solids are approximately 23 percent dry weight. The filtrate solids have a concentration of approximately 0.05 percent and are returned to the DAFT.

The biosolids loading facility uses a counter balanced swing arm for top loading of the sludge tanks. The two sludge loading pumps each have a capacity of 600 gpm.

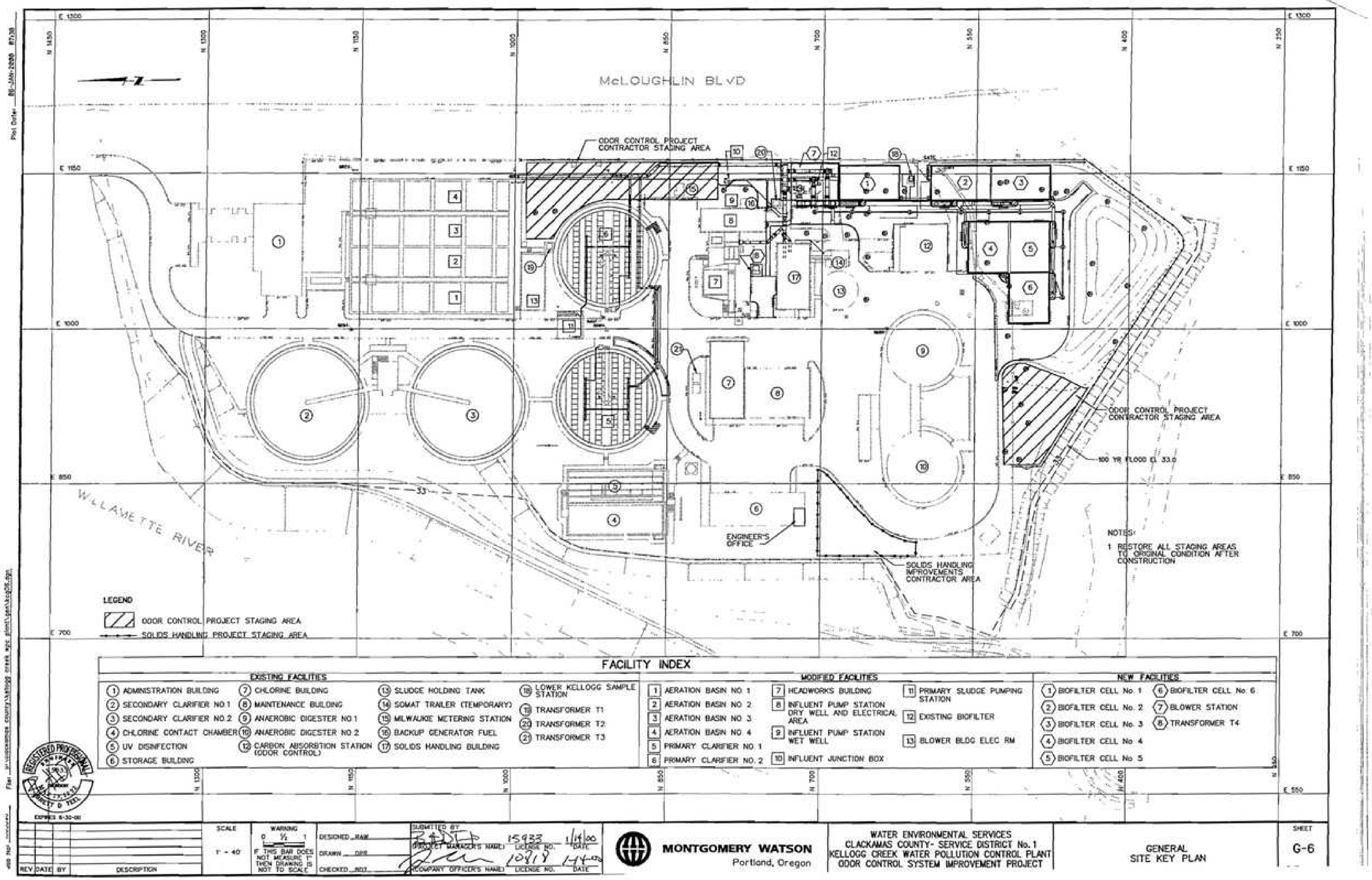
3.2.3 Septage Processing

The Kellogg Creek WPCP is not equipped to handle septage.

3.2.4 Pre-Treatment Program

The Kellogg Creek WPCP receives 3.0 percent of its flow from industrial dischargers. CCSD #1 has an industrial pre-treatment program to address these flows. Federal and state industrial pretreatment requirements (e.g. industrial user permitting and pollutant monitoring) help to ensure that the quality of biosolids that are land applied meet federal and state biosolids regulations.

Figure 5. Kellogg Creek WPCP Site Plan



3.3 Hoodland STP

3.3.1 Liquid Processing

The Hoodland STP is a rotating biological contactor (RBC) process treatment plant located at 24596 E. Bright Avenue, Welches, OR in Clackamas County. Treated effluent is discharged year round to the Sandy River at river mile 41. The designed peak flow capacity is 0.9 MGD. Average dry weather flows average 0.45 MGD. The plant only treats domestic wastewater with no industrial or septage discharge. The plant was constructed in 1981-1982 and became fully operational in June 1982. A schematic diagram and hydraulic profile of the Hoodland STP is provided in Figure 6.

As flow enters the plant, it is processed by a step screen system to remove rags and other debris. The grit settles out as the flow passes through the aerated grit chamber. It then leaves the headworks building and goes directly to the primary clarifiers where settleable solids and scum are removed. The primary effluent then typically flows by gravity into both of two RBC trains consisting of three contactors apiece. The flow leaves the RBCs and enters the secondary clarifiers where solids settle out. The secondary effluent is disinfected with a 0.8 percent chlorine bleach solution right before it travels through a Parshall flume and enters the chlorine contact chamber. From there, the effluent is de-chlorinated and flows by gravity to the outfall diffuser system embedded in the Sandy River.

3.3.2 Solids Processing

The method of sludge treatment utilized at the Hoodland STP is aerobic digestion. Settled solids from the secondary clarifiers are returned by the secondary sludge pumps to the primary inlet channel, from which they flow to the primary clarifiers with the incoming plant flow. Secondary and primary solids are settled together in the primary clarifiers and then pumped to the aerobic digesters. Aerobic digestion is comprised of two stages and capable of either parallel or series operation. Total digester volume is about 130,000 gallons (17,343 cubic feet), with two adjoining rectangular concrete basins, each 17.6 feet wide by 43.5 feet long by 13 feet deep. Digester Number 1 has a volume of 68,816 gallons (9,200 cubic feet).

Digester Number 2 has a volume of 60,910 gallons (8,143 cubic feet), since a decant basin is built into the south end of the tank. Hydraulic detention time is 24 days at 0.90 MGD, which provides a solids loading rate of 0.07 pounds volatile solids per cubic foot of digester per day. Air is provided both for mixing at the maximum rate of 44 standard cubic feet per minute (scfm) per 1,000 cubic feet and to satisfy volatile solid demand (1 pound Oxygen transferred per pound of volatile solids added). Digester supernatant is collected by floating draw off devices in each basin and returned to the headworks' aerated grit chamber through a separate digester transfer pump. After testing, digested biosolids are pumped out through a standpipe for truck loading to be land applied. Typically 60,000 gallons are hauled every five to six weeks.

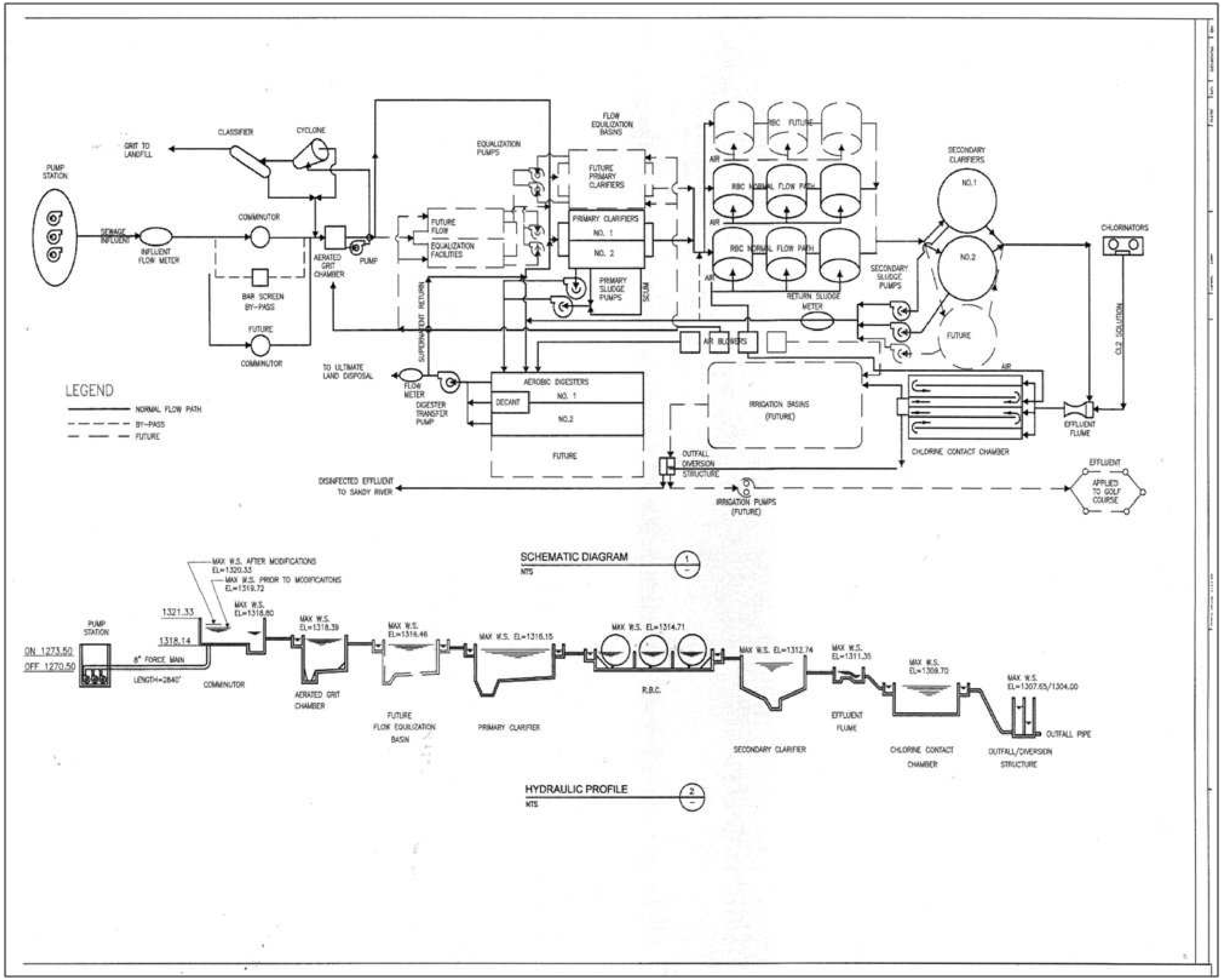
3.3.3 Septage Processing

The Hoodland STP is not equipped to handle septage.

3.3.4 Pre-Treatment Program

The Hoodland STP is not required to implement an industrial pretreatment program.

Figure 6. Hoodland STP Schematic Diagram and Hydraulic Profile



3.4 Boring STP

3.4.1 Liquid Processing

WES operates the Boring STP, located at 13305 SE Richey Road, Boring, OR in Clackamas County, which consists of two aerated lagoons in series with approximately 160,800 gallons of capacity, two slow-rate, 1,600 square-foot sand filters, a chlorine disinfection system with a detention time of approximately 60 minutes, and a de-chlorination system. A collection system of approximately 3,400 feet gravity feeds into the plant. . The Boring STP was built in the spring and summer months of 1984 to serve the local business and residents of small lots in the central Boring area. Treated effluent is discharged year round as needed (not continuously) into the North Fork Deep Creek at river mile 3.0. The designed ADWF is 0.012 MGD and peak design flow is 0.018 MGD. Actual flows during 2009 averaged 0.018 MGD. The origin of wastewater processed is entirely domestic, and no septage or industrial flow is handled at the Boring plant.

3.4.2 Solids Processing

Waste sludge has been pumped from the lagoons four times since the plant first opened. Approximately 60,000 gallons of “settled” sludge, averaging one percent total solids were hauled during each of those events.

During the 26-year history of the plant, approximately 1,050 yards of waste sand has been removed from both filters, stored on site for three to four years, tested, and hauled and used as clean fill. In 2009, an additional 580 yards of waste sand was tested and hauled to a nearby farm and used as clean fill.

DEQ’s Northwest Region Solid Waste Program has provided guidance to WES stating the waste sand may be able to be land applied once DEQ’s ‘Guidelines For Soil Management Determinations’ is finalized and suggested contacting them when there is a need for future removal and disposal of the waste sand. Land application of this sand would be authorized under a separate permit or process from this BSMP since it is not considered biosolids.

Future projections of waste sludge and sand cannot be based solely on previous data because of earlier process experimentation and modification. However, it is reasonable to project, that approximately 50-60 cubic yards of waste sand is produced annually and 6,000 gallons of one percent solids accumulate annually in each lagoon. Approximately 30,000 gallons (15,000 from each lagoon) of settled waste sludge would be hauled for each cleaning.

3.4.3 Septage Processing

The Boring STP is not equipped to handle septage.

3.4.4 Pre-Treatment Program

The Boring STP is not required to implement an industrial pretreatment program.

Section 4: Biosolids Treatment Processes

WES currently operates a Class B biosolids beneficial use program via agricultural land application. In accordance with 40 CFR Part 503 and OAR 340-050 pathogen reduction and vector attraction reduction for biosolids must be met prior to land application. Pathogen reduction must be met before or at the same time that vector attraction reduction is achieved.

WES must notify DEQ in writing and get approval prior to any process change that would utilize pathogen reduction or vector attraction reduction alternatives other than their primary reduction alternatives contained in this BSMP. WES must also certify the alternatives used are EPA approved and that sampling and monitoring conforms to the 40 CFR 503 and OAR 340-050 regulations. This section describes the processes implemented by WES to achieve Class B biosolids criteria.

4.1 Class B Biosolids

WES must comply with 40 CFR 503.32(b)(2), (b)(3), or (b)(4) to meet pathogen reduction requirements for Class B biosolids production and land application. Additionally, vector attraction reduction requirements must be met under 40 CFR 503.33(b)(1) through (b)(10) to qualify for land application of Class B biosolids.

4.2 Class B Pathogen Reduction and Vector Attraction Reduction

4.2.1 Pathogen Reduction

The Tri-City, Kellogg Creek, and Hoodland Plants assure pathogen reduction requirements for Class B biosolids by monitoring fecal coliform bacteria in accordance with 40 CFR Part 503.32(b)(2), Alternative 1. This method requires that the geometric mean of fecal coliform density in seven samples of treated biosolids be less than 2,000,000 Colony Forming Units (CFU) or Most Probable Number (MPN) per gram of treated solids (dry weight basis).
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In the future, the Tri-City and Kellogg Creek WPCPs may elect to meet pathogen reduction requirements for Class B biosolids using anaerobic digestion in accordance with 40 CFR Part 503.32(b)(3), Processes to Significantly Reduce Pathogens. The Hoodland STP may elect to use aerobic digestion in accordance with 40 CFR Part 503.32(b)(3), Processes to Significantly Reduce Pathogens to meet pathogen reduction requirements.

4.2.2 Vector Attraction Reduction

Tri-City and Kellogg Creek WPCPs meet vector attraction reduction requirements for Class B biosolids through anaerobic digestion by reducing volatile solids content by an average monthly minimum of 38 percent in accordance with 40 CFR 503.33(b)(1), Alternative 1. Hoodland STP meets vector attraction reduction requirements for Class B biosolids through aerobic digestion by reducing volatile solids content by a minimum of 38 percent in accordance with 40 CFR 503.33(b)(1), Alternative 1.

Section 5: Biosolids Monitoring and Characteristics

5.1 Biosolids Monitoring

WES samples and monitors biosolids to ensure they meet quality requirements for Class B biosolids in accordance with 40 CFR Part 503 and OAR 340-050. Biosolids samples collected and analyzed are representative of the biosolids to be land applied. Quality control measures and procedures are implemented for microbiological tests to verify precision and accuracy.

All monitoring and reporting are conducted in accordance with the NPDES permits for the plants.

Biosolids are sampled for nutrients, pollutants, pathogen reduction and vector attraction reduction. The required monitoring frequency depends on the amount of bulk biosolids applied to the land. Since the amount of biosolids produced at Tri-City and Kellogg Creek WPCPs is more than 290 but less than 1,500 metric tons of solids per year, the required monitoring frequency is once per quarter (per 40 CFR Part 503, Table 503.16). The Hoodland STP produces less than 290 metric tons of solids per year, thus requiring monitoring only once annually.

Sample analysis methods implemented by WES follow the requirements specified in 40 CFR Part 503 and Part 136, and OAR 340-050.

5.1.1 Biosolids Quality

Tables 2, 3, and 4 summarize biosolids metals, nutrients, and physical parameters measured at the Tri-City, Kellogg Creek, and Hoodland plants for 2009, respectively. A summary of these parameters is contained in the annual biosolids report for each plant that is provided to DEQ and EPA every February. Tables 2, 3 and 4 show biosolids from the three plants met the concentration limits for pollutants set forth in Table 3 of 40 CFR Part 503.13(b). These are commonly referred to as “low” metals limits, therefore tracking the loading of metals to land application sites is not required by federal or state biosolids regulations as long as pollutant concentrations do not exceed these limits.

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

Table 2: Tri-City WPCP Biosolids Quality Data for 2009

Parameter (a)(b)(c)(d)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Mean	Table 3 of 40 CFR Part 503.13(b)
Total Solids, %	25.3	25.3	22.3	22.8	23.9	---
Volatile Solids, %	18.8	18.4	17.1	17.6	17.9	---
TKN, %	7.2	6.9	8.6	6.9	7.4	---
NH_4-N, %	0.8	1.0	1.5	1.2	1.1	---
NO_3-N, %	0.00	0.00	0.01	0.00	0.00	---
P, %	2.2	2.7	3.4	2.7	2.7	---
K, %	0.2	0.1	0.2	0.2	0.2	---
As, mg/kg	3.3	1.8	2.3	2.5	2.5	41
Cd, mg/kg	<3.9	<0.8	<8.9	8.8	5.6	39
Cr, mg/kg	36.6	25.3	27.8	20.6	27.6	---
Cu, mg/kg	258.1	210.3	270.5	227.9	241.7	1500
Pb, mg/kg	32.1	17	23.7	17.6	22.6	300
Hg, mg/kg	1.00	0.8	0.6	1.2	0.9	17
Mo, mg/kg	11.2	7.5	12.1	8.8	9.9	75
Ni, mg/kg	22.9	<1.2	<13.4	15.8	13.4	420
Se, mg/kg	5.7	5.3	4.2	4.9	5.0	36
Zn, mg/kg	1070	762	923	769	881	2800

Notes:

(a) All values are arithmetic means.
(b) "<" indicates the concentration was not detected above the indicated method detection limit.
(c) "---"indicates there is no federal or state regulatory limit for this parameter.
(d) All concentrations are on a dry weight basis.

Table 3: Kellogg Creek WPCP Biosolids Quality Data for 2009

Parameter (a)(b)(c)(d)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Mean	Table 3 of 40 CFR Part 503.13(b)
Total Solids, %	2.7	2.1	2.2	2.2	2.3	---
Volatile Solids, %	1.8	1.5	1.5	1.6	1.6	---
TKN, %	12.0	14.1	13.0	10.8	12.5	---
NH_4-N, %	5.2	7.2	7.7	4.6	6.2	---
NO_3-N, %	0.01	0.01	0.01	0.00	0.01	---
P, %	4.2	4.7	4.7	0.9	3.6	---
K, %	0.9	1.1	1.4	1.4	1.2	---
As, mg/kg	2.1	<2.5	3.5	3.0	2.8	41
Cd, mg/kg	<7.3	<9.4	<9.2	8.9	8.7	39
Cr, mg/kg	49.6	51.6	29.8	35.7	41.7	---
Cu, mg/kg	251.5	248.8	292.7	263.4	264.1	1500

Parameter (a)(b)(c)(d)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Mean	Table 3 of 40 CFR Part 503.13(b)
Pb, mg/kg	19.7	<18.8	<18.4	17.9	18.7	300
Hg, mg/kg	0.8	0.7	1.3	1.1	0.9	17
Mo, mg/kg	<7.3	14.1	<9.2	8.9	9.9	75
Ni, mg/kg	45.3	51.6	21.6	35.7	38.5	420
Se, mg/kg	4.0	<5.0	<4.6	4.6	4.6	36
Zn, mg/kg	825	704	725	772	757	2800

Notes:

(a) All values are arithmetic means.
(b) "<" indicates the concentration was not detected above the indicated method detection limit.
(c) "---"indicates there is no federal or state regulatory limit for this parameter.
(d) All concentrations are on a dry weight basis.

Table 4: Hoodland STP Biosolids Quality Data for 2009

Parameter (a)(b)(c)(d)	1st Quarter	3rd Quarter	Mean	Table 3 of 40 CFR Part 503.13(b)
Total Solids, %	1.1	1.5	1.3	---
Volatile Solids, %	0.9	1.2	1.0	---
TKN, %	5.6	6.3	5.9	---
NH_4-N, %	0.1	0.01	0.1	---
NO_3-N, %	0.3	0.1	0.2	---
P, %	1.9	2.2	2.1	---
K, %	0.4	0.5	0.4	---
As, mg/kg	2.8	4.1	3.5	41
Cd, mg/kg	<9.3	<13.4	<11.4	39
Cr, mg/kg	17.6	13.4	15.5	---
Cu, mg/kg	480.6	535.6	508.1	1500
Pb, mg/kg	19.2	<26.9	23.0	300
Hg, mg/kg	1.2	0.9	1.1	17
Mo, mg/kg	<9.2	<13.4	<11.3	75
Ni, mg/kg	<13.9	<20.1	<17.0	420
Se, mg/kg	4.3	<6.6	5.5	36
Zn, mg/kg	893	1000	947	2800

Notes:

(a) All values are arithmetic means.
(b) "<" indicates the concentration was not detected above the indicated method detection limit.
(c) "---"indicates there is no federal or state regulatory limit for this parameter.
(d) All concentrations are on a dry weight basis.

Tables 5 6, and 7 summarize current and projected future solids loading and Class B biosolids production at the Tri-City WPCP, Kellogg Creek, and Hoodland Plants, respectively.

Table 5: Tri-City WPCP Biosolids Summary

Parameter	Year 2009	2020	2030
SOLIDS LOADING			
Solids loading rate, dry lbs per day	8,028	13,195	16,425
Solids loading rate, dry tons per year	1,465	2,408	2,997
Average total thickened solids, %	6.07	6.07	6.07
CLASS B PRODUCTION			
Class B, dry lbs per day	6,099	10,024	12,478
Class B, dry tons per year	1,113	1,829	2,277

Table 6: Kellogg Creek WPCP Biosolids Summary

Parameter	Year 2009	2020	2030
SOLIDS LOADING			
Solids loading rate, dry lbs per day	10,135	7,882	7,882
Solids loading rate, dry tons per year	1,850	1,439	1,439
Average total thickened solids, %	4.97	4.97	4.97
CLASS B PRODUCTION			
Class B, dry lbs per day	6,800	5,288	5,288
Class B, dry tons per year	1,241	965	965

Table 7: Hoodland STP Biosolids Summary

Parameter	Year 2008	2020	2030
SOLIDS LOADING			
Solids loading rate, dry lbs per day	854	854	854
Solids loading rate, dry tons per year	156	156	156
CLASS B PRODUCTION			
Class B, dry lbs per day	181	181	181
Class B, dry tons per year	33	33	33

5.1.2 Vector Attraction Reduction

The Tri-City and Kellogg Creek WPCPs and Hoodland STP consistently meet the 40 CFR Part 503 requirements for volatile solids reduction (>38 percent) in the biosolids. At the Tri-City and Kellogg Creek WPCPs, sampling occurs at the anaerobic digester, and at the Hoodland STP sampling occurs at the aerobic digester. Samples are stored in a cooler to maintain temperature and are delivered to the lab within six hours of sample collection to commence volatile solids and total solids testing. This data is used to calculate volatile solids reduction.

Calculation procedures for determining the minimum 38 percent volatile solids reduction are followed in accordance with "Environmental Regulations and Technology—Control of Pathogens and Vector Attraction in Sewage Sludge", EPA–625/R–92/013, 1992, U.S. Environmental Protection Agency.

Volatile solids reduction is verified at the Tri-City and Kellogg Creek WPCPs at least once per quarter. In 2009, volatile solids reduction averaged 68 percent at the Tri-City WPCP and 65 percent at the Kellogg Creek WPCP.

Volatile solids reduction is verified at the Hoodland STP at least once per year. Meeting the minimum requirements for volatile solids reduction has never, in the entire history of the Hoodland STP, been a limiting factor. The digested sludge pH is, on occasion, a limiting factor; when this occurs the pH is adjusted to between 6.5 and 7.5 allowing for disposal. This is done by the addition of bicarbonate of soda or soda ash or by controlling the process air flow to the digester.

5.1.3 Pathogen Reduction

The Tri-City and Kellogg Creek WPCPs utilize anaerobic digestion as the treatment method for reducing pathogen density and to meet pathogen reduction requirements for Class B biosolids by monitoring bacteria in accordance with 40 CFR Part 503.32(b)(2), Alternative 1.

The anaerobic digesters receive and digest waste solids generated at the treatment plant. Raw sludge, thickened waste activated sludge, and scum is pumped directly to the digesters. Digestion of these materials reduces their organic content, or volatility, and leaves biosolids, which is lower in offensive odors and pathogens, and suitable for land application.

The stabilization is accomplished in an anaerobic (or oxygen-free) environment by microorganisms naturally present in sludge. The digestion process is most efficient when operated in a temperature range from 96-101^{o}F. This condition provides the environment for optimum microbial growth; control of pH, alkalinity, and volatile acids; and maximum methane production. Digester efficiency is also increased if the contents are optimally mixed.

The anaerobic digestion process involves the following components:

- Digesters and sludge transfer system
- Digester gas handling equipment
- Digester mechanical mixing system
- Digester hot water boiler
- Digester hot water circulation system
- Digester gas engine generator
- Digester waste gas incinerator

The Hoodland STP utilizes aerobic digestion as the treatment method for reducing pathogen density. This is accomplished by mixing sludge with air to maintain optimum aerobic conditions for the bacteria (e.g. specific mean cell residence time at a specific temperature). Values for the mean cell residence time and temperature are between 40 days at 20 degrees Celsius (°C) and

60 days at 15 °C.

The Tri-City, Kellogg, and Hoodland Plants sample fecal coliform to meet pathogen reduction requirements for Class B biosolids in accordance with 40 CFR Part 503.32(b)(2), Alternative 1. Tables 8 and 9 below summarize Tri-City and Kellogg Creek WPCP fecal coliform data from 2009.Two samples were analyzed for fecal coliform at the Hoodland STP in 2009, with concentrations of 37,022 and 186,927 MPN/g TS.

Table 8: Tri-City WPCP Fecal Coliform Data for 2009

1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
Date	MPN/g TS	Date	MPN/g TS	Date	MPN/g TS	Date	MPN/g TS
2/2/09	1,100	5/4/09	1,000	8/3/09	70,000	11/2/09	73,000
2/3/09	900	5/4/09	3,100	8/3/09	68,00	11/3/09	37,000
2/4/09	9,800	5/5/09	9,000	8/4/09	130,000	11/4/09	57,000
2/4/09	400	5/6/09	2,000	8/5/09	22,000	11/9/09	74,000
2/9/09	1,000	5/11/09	2,900	8/10/09	32,000	11/9/09	35,000
2/10/09	4,200	5/12/09	2,200	8/11/09	7,000	11/10/09	356,000
2/11/09	1,200	5/13/09	400	8/12/09	6,800	11/10/09	22,000
Geo-Mean	1,529		2,031		29,773		60,945

Table 9: Kellogg Creek WPCP Fecal Coliform Data for 2009

1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
Date	MPN/g TS	Date	MPN/g TS	Date	MPN/g TS	Date	MPN/g TS
2/2/09	47,800	5/4/09	161,000	8/3/09	750,000	11/2/09	310,000
2/3/09	309,300	5/6/09	429,000	8/4/09	2,340,000	11/3/09	669,000
2/4/09	565,400	5/11/09	690,000	8/5/09	121,000	11/4/09	7,800
2/9/09	544,000	5/11/09	409,000	8/10/09	1,600,000	11/9/09	66,400
2/9/09	559,400	5/12/09	7,300,000	8/11/09	30,000	11/9/09	347,000
2/10/09	595,000	5/12/09	7,300,000	8/10/09	320,000	11/10/09	250,000
2/11/09	10,600	5/13/09	780,000	8/12/09	340,000	11/10/09	27,300
Geo-Mean	206,559		970,381		378,310		114,268

Section 6: Biosolids Storage

Under current practices, the three Plants have been able to beneficially reuse most biosolids on agricultural fields in Clackamas and Sherman counties. However, biosolids storage is necessary to accommodate fluctuations in biosolids production rates, equipment maintenance, agricultural cropping changes, and adverse weather conditions which prevent immediate biosolids application. Tri-City Service District recently completed construction of a 6,000 square foot biosolids storage facility at the Tri-City WPCP for cake storage.

6.1 Treatment Facility

With the use of existing digester capacity, Tri-City, Kellogg Creek, and Hoodland Plants have the potential to store sludge during periods of wet weather. Biosolids storage is provided within the anaerobic digesters at both the Tri-City and Kellogg Creek WPCPs and the aerobic digester at Hoodland STP. Based on the digesters and estimated biosolids production volumes, approximately one month (28 days) of storage capacity was available when these digesters became operational. However, as biosolids production increases with increasing wastewater flows to the plants, the volume available for biosolids storage will decrease to approximately 14 days at both Tri-City and Kellogg Creek WPCPs by 2016.

6.2 Field Staging

The unloading and placement of dewatered biosolids in a designated area at DEQ authorized land application sites may occur on a limited time basis, typically up to 21 days. When field staging of biosolids occurs, the requirements outlined in the DEQ site authorization letters for each site are followed.

6.3 Field Storage

The storage of biosolids in designated areas at DEQ authorized land application sites may occur on a limited basis, up to six months. When field storage of dewatered biosolids occurs, the requirements outlined in the DEQ site authorization letters for each site are followed. Field storage areas are normally used between the transportation and land application to provide temporary biosolids storage during times when immediate biosolids land application is prevented because of adverse weather conditions or agriculture cropping changes.

WES currently has five DEQ approved winter biosolids storage sites located within DEQ approved biosolids land application sites in Sherman County. Details of the five sites are contained within the individual DEQ approved site authorization letters issued to WES on 5 March 2007.

Once biosolids are delivered to the winter storage sites or the staging areas, they are unloaded directly onto the earth surface. Piles are managed to ensure that biosolids are contained well within the designated storage areas. Typically unloaded biosolids do not exceed four feet in height. Biosolids are loaded either from the piles into an Ag-Chem Terragator using a front-end loader or directly from the trucks using WES' hopper and conveyor system. The loader is also used, along with manual shovels, to manage the site and maintain tidy storage areas.

During the life of this BSMP, WES may choose to seek DEQ authorization for additional land application and winter storage sites in Clackamas County, Sherman County, and other Oregon counties as identified in section 9.1.1 if necessary. The criteria and process to seek DEQ authorization will follow the February 2007 submittal to DEQ titled, *"Clackamas County Water Environment Services Sherman County Biosolids Field Storage Authorization."* WES may also choose to alter the equipment used to transport and land apply biosolids.

Section7: Transportation

WES operates two distinctly different transportation and application programs. Liquid biosolids are land applied in Clackamas County and dewatered biosolids are land applied in Sherman County. In the future, WES may implement a dewatered biosolids program or a combination dewatered and liquid program within Clackamas County.

WES may choose to modify, purchase or lease equipment to improve current biosolids management practices during the life of this biosolids management plan. During emergencies, WES may elect to use contract hauling services.

7.1 Clackamas County

Liquid biosolids from the Kellogg WPCP and Hoodland STP are transported to DEQ authorized land application sites in Clackamas County using equipment owned and operated by WES. All units are equipped with splash plates for even distribution of liquid biosolids to the land application sites which generally grow grass for pasture or hay and oats.

Approximately every 30 days, for one to two days, liquid biosolids from the Hoodland STP are land applied or discharged to the Kellogg Creek or the Tri-City WPCP for processing.

7.2 Sherman County

Dewatered biosolids are transported from the Tri-City WPCP and delivered to Sherman County by equipment owned and operated by WES. One to two truckloads per day (12-28 yards) of TC biosolids are generated on a five days per week operating schedule. Dewatered biosolids from Kellogg Creek will also be transported to Sherman County and applied on fields authorized to receive Kellogg Creek dewatered biosolids.

Section 8: Remedial Procedures

All spills into waters of the state or spills on the ground surface that are likely to enter waters of the state are reported to:

- Oregon Emergency Response System (OERS) at (800) 452-0311 and
- DEQ's Northwest Region biosolids specialist at (503) 229-5263. If outside the DEQ Northwest Region, the DEQ Bend area office is contacted at (541) 633-2036 or (541) 633-2028.

The following section references procedures to address biosolids spills and solids process failures.

8.1 Spill Response

Spill response procedures are detailed in WES' Spill Response Plan (see Appendix A).

8.2 Solids Treatment Process Failure or Modification

If a mechanical problem occurs with digesters or other biosolids treatment components and replacement parts are not in stock at the treatment facility, an emergency parts order is placed. During this period, treatment, storage, handling and transportation activities are modified to ensure that pathogen reduction, vector attraction reduction, and pollutant concentration limits do not result in non-compliance with the requirements of 40 CFR Part 503 and OAR 340-050.

Procedures for properly maintaining, operating and addressing repairs of WES' treatment processes are outlined in operation and maintenance manuals located at the individual wastewater plants.

8.3 Odor Response

In the event of odor complaints at the Plants or at DEQ authorized land application sites, WES staff speak or meet with complainants to understand the specific date, location and nature of the incident. Rarely does WES receive odor complaints regarding operations at the Plants. However, odor complaints periodically occur at the land application sites and the following procedure is implemented to address these complaints.

WES staff speaks with the complainant by phone or in person. Information is gathered from the complainant such as their name and address; date, time and location of the odor event; and any other pertinent site information such as other ongoing farm operations at the time of the alleged odor incident. WES staff immediately drives to the land application site and assess the presence of odors and may discuss farm operations with the land owner. If offensive odor from biosolids exists, WES may apply hydrated lime over the land application site. If necessary, additional mitigation measures at the land application sites may involve modifying the timing (e.g., time of day or date) of the land application practice or increase in site buffers. The incident is documented in writing and maintained in WES' biosolids database.

Section 9: Biosolids Utilization and Land Application Site Management Practices

The following describes the WES biosolids utilization program. Site inspections, obtaining user agreements, scheduling of biosolids applications, monitoring of biosolids properties, conducting land application site soil tests, calculation and tabulation of biosolids agronomic rates and pollutant loading, summarizing of land application site status, monthly and annual reporting, and overall program direction is provided by the Biosolids Management Program in coordination with the Environmental Monitoring Division. The Water Quality Manager is responsible for submitting all required NPDES biosolids quality and quantity data to DEQ on a monthly basis. This includes making sure the Environmental Monitoring Division conducts the required analyses and submits the results in a timely manner.

9.1 Biosolids Land Application Plan

When possible, Class B biosolids are land applied (beneficially used) on DEQ authorized land application sites in accordance with 40 CFR Part 503 and OAR 340-050. At times, land application is not possible. Under these circumstances, contingency plans are used. These include:

- Partner with other wastewater agencies to accept Class B biosolids or raw sludge
- Utilize private dewatering companies
- Take to landfill (cake product only)
- Bring liquid biosolids to TC for dewatering
- Bring liquid biosolids to TC or KC for placement in the digester

WES may elect to add additional contingency options to maximize flexibility and/or to reduce costs to ratepayers.

The beneficial use practices are governed under a DEQ approved Biosolids Management Plan and DEQ approved site authorizations. WES transports Class B biosolids from the Tri-City, Kellogg Creek, and Hoodland Plants and land applies liquid as well as dewatered biosolids on the DEQ authorized sites.

WES' biosolids land application program consists of several key elements, including:

- Producing biosolids that meet pathogen reduction, vector attraction reduction, and pollutant concentrations in accordance with 40 CFR Part 503 and OAR 340-50 (these elements are explained in detail in Section 4 of this BSMP).
- Obtaining biosolids site authorizations from DEQ. This includes selecting sites using, at a minimum, criteria specified in OAR 340-050 (current DEQ authorized land application sites are listed in Appendix B of this BSMP).
- Determining appropriate agronomic rate calculations based on crop nitrogen requirements (agronomic rate calculation methodology is explained in detail within this section of the BSMP).
- Soil sampling in accordance with this plan
- Implementing site management practices as required in the DEQ site authorization

WES strives to implement Best Management Practices (BMPs) in the operation of the biosolids program. Managing biosolids from each plant under one comprehensive program positions WES to more readily apply BMPs to all sites at all times of the year and maximize efficiencies.

9.1.1 Site Inventory of Existing and Potential Land Application Sites

WES is authorized to apply Class B biosolids on 176 active DEQ authorized sites totaling approximately 5,850 acres of farmland in Clackamas and Sherman counties.

WES may elect to seek additional DEQ site authorizations for Class B biosolids land application anywhere in Oregon, but at present is considering pursuing additional land application sites in the following Counties: Yamhill, Clackamas, Marion, Wasco, Sherman, Gilliam, Morrow, Washington, Polk, and Linn.

Appendix B contains the list of active DEQ authorized biosolids land application sites. Specific site information such as authorized acreage, nitrogen loading limits, and time of year authorized for land application is contained within each DEQ site authorization letter and on file at WES.

9.1.2 Site Authorizations

A site authorization letter issued by DEQ outlines site management conditions that are based on the characteristics of the biosolids being land applied and the specific location where land application occurs. The letter is considered an integral part of the BSMP, and the provisions stated in the letter are considered permit requirements and enforceable conditions under each plant's NPDES permit.

When WES wants to land apply Class B biosolids to a new site, the following requirements are followed prior to commencing land application:

- Submission of a site authorization request with supporting documentation specified in DEQ's, "Site Authorization Documentation Checklist for the Land Application of Biosolids" (e.g. site selection criteria, public notification process), and data is submitted to the appropriate DEQ regional biosolids specialist.
- Documentation regarding public notification (kept on file by WES and available upon request).
- Receipt of the site authorization letter from the DEQ.

9.1.3 Site Selection Criteria for New Land Application Sites

At a minimum and in accordance with OAR 340-050, the following site selection criteria are used by WES when selecting new biosolids land application sites:

(a) Sites are on a stable geologic formation not subject to flooding or excessive runoff from adjacent land. If periodic flooding cannot be avoided, the period of application is restricted and soil incorporation may be implemented.

(b) The minimum depth to permanent groundwater is four feet and the minimum depth to temporary groundwater is one foot.

(c) Topography of the site is suitable to allow normal agricultural operations. Where needed, runoff and erosion control measures are constructed. In general, liquid biosolids are not surface applied on bare soils where the ground slope exceeds 12 percent unless otherwise approved by DEQ. Well vegetated sites with slopes up to 30 percent may be used for dewatered biosolids.

(d) Soil has a minimum rooting depth of 24 inches. The underlying substratum to at least 24 inches should not be rapidly draining so that leachate is not short circuited to groundwater.

(e) Sites with saline and/or sodic soils are avoided.

(f) Buffer strips large enough to prevent nuisance odors or wind drift are implemented. Approval of buffer strip sizes are determined by DEQ through the site authorization process and depend upon the method of application used, total solids content, and proximity to sensitive areas, for example:

1) Truck spreading (liquid): 0 to 200 feet
2) Cake or dried solids: 0 to 50 feet
3) Buffer strips are provided along well traveled highways

(g) No Class B biosolids are spread at a land application site closer than 50 feet to any ditch, channel, pond or waterway or within 200 feet of a domestic water source or well, or 100 feet of residences and occupied structures.

9.1.4 Public Notification

WES is required to notify the public of any proposed new Class B biosolids land application activity. DEQ's Biosolids IMD describes the requirements for notifying the public and neighbors of land application sites. There are two methods typically used to meet the requirements for notification, as follows: 1) a printed flyer or letter with information about biosolids land application is mailed or left with neighbors or, 2) going "door-to-door" to inform neighbors of the proposed land application activity. WES mails a letter to residents at the same time or immediately following the submittal of a site authorization request to DEQ. An example of a neighborhood notification letter can be found in Appendix C. Any verbal or written questions or comments obtained from residents are addressed by WES' Environmental Program Coordinator or other biosolids program staff, as appropriate. WES may also contact DEQ's Regional Biosolids Coordinator to discuss issues. Written comments or questions are maintained by WES.

9.1.5 Site Management Practices

Site access restrictions and setbacks are followed as outlined in DEQ site authorization letters. WES ensures that access is restricted by appropriate means as necessary, such as fencing or posting of signs at the land application sites. However, in accordance with OAR 340-050-0065, access control is assumed on rural private land. Biosolids land application does not occur in those areas designated as buffer strips and the application areas are identified through accurate measurement of required buffers prior to commencing land application. WES has historically measured buffers by manually "walking-off" the measurements, but now implements Global Positioning System (GPS) technology that is incorporated into Geographic Information System (GIS) map overlays. The application of GPS and GIS technologies provide for a higher degree of accuracy regarding land application areas and buffers as well as biosolids loading or application rate determinations. WES may eliminate the use of this technology in the future.

9.1.6 Agronomic Application Rates and Site Crops

9.1.6.1 Introduction

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

9.1.6.2 Nitrogen

Biosolids Nitrogen (N) is present in two forms, inorganic and organic. Inorganic or mineral N as ammonium (NH_4) and nitrate (NO_3) is typically immediately available for plant uptake, while organic N must first be biologically transformed (mineralized). The concentration of various N forms in biosolids, plus the rate of organic N mineralization, is used to determine the annual agronomic loading of biosolids. Mineralization rates vary depending on the stabilization process and duration, application method, soil temperature and moisture conditions, and season. Table 10 shows estimated organic N mineralization rates for the first year after biosolids application (source: Worksheet for Calculating Biosolids Application Rates in Agriculture, 1999 (revised 2007), Washington State University, Oregon State University, and University of Idaho extension agencies, and USDA Publication PNW 511.E). The range of values listed allows WES the flexibility to decide on a mineralization rate based on WPCP specific data. Mineralization rates for aerobic and anaerobic digestion are used for agronomic rate calculations implemented by WES.

Table 10: Mineralization Rate Estimates of Organic Nitrogen for WES Biosolids

Biosolids Stabilization Process	Biosolids Stabilization Process First Year Mineralization Rate[a] (percent of organic N)
Fresh[b]	
Anaerobic Digestion, liquid or dewatered	30-40
Aerobic Digestion, liquid or dewatered	30-40

Notes:

(a) Estimated mineralization rates are cumulative in 2-5 months in spring, summer, or fall.
(b) "Fresh" includes all biosolids that have not been stabilized by long-term storage in lagoons or composting.

Ammonia volatilization and denitrification are active processes affecting nitrogen availability. Ammonia loss through volatilization is affected by soil pH, soil moisture, and the land application method and rate. For example, if biosolids are immediately tilled in (e.g., through soil incorporation) then the maximum amount of NH4 is retained. WES does not incorporate, so values of 55% and 20% are used to determine agronomic loading rates for liquid and dewatered biosolids, respectively (reference Table 11).

Table 11: Estimates of Ammonium-N Retained for WES Biosolids

Time to Incorporation by Tillage	Liquid Biosolids	Dewatered Biosolids
	Ammonium-N retained, percent of applied	
Incorporated immediately	95	95
After 1 day	70	50
After 2 days	60	30
No Incorporation	55	20

9.1.6.3 Soil Sampling

Prior to the initiation of biosolids application to a new site, a representative soil sample is collected across the entire site, and analyzed by an independent commercial laboratory. This is done to assess pre-planting soil nutrient levels.

Available nitrogen concentrations in soil for a given season are affected by other sources of nitrogen; soil pH; rainfall; and carry-over from previous year's applications or crop residuals. Existing nitrogen levels in the soil profile are subtracted from the OSU Fertilizer Guides application rates for the crop and the biosolids application rate is adjusted.

In the event of annual biosolids application to the same field for three consecutive years, soils are sampled from the field and tested for nitrate and ammonia nitrogen prior to the third year's biosolids application in accordance with OAR 340-050-0080(5)(a). Application rates are adjusted to account for available nitrogen carried over from previous applications.

The following regional university and, federal and state agency references are used by WES to assist with soil sampling procedures (including the most recent additions):

- *Monitoring Soil Nutrients Using a Management Unit Approach*, October 2003, Pacific Northwest Extension publication PNW 570-E. Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/PNW570-E.pdf.

- *Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascades - second section on detailed suggestions for soil sampling and planning*, May 2003, OSU Extension Service publication EM 8832-E. Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/EM8832-E.pdf.

- *Soil Sampling*, August 1997 (reprint), University of Idaho Cooperative Extension System Bulletin 704 (revised). Link to on-line version: http://info.ag.uidaho.edu/resources/PDFs/EXT0704.pdf.

- *Soil Sampling for Home Gardens and Small Acreages*, Reprinted April 2003, OSU Extension Service publication EC 628. Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/ec628.pdf.

- *Soil Test Interpretation Guide*, Reprinted August 1999, OSU Extension Service publication EC 1478. Link to on-line version: http://eesc.orst.edu/agcomwebfile/edmat/EC1478.pdf.

9.1.6.4 Agronomic Application Rate Methodology

Biosolids agronomic application rates for WES sites were developed following OSU Extension Service Fertilizer Guides for the specific crops receiving biosolids. These crops may include soft white winter wheat, hard red wheat, grass hay, pasture, and nursery stock. Other crops may be added to the program in the future. Specific site agronomic loading limits and authorized months of application (e.g., March through October) are specified in the DEQ issued site authorization letters.

WES' agronomic rate calculation method follows, "Cogger, C.G. and D.M. Sullivan. 1999 (revised 2007). Worksheet for Calculating Biosolids Application Rates in Agriculture, PNW 511.E (WSU, OSU, and University of Idaho extension agencies, and USDA). A copy of the worksheet and associated calculations used by WES can be found in Appendix D.

The following regional university and, federal and state agency references are used by WES to assist with agronomic application rate calculations (including the most recent additions):

- Sullivan, D.M. 1998. *Fertilizing with Biosolids*, PNW 508 (Oregon State University, Corvallis, OR).
- Sullivan, D.M., D.M. Granatstein, C.G. Cogger, C.L. Henry, and K.P. Dorsey. Revised 2000. *Biosolids Management Guidelines for Washington State* (Chapter 7, Forest Site Design and Management, and Chapter 9, Site Monitoring), WA. Department of Ecology Publication #93-80 (Olympia, WA). Link to on-line version: http://www.ecy.wa.gov/../biblio/9380.html.

9.1.6.5 Site Crops

WES land applies to crops that benefit from the nutrient and organic matter content of the Class B biosolids. Crops typically consist of grass pasture, grass hay, small grains and nursery stock. However, other crops may receive biosolids based on customer and WES staff approval and in accordance with 40 CFR Part 503 and OAR 340-050 requirements.

Nitrogen requirements for specific crops vary from field to field and year to year depending on soil fertility, crop productivity, cropping methods and history, fertilizer applications, weather, and crop management. The plant available nitrogen (PAN) needed from biosolids to produce the desired yield of a crop is determined by using OSU fertilizer guides as well as specific information pertaining to elements such as yield, biosolids quality, and nitrogen cycling dynamics. PAN needed from biosolids varies based on this specific information and thus alter the actual agronomic rate for a given land application site. The following ranges of PAN needed from biosolids are used by WES:

- Pasture and Hay: 60-150 pounds of Nitrogen per acre.
- Small grains: 40-160 pounds of Nitrogen per acre.
- Nursery stock: variable depending on species (tree, shrubs, etc.).

Section 10: Recordkeeping and Reporting Procedures

WES, as the preparer and land applier of biosolids, is required to maintain records to demonstrate that federal and state biosolids requirements are met. Records are kept on file by WES, and available upon request by DEQ. Monitoring and sampling records are retained for a period no less than five years, unless otherwise required by the NPDES permit or a DEQ site authorization letter. The minimum required records include the following information:

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

10.1 Annual Reporting

The DEQ Annual Biosolids Report is due February 19 of each year for the previous year's land applied Class B biosolids. Copies of this report are submitted to the DEQ and EPA Region 10. The annual report describes the quality and quantity of biosolids produced and land applied, as well as the specific land application activities practiced. The annual biosolids report includes, at a minimum, the following:

- Description of how biosolids were produced, stabilized, and tested.
- The amount of biosolids produced.
- Information characterizing the quality of the biosolids.
- Description of how pathogen reduction and vector attraction reduction requirements were met.
- Description of how and where the biosolids were managed.
- Necessary signed certifications for pathogen reduction, vector attraction reduction, and site management practices.
- Description of any major modifications to solids handling or land application site management practices.
- Date of DEQ approval of any change or modification, or the date of written notification to DEQ if the change or modification is in the process of review and approval.
- Description of any violation of state or federal rules pertaining to biosolids and remedial actions taken.

- Daily site logs for Class B biosolids, which have the date, time, and quantity land applied. Site logs have a scaled map showing the site and the land application location that coincides with the daily site loading methods (i.e., truck splash plate).

In addition to the above information, the following are provided on the land application sites:

- Site names and locations
- Crops grown
- Amount of acreage amended
- Amount of biosolids (dry tons/acre), including date and location
- Amount of available nitrogen supplied by the biosolids
- Soil test(s) if required by a site authorization letter

Preparation of the Annual Biosolids Report is created, in part, by WES' Biosolids Database which is a tool used for collecting, organizing, reporting, and implementing the biosolids utilization program. This tool is also used to generate monthly reports for WES' biosolids program.

The Annual Biosolids Reports have a signed copy of the certification statements for pathogen reduction, vector attraction reduction and the biosolids have been land applied at approved agronomic loading rates. The person signing the statements is the operator of record at the wastewater treatment plant. The operator shows how the vector attraction reduction was met (e.g., time and temperature) for biosolids generated at the Tri-City, Kellogg, and Hoodland Plants. Certification of pathogen reduction is required and is satisfied by submittal of test results in the DEQ Annual Biosolids Report. All the previous year's biosolids sampling and analysis that is required by the permit is included in each year's annual report appendix.

The dates, volumes, and locations of any Class B biosolids land applications are recorded in a log that can be reviewed by DEQ and records are kept for at least five years.

10.2 Certification Statements

The Tri-City, Kellogg, and Hoodland Plants are capable of meeting alternatives for achieving biosolids pathogen and vector attraction reduction criteria. Signed Class B biosolids and vector attraction certification statements are maintained at Clackamas County WES and are available upon request. As required in accordance with 40 CFR Part 503.17, WES retains a certification statement indicating whether compliance with pathogen reduction, vector attraction reduction, and certain site restrictions has been met. The certification statement is retained for a period of at least five years, and submitted with the annual report that is due February 19 or as required by the permit. WES retains the certification statement and it is signed by the Operations Supervisor for each plant.

The following certification statements are applicable to WES' biosolids management program:

Class B Biosolids Pathogen and Vector Attraction Reduction Requirements

"I certify, under penalty of law, that the information that will be used to determine compliance with the Class B pathogen requirements in 40 CFR §503.32(b)(2),

the vector attraction reduction requirement in 40 CFR §503.33(b)(1), and the site restrictions in 40 CFR §503.32(b)(5) for each site on which Class B sewage sludge was applied, was prepared under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate this information. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

Signature____Date___________________

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

Class B Biosolids Site Management Requirements

"I certify, under penalty of law that the management practices in 40 CFR §503.14 have been met for each site on which bulk biosolids is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

Signature____Date___________________

Appendix A

Spill Response Plan

WATER ENVIRONMENT SERVICES	Title: Response to a spill of liquid or cake biosolids or raw sludge in Oregon and Washington
Policy /procedure no: 100.05 Ver. 2	Last review date: March 2012

Purpose	To describe how WES will respond to a spill of biosolids or raw sludge in Oregon and Washington.			
Policy	In accordance with the specifics below, WES will report all spills of biosolids or raw sludge in accordance with the rules and regulations of all States we haul to.			
Scope	This policy applies to biosolids and raw sludge from Kellogg Creek Water Pollution Control Plant, the Tri-City Water Pollution Control Plant and the Hoodland Sewage Treatment Plant.			
Equipment	• Copy of this Plan	• Gloves, Boots		
	• Cell phone	• Hazard flares	• Reflective vests	
Materials	• Spill report form			
Definitions	**Reportable spill:** • Any spill of 50 gallons or more and/or a spill that creates a threat to the environment or public health. • Any spill of 0.19 cubic meters (1/4 cubic yard) and/or a spill that creates a threat to the environment or public health. **Unintended discharge:** any unintended loss of biosolids or raw sludge from application equipment or a transport vehicle that is less than 50 gallons or 1/4 cubic yard (unless the spill creates a threat to the environment or public health).			
Attachments	Attachment 1: General guidance for biosolids spill cleanup Attachment 2: Directions from Kellogg Creek Water Pollution Control Plant to Westside Wastewater Treatment Plant in Vancouver, WA Attachment 3: Biosolids Spill Report Form			

Spill Prevention Measures

To minimize the possibility of spills, WES has implemented the following measures:

- All vehicles are regularly inspected and serviced.
- Daily checks are performed by drivers.
- Drivers never exceed the posted speed limit and only travel at speeds appropriate for current road conditions.
- All drivers possess CDL.
- Drivers attend a “Defensive Driving” course at least every 3 years.
- Loads are secure in tanker trucks (see Figure 1 below).
- Vehicles are certified to be “leak-proof” upon purchase and are regularly examined to ensure no leaking occurs.

- Drivers consult the Washington State's and Oregon State's Departments of Transportation websites during times of possible inclement weather.
- Drivers stay on main highways (see Attachment 2 for route information)
- Drivers receive regular training on the requirements of this spill plan.

Figure 1

This policy/procedure provides specific instructions for two (2) types of spills:

1. Spills **greater** than 50 gallons or ¼ cubic yard (reportable spill)
2. Spills **less than** 50 gallons or ¼ cubic yard (unintended discharge)

1. Reportable Spill (Greater than 50 gallons or ¼ cubic yard)	
Responsible Person(s)	**Actions Required**
Biosolids Application Technicians and Temporary drivers	**IN OREGON AND WASHINGTON** • If safe to do so, take immediate action to stop the spill. • Secure area if safe to do so. • If an emergency exists call 911 • Contact Biosolids Supervisor and advise of situation. If Biosolids Supervisor is unavailable, contact Environmental Programs Coordinator. See Table 1 for contact information. • Complete spill report (Attachment 3)
Biosolids Supervisor	**IN STATE OF OREGON:** • Arrive at the scene as soon as possible. • Function as spill response representative for WES • Determine, in coordination with the driver, immediate actions needed at the site and coordinate activities of response. Options include use of internal WES staff and equipment, NRC Environmental Services (private contractor) 1-800- 337-7455 • Contact the Oregon Emergency Response System (OERS) at 1/800-452-0311 to report spill within 24 hours • Contact DEQ's NW Region Biosolids Specialist at 503/229-5263 immediately • Conduct Root Cause Analysis (RCA) to address cause and make recommended changes.

1. Reportable Spill (Greater than 50 gallons or ¼ cubic yard)

Responsible Person(s)	Actions Required
Biosolids Supervisor	

SUMMARY OF OREGON REPORTING REQUIREMENTS		
Oregon Contact	**Phone**	**Conditions**
Oregon Emergency Response System (OERS)	**1.800.452.0311**	**Within 24 hours**
NRC Environmental Services (private contractor)	**1.800.337.7455**	**As needed**

IN STATE OF WASHINGTON

Arrive at the scene as soon as possible.

- Function as spill response representative for WES
- Determine, in coordination with the driver, immediate actions needed at the site and coordinate activities of response. Options include use of internal WES staff and equipment, NRC Environmental Services (private contractor) 1-800- 337-7455 and Department of Ecology's Spill Response Team 360-407-6300.

SUMMARY OF WASHINGTON REPORTING REQUIREMENTS		
Washington Contact	**Phone**	**Conditions**
Emergency	**911**	**Emergency**
Department of Ecology's Spill Response Team	**360.407.6300**	**If needed**
DOT Southwest Regional office	**509.577-1600**	**As soon as possible but no longer than 48 hrs after spill. See below for details of report[1]**
Biosolids Coordinator at Department of Ecology's Southwest Regional Office	**360.407.6393**	**Mandatory contact within 24 hours[1]**
Clark County Health Department	**360.397.8000**	**Contact within 24 hours**
Fish & Wildlife Southwest Region	**360.696.6211**	**If spill may have affected fish or wildlife**
Department of Natural Resources Pacific Cascade Region	**206.440.4000**	**If the spill may have affected natural resources other than fish or wildlife.**

[1]File written report with **Department of Ecology's Southwest Regional Office within 5 days** of the spill (unless report is waived by Ecology). Report must include the following:

- A description of the spill and its cause
- The exact date and time of the spill, and if it has not been cleaned up, the anticipated date /time for clean-up
- Steps taken or planned to reduce, eliminate, and prevent recurrence of spills (findings of the RCA)

1. Reportable Spill (Greater than 50 gallons or ¼ cubic yard)	
Responsible Person(s)	**Actions Required**
	• Conduct Root Cause Analysis (RCA) to address cause and make recommended changes.

2. Unintended discharge (Less than 50 gallons or ¼ cu yd) – OREGON AND WASHINGTON	
Responsible Person(s)	**Actions Required**
Biosolids Application Technicians 1 and 2 and temp drivers	• If safe to do so, take immediate action to stop the spill. • Secure area if safe to do so. • Contact Biosolids Supervisor and advise of situation. If Biosolids Supervisor is unavailable, contact Environmental Programs Coordinator. See Table 1 for contact information. • Determine immediate actions needed at the site and coordinate activities of response. Options include use of internal WES staff and equipment and NRC Environmental Services (private contractor). 1-800- 337-7455
Biosolids Supervisor	**THERE ARE <u>NO REPORTING REQUIREMENTS IN OREGON</u> FOR A SPILL THIS SIZE** **PROCEDURES IN STATE OF WASHINGTON:** • Contact **Biosolids Coordinator at Department of Ecology's Southwest Regional Office - 360.407.6393. Mandatory contact within 24 hours.**

Table 1: Summary of WES Contact Information

Biosolids Supervisor	Office	503-557-2810
	Cell	503-750-1889
Wastewater Treatment Services Manager	Office	503-752-4560
	Cell	503-593-9357
Community Relations Specialist	Office	503-353-4561
	Cell	503-793-9222
Wastewater Treatment Supervisor, TC	Office	503-557-2803
	Cell	503.729.3099
Wastewater Treatment Supervisor, KC	Office	503-794-8050
	Cell	503-975-1363
Environmental Programs Coordinator (Biosolids Program Manager)	Office	503-742-4608
	Cell	503-793-7147
Tri-City Plant Operator	Office	503-557-2803
NRC Environmental Services (private contractor)	Office	800- 337-7455
Oregon Emergency Response System (OERS)	Office	800-452-0311
Oregon DEQ Soils/Land Application Specialist	Office	503-229-5347
	Cell	503-861-3280
Kellogg Creek Plant Operator	Office	503-794-8050

Document Control

Response to a spill of liquid or cake biosolids	**Policy No. 100-05**
Document prepared by	Environmental Programs Coordinator
Creation date	Dec 2010
Document reviewed by	Biosolids Supervisor
References	• Washington State Ecology rules • State of Oregon rules
Supporting policies/documents	
Next review date	March 2013
Attachments	Attachment 1: General guidance for biosolids spill cleanup Attachment 2: Directions from KC to Westside WWTP Attachment 3: Spill Report Form
Signatures ________________________________ ________________________ Environmental Programs Coordinator (BS Program Manager) Date	

Attachment 1: General guidance for biosolids spill cleanup

The specific method for spill containment and cleanup is dependent on several variables, including the quantity of biosolids spilled, location, contamination of the biosolids and weather. Prediction and planning for all scenarios is impossible, and cannot replace the judgment of the spill response coordinator. The information below is intended only to be general guidance and suggestions for resources.

Cake Biosolids Cleanup

If the spill has been contained on an impervious paved surface, material should be scraped from the surface and loaded with flat edged shovel or loader. Any material remaining on paved surfaces should be absorbed onto a compatible material (i.e. sand, diatomaceous earth or dirt).

If the spill has reached earth, all affected soil should be collected. If biosolids are contaminated with fuels, oils, or other debris which precludes land application, the Environmental Coordinator will determine appropriate final disposition.

Liquid Biosolids or Raw Sludge Cleanup

Contain the spill as possible; damn with dirt or bales of straw, and cover drains with mats or create a damn around drains with dirt. WES field operations vac truck can generally be used to vacuum liquid spills. Application of lime may be warranted. Consider the need to remove and dispose of contaminated dirt.

Attachment 2: Route Traveled to Westside WWTP in Vancouver, WA.

WES utilizes the following routes to haul to the Westside WWTP. These routes take our trucks through Clackamas and Multnomah Counties in Oregon and Clark County in Washington.

Figure 2 - Route 1 Detail

A 11525 SE McLoughlin Blvd, Milwaukie, OR 97222

1. Head **north** on **SE McLoughlin Blvd** toward **SE Washington St** About 8 mins	go 4.5 mi total 4.5 mi
2. Continue onto **SE Grand Ave** About 2 mins	go 1.1 mi total 5.6 mi
3. Turn left onto **SE Morrison Bridge** About 1 min	go 0.2 mi total 5.8 mi
4. Merge onto **I-5 N** via the ramp to **Seattle** Entering Washington About 10 mins	go 8.2 mi total 14.0 mi
5. Take exit **1C** for **Mill Plain Blvd/WA-501**	go 0.2 mi total 14.2 mi
6. Turn left onto **E Mill Plain Blvd** About 2 mins	go 0.2 mi total 14.3 mi
7. Continue onto **E 15th St** About 2 mins	go 0.8 mi total 15.2 mi
8. Continue onto **W Mill Plain Blvd** About 1 min	go 0.6 mi total 15.8 mi
9. Make a U-turn Destination will be on the right About 2 mins	go 279 ft total 15.8 mi

B 2323 W Mill Plain Blvd, Vancouver, WA 98660

Figure 3 - Route 1 Map

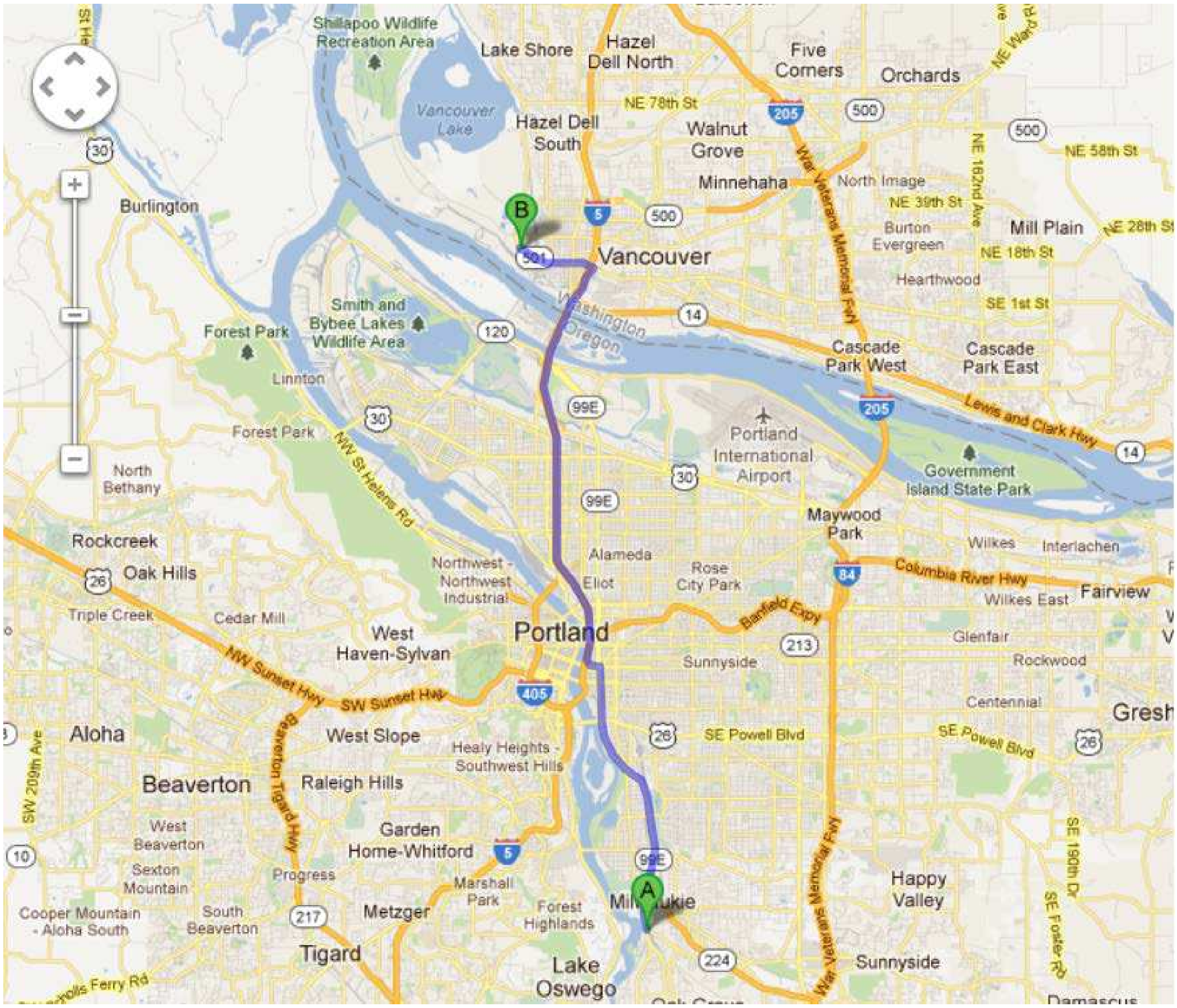


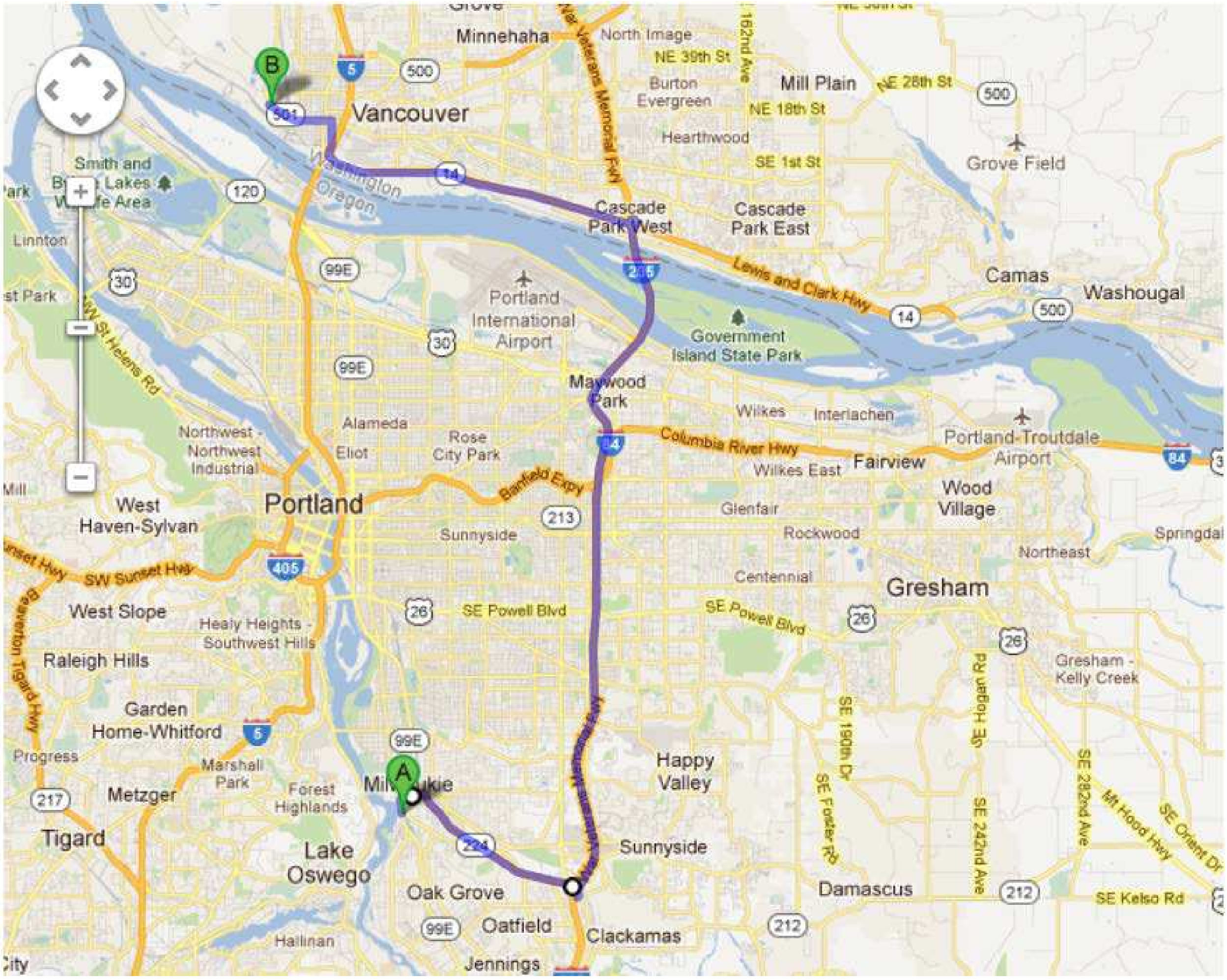
Figure 4 - Route 2 Detail

11525 SE McLoughlin Blvd, Milwaukie, OR 97222

	1. Head **north** on **SE McLoughlin Blvd** toward **SE Washington St**	go 0.3 mi total 0.3 mi
	2. Turn right onto **SE Harrison St** About 2 mins	go 0.5 mi total 0.8 mi
224	3. Turn right onto **OR-224 E** About 4 mins	go 3.4 mi total 4.2 mi
	4. Continue onto **82nd Dr**	go 0.3 mi total 4.5 mi
205	5. Take the ramp onto **I-205 N** Entering Washington About 16 mins	go 13.6 mi total 18.1 mi
	6. Take exit **27** toward **Vancouver**	go 0.5 mi total 18.6 mi
14	7. Continue on the ramp and merge onto **WA-14 W** About 5 mins	go 5.7 mi total 24.3 mi
	8. Keep left at the fork, follow signs for **City Center** and merge onto **C St** About 2 mins	go 0.9 mi total 25.2 mi
	9. Turn left onto **E 15th St** About 3 mins	go 0.7 mi total 25.9 mi
	10. Continue onto **W Mill Plain Blvd** About 1 min	go 0.6 mi total 26.5 mi
	11. Make a U-turn Destination will be on the right About 2 mins	go 279 ft total 26.5 mi

2323 W Mill Plain Blvd, Vancouver, WA 98660

Figure 5 - Route 2 Map



Attachment 3: Spill Response Form

WATER ENVIRONMENT SERVICES
A Department of Clackamas County

BIOSOLIDS SPILL REPORT FORM

A. SPILL DESCRIPTION	
Date spill occurred:	**Time spill occurred:**
Who discovered spill:	
Description of spill incident:	
Factors that may have contributed to spill. Example: equipment failure, road conditions, etc.	
Estimated Amount of Biosolids Spilled: ______________ cubic yards/gallons (CIRCLE ONE)	

B. NOTIFICATIONS – WASHINGTON (Complete as applicable. Reference spill policy for required notifications and phone numbers)			
Agency	**Time Notified**	**Contact Person's Name**	**Who Performed Notification**
Emergency – 911			
Department of Ecology's Spill Response Team			
DOT Southwest Regional office			
Biosolids Coordinator at Department of Ecology's Southwest Regional Office			
Clark County Health Department			

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(continued)			
Agency	Time Notified	Contact Person's Name	Who Performed Notification
Fish & Wildlife SW Region			
Department of Natural Resources Pacific Cascade Region			
WES			
C. NOTIFICATIONS – OREGON (Complete as applicable. Reference spill policy for required notifications and phone numbers)			
Oregon Emergency Response System (OERS)			
WES			

D. IMPACTS OF SPILL
Injuries (describe)
Environmental (describe)
Health (describe)
Other

E. CLEAN UP ACTIONS
Who performed the clean up?
What was final destination for the spilled material?
Date/Time clean up was completed:
Name of person completing this report form:
Date/Time this spill report form was completed:

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Describe clean- up activities and results:

Give completed form to Biosolids Supervisor for evaluation and necessary follow-up activities.

X ______________________________

Biosolids Supervisor **Date**

X ______________________________

Biosolids Program Manager **Date**

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Appendix B

Active DEQ Authorized Biosolids Land Application Sites

Appendix B: Active DEQ Authorized Biosolids Land Application Sites

Service District	Field Number	Owner Name	Owner Address	City	DEQ Approval Date	Crop	Taxlot
CCSD	B00201	Carey, Phil	18780 S Upper Highland Rd	Beavercreek	4/1/1986	Hay	43E06 01700
CCSD	B03701	Bever, Margaret	c/o Walt Bever 27037 S Shibley Rd	Colton	10/7/2008	Hay	33E32 01700
CCSD	B03702	Bever, Margaret	c/o Walt Bever 27037 S Shibley Rd	Colton	10/7/2008	Hay	33E32 01700
CCSD	B03801	Bravo Environmental	4927 NW Front Ave	Portland			
CCSD	C00000	Columbia Blvd S T P					23E31B 01100
CCSD	C02201	Durham CWS	16580 SW 85th Ave	Tigard			31E13 00801
CCSD	C02601	Cranston, Ed	20437 S Sweetwood Ln	Oregon City	5/11/2007	Hay	32E14B 01911
CCSD	D01101	Delano Farms LLC	17572 S Hattan Rd	Oregon City	10/14/2010	Hay	23E31C 00101
CCSD	D01111	Delano Farms LLC	17572 S Hattan Rd	Oregon City	10/14/2010	Hay	23E31 01100
CCSD	D01112	Delano Farms LLC	17572 S Hattan Rd	Oregon City	10/14/2010	Hay	23E31 01100
CCSD	D01113	Delano Farms LLC	17572 S Hattan Rd	Oregon City	10/14/2010	Hay	23E31 01100
CCSD	D01114	Delano Farms LLC	17572 S Hattan Rd	Oregon City	10/14/2010	Hay	
CCSD	D01115	Delano Farms LLC	17572 S Hattan Rd	Oregon City	10/14/2010	Hay	
CCSD	D01116	Delano Farms LLC	17572 S Hattan Rd	Oregon City	10/14/2010	Hay	
CCSD	D01501	Holmes, Deborah	21995 S Lewellen Rd	Beavercreek	6/1/1990	Hay	43E10 00101
CCSD	E00501	Eubanks, Kevin	PO Box 886	Beavercreek	2/9/1984	Hay	32E23D 00302
CCSD	E00502	Eubanks, Kevin	PO Box 886	Beavercreek	2/8/1984	Hay	32E23D 00302
CCSD	E01101	Elledge, Rhonda	18138 S Strowbridge Rd	Oregon City	6/15/1999	Hay	33E05 00100
CCSD	E01102	Elledge, Rhonda	18138 S Strowbridge Rd	Oregon City	6/15/1999	Hay	33E04 00404
CCSD	E01103	Elledge, Rhonda	18138 S Strowbridge Rd	Oregon City	6/15/1999	Hay	33E04 00401
CCSD	E01104	Elledge, Rhonda	18138 S Strowbridge Rd	Oregon City	6/15/1999	Hay	33E04 00402
CCSD	E01105	Elledge, Rhonda	18138 S Strowbridge Rd	Oregon City	6/15/1999	Hay	33E04 00401
CCSD	E01801	Emmert, Terry	11811 SE Hwy 212	Clackamas	4/17/2006	Hay	33E06 00700
CCSD	E01904	DeLaat, Richard	25883 S Gage Rd	Beavercreek	6/24/2010	Pasture	43E07 01400
CCSD	F00101	Frome, Paul	17133 S Steiner Rd	Beavercreek	7/24/2003	Hay	32E24 01501
CCSD	F00602	Frome, Paul	17133 S Steiner Rd	Beavercreek	7/24/2003	Hay	32E24 01601
CCSD	F01101	Fry, Robert	21582 S Ferguson Rd	Oregon City	2/28/1995	Hay	32E23D 00301
CCSD	F01201	Fischer, Gene	18573 S Strowbridge Rd	Oregon City	8/4/1989	Hay	33E03 01200
CCSD	F01301	Farrens, Richard	22630 S Upper Highland Rd	Beavercreek	6/24/2010	Pasture	43E02 02000
CCSD	G01701	Gilbert, Jay	24490 S Richter Rd	Beavercreek	10/7/2008	Hay	43E03 01800
CCSD	H02401	Heintz, Dave	13423 S Warnock Rd	Oregon City	11/28/1989	Hay	32E17 01402
CCSD	H02402	Heintz, Dave	13423 S Warnock Rd	Oregon City	11/28/1989	Hay	32E17 01402
CCSD	H02501	Hilderbrand, D A	PO Box 490	Beavercreek	2/7/1990	Hay	32E23A 00100
CCSD	H02503	Hilderbrand, D A	PO Box 490	Beavercreek	2/7/1990	Hay	32E23A 00900
CCSD	H02504	Hilderbrand, D A	PO Box 490	Beavercreek	2/7/1990	Hay	32E23A 00902
CCSD	H02901	Hutchinson, Annie	PO Box 737	Oregon City	8/5/1993	Hay	43E28 02000
CCSD	H03301	Hagen, L B	PO Box 522	Beavercreek	6/24/2003	Hay	43E08 00300
TCSD	H03401	Holmlund Nursery	9400 S Gibson Rd	Molalla	5/30/2003	Nursery Stock	51E27 00300
TCSD	H03402	Holmlund Nursery	9400 S Gibson Rd	Molalla	5/30/2003	Nursery Stock	51E27 00200
TCSD	H03403	Holmlund Nursery	9400 S Gibson Rd	Molalla	5/30/2003	Nursery Stock	51E27 00100
TCSD	H03404	Holmlund Nursery	9400 S Gibson Rd	Molalla	5/30/2003	Nursery Stock	51E26 00500
TCSD	H03405	Holmlund Nursery	9400 S Gibson Rd	Molalla	5/30/2003	Nursery Stock	51E22 01000
TCSD	H03406	Holmlund Nursery	9400 S Gibson Rd	Molalla	5/30/2003	Nursery Stock	51E26 00500

Appendix B: Active DEQ Authorized Biosolids Land Application Sites

Service District	Field Number	Owner Name	Owner Address	City	DEQ Approval Date	Crop	Taxlot
CCSD	H03601	Herson-Hord, Judy	PO Box 783	Beavercreek	3/23/2006	Hay	32E20 01301
CCSD	I00101	Indermuhle, Marvin	22560 S Beavercreek Rd	Beavercreek	8/30/1989	Hay	32E25 01102
CCSD	I00102	Indermuhle, Marvin	22560 S Beavercreek Rd	Beavercreek	8/30/1989	Hay	32E23 00200
CCSD	I00103	Indermuhle, Marvin	22560 S Beavercreek Rd	Beavercreek	8/30/1989	Hay	43E03 00700
CCSD	J01101	Watkins, Beverly	34825 SE Woodle Rd	Eagle Creek	6/11/1992	Hay	24E34 01200
CCSD	J01102	Watkins, Beverly	34825 SE Woodle Rd	Eagle Creek	6/11/1992	Hay	24E34 01200
CCSD	K00501	Klein, Dawn	14020 S Mueller Rd	Oregon City	6/14/1998	Hay	32E28 00711
CCSD	K00601	Knepper, Robert	18910 S Upper Highland Rd	Beavercreek	1/20/1987	Hay	43E06 01700
CCSD	K00602	Knepper, Robert	18910 S Upper Highland Rd	Beavercreek	1/20/1987	Hay	43E06 01700
CCSD	K00603	Knepper, Robert	18910 S Upper Highland Rd	Beavercreek	1/20/1987	Hay	43E06 01700
CCSD	K00604	Knepper, Robert	18910 S Upper Highland Rd	Beavercreek	1/20/1987	Hay	43E06 01700
CCSD	K00801	Kraft, Herman E	20909 S Ferguson Rd	Oregon City	9/8/1975	Hay	32E14 00200
CCSD	K00802	Kraft, Herman E	20909 S Ferguson Rd	Oregon City	9/8/1975	Hay	32E14 00200
CCSD	K00803	Kraft, Herman E	20909 S Ferguson Rd	Oregon City	9/8/1975	Hay	32E14 00200
CCSD	K00806	Kraft, Herman E	20909 S Ferguson Rd	Oregon City	9/8/1975	Hay	32E14 01000
CCSD	K00807	Kraft, Herman E	20909 S Ferguson Rd	Oregon City	9/8/1975	Hay	32E14 00900
CCSD	K02701	Kammeyer, Elva	22209 S Springwater Rd	Estacada	2/20/2002	Hay	33E24 04800
CCSD	K02801	Keeley, John	20774 S Lower Highland Rd	Beavercreek	10/7/2008	Hay	33E34 01500
CCSD	K02802	Keeley, John	20774 S Lower Highland Rd	Beavercreek	11/7/2008	Hay	43E03 01200
CCSD	K02803	Keeley, John	20774 S Lower Highland Rd	Beavercreek	11/7/2008	Hay	43E04 00100
CCSD	K02901	Kloer, Herman	20396 S Unger Rd	Beavercreek	3/8/2010	Hay	43E16 00500
CCSD	K02902	Kloer, Herman	20396 S Unger Rd	Beavercreek	3/8/2010	Hay	43E21 00500
HCSD	K03001	Kellogg Creek WWTP	11525 SE McLoughlin Blvd	Milwaukie		Pasture	
HCSD	L01901	Littlepage, Dale	33242 SE Kelso Rd	Boring	7/10/2008	Hay	24E09 01100
HCSD	L01902	Littlepage, Dale	33242 SE Kelso Rd	Boring	7/10/2008	Hay	24E09 01100
CCSD	M00101	Main, Jay	20870 S Ferguson Rd	Oregon City	2/8/1998	Hay	32E24 00901
CCSD	M00102	Main, Jay	20870 S Ferguson Rd	Oregon City	2/8/1998	Hay	32E14 00900
CCSD	M00103	Main, Jay	20870 S Ferguson Rd	Oregon City	2/8/1998	Hay	32E14 00900
CCSD	M00801	Meyer, Ralph	21700 S Ridge Rd	Oregon City	10/18/2010	Hay	33E21 01300
CCSD	M00805	Meyer, Ralph	21700 S Ridge Rd	Oregon City	10/14/2010	Hay	33E21 01400
CCSD	M00812	Meyer, Ralph	21700 S Ridge Rd	Oregon City	10/18/2010	Hay	33E21 01400
CCSD	M00813	Meyer, Ralph	21700 S Ridge Rd	Oregon City	10/18/2010	Hay	33E21 01400
CCSD	M00814	Meyer, Ralph	21700 S Ridge Rd	Oregon City	10/18/2010	Hay	33E21 00800
CCSD	M01601	Morelli, Dominic	23251 S Bluhm Rd	Beavercreek	1/11/2011	Hay	33E31 00900
CCSD	M03401	Miotke, Neil	25720 S Beavercreek Rd	Beavercreek	7/24/2003	Hay	43E08 00900
CCSD	M03701	Moehnke, Wesley	18725 S Lower Highland Rd	Beavercreek	1/21/2010	Hay	33E31 00400
CCSD	M03801	Morelli, Jim	23251 S Bluhm Rd	Beavercreek	1/21/2010	Hay	33E30 00400
CCSD	M03802	Morelli, Jim	23251 S Bluhm Rd	Beavercreek	1/21/2010	Hay	33E31 00700
CCSD	M03803	Morelli, Jim	23251 S Bluhm Rd	Beavercreek	1/21/2010	Hay	33E30 00400
HCSD	M03901	Mantei, Jay	49512 SE Baty Road	Sandy	8/26/2010	Pasture	
CCSD	M0814	Adams, George	18813 S Windy City Rd	Mulino	7/29/1997	Hay	43E18 02200
CCSD	N00302	Buller, Chuck	22940 S Viola Welch Rd	Beavercreek	10/12/2010	Hay	33E27 01300
CCSD	O00701	Owens, Judy	1155 Princeton Rd	Woodburn	2/11/2008	Hay	33E33 01300
CCSD	O00702	Owens, Judy	1155 Princeton Rd	Woodburn	1/15/2008	Hay	33E33 01300
CCSD	P02001	Pestes, Larry	16007 SE Amisigger Rd	Boring	2/16/1996	Hay	23E12 02100

Appendix B: Active DEQ Authorized Biosolids Land Application Sites

Service District	Field Number	Owner Name	Owner Address	City	DEQ Approval Date	Crop	Taxlot
CCSD	P02002	Pestes, Larry	16007 SE Amisigger Rd	Boring	9/8/2008	Hay	23E12 01907
HCSD	P02301	Pfau, Michael	58885 E Marmot Rd	Sandy	8/25/2010	Pasture	
HCSD	P02302	Pfau, Michael	58885 E Marmot Rd	Sandy	8/25/2010	Pasture	
HCSD	P02303	Pfau, Michael	58885 E Marmot Rd	Sandy	8/25/2010	Pasture	
CCSD	R00301	Robinson, Josephine R	21807 S Schram Rd	Beavercreek	7/14/1987	Hay	43E10 03300
CCSD	R00401	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	33E31 00800
CCSD	R00402	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	33E31 00800
CCSD	R00403	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	33E31 00800
CCSD	R00404	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	33E31 00800
CCSD	R00405	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	33E31 00800
CCSD	R00406	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	32E36 00100
CCSD	R00407	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	32E25 00900
CCSD	R00408	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	32E25 00900
CCSD	R00409	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	32E25 00900
CCSD	R00410	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	32E25 00900
CCSD	R00411	Rosebrook, John R	PO Box 46	Beavercreek	7/1/1975	Hay	32E25 00900
CCSD	R00412	Rosebrook, John R	PO Box 46	Beavercreek	2/23/2012	Hay	32E31 00800
CCSD	R01001	Rumgay, Ernestine	15861 S Springwater Rd	Oregon City	2/20/1991	Hay	23E19 03502
CCSD	R01002	Rumgay, Ernestine	15861 S Springwater Rd	Oregon City	2/20/1991	Hay	23E19 03502
CCSD	R01003	Rumgay, Ernestine	15861 S Springwater Rd	Oregon City	2/20/1991	Hay	23E19 03502
CCSD	R01601	Rambo Family Trust	21243 S Ridge Rd	Oregon City	11/6/1992	Hay	33E16 01500
CCSD	R01701	Rosebrook, John R	17565 S Carus Rd	Beavercreek	2/23/2012	Hay	32E25 00900
CCSD	R01702	Rosebrook, John R	17565 S Carus Rd	Beavercreek	2/23/2012	Hay	32E25 00900
CCSD	R01802	Raines, Gary	11852 S Union Hall Rd	Canby	1/26/1994	Hay	41E12 00101
CCSD	R01803	Raines, Gary	11852 S Union Hall Rd	Canby	1/26/1994	Hay	41E12 00101
CCSD	R02001	Rinkes, Terry	21640 S Beavercreek Rd	Oregon City	7/16/1998	Hay	32E23 00400
	R02101	River Bend Landfill	13469 SW Highway 18	McMinnville			
CCSD	R02201	Riehl, John	PO Box 1460	Clackamas	6/24/2010	Hay	33E03 01902
CCSD	S00101	Saltmarsh, Ron	17092 S Carus Rd	Beavercreek	4/5/1999	Hay	33E36 00401
CCSD	S00601	Schaffer, Thomas K	17323 S Steiner Rd	Beavercreek	9/9/1980	Hay	32E24 00902
CCSD	S00602	Schaffer, Thomas K	17323 S Steiner Rd	Beavercreek	9/9/1980	Hay	32E24 00903
CCSD	S00901	Schiffer, Delores	21311 S Upper Highland Rd	Beavercreek	11/1/1988	Hay	43E03 02000
CCSD	S01701	Snyder, Phil	19993 S South End Rd	Oregon City	5/22/1992	Hay	32E18 02000
CCSD	S01702	Snyder, Phil	19993 S South End Rd	Oregon City	5/22/1992	Hay	32E18 02000
CCSD	S01703	Snyder, Phil	19993 S South End Rd	Oregon City	5/22/1992	Hay	32E18 02000
CCSD	S02401	Svetlik, Chuck	23174 S Upper Highland Rd	Beavercreek	2/6/1987	Hay	43E12 00100
CCSD	S03701	Sprague, Edward A	18620 S Fischer Mill Rd	Oregon City	5/30/1990	Hay	33E06 00400
CCSD	S03702	Sprague, Edward A	18620 S Fischer Mill Rd	Oregon City	5/30/1990	Hay	33E06 00400
CCSD	S04501	Smith, William	17484 S Steiner Rd	Beavercreek	8/6/1978	Hay	32E25 00800
CCSD	S04701	Sauer, Jack	25300 S Ridge Rd	Beavercreek	5/20/1994	Hay	43E08 00200
CCSD	S04901	Smith, Fred	25208 S Elwood Rd	Colton	5/9/2007	Hay	44E29 00500
CCSD	S05001	Saucy, Mike	26022 S Schockley Rd	Beavercreek	2/17/2010	Hay	43E11 01700
CCSD	S05002	Saucy, Mike	26022 S Schockley Rd	Beavercreek	2/17/2010	Hay	43E14 00100
CCSD	S05003	Saucy, Mike	26022 S Schockley Rd	Beavercreek	12/7/1995	Hay	43E14 00100
CCSD	S05005	Carnahan, Charles	22204 S Schram Rd	Beavercreek	12/7/1995	Hay	43E14 00500

Appendix B: Active DEQ Authorized Biosolids Land Application Sites

Service District	Field Number	Owner Name	Owner Address	City	DEQ Approval Date	Crop	Taxlot
CCSD	S05006	Carnahan, Charles	22204 S Schram Rd	Beavercreek	12/7/1995	Hay	43E15 00500
CCSD	S05007	Carnahan, Charles	22204 S Schram Rd	Beavercreek	12/7/1995	Hay	43E15 00100
CCSD	S05008	Carnahan, Charles	22204 S Schram Rd	Beavercreek	12/7/1995	Hay	43E15 00100
CCSD	S05201	Sandberg, Daniel	12676 S Union Hall Rd	Canby	5/6/2000	Hay	42E07 00200
CCSD	S05202	Sandberg, Daniel	12676 S Union Hall Rd	Canby	6/19/2001	Hay	42E07 00200
CCSD	S05203	Sandberg, Daniel	12676 S Union Hall Rd	Canby	6/19/2001	Hay	42E07 00200
CCSD	S05301	Staats, Ruth	20052 S Redland Rd	Oregon City	8/4/2004	Hay	32E17 00200
CCSD	S05302	Staats, Ruth	20052 S Redland Rd	Oregon City	8/4/2004	Hay	32E17B 00400
CCSD	S05303	Staats, Ruth	20052 S Redland Rd	Oregon City	8/4/2004	Hay	32E17B 00400
CCSD	S05401	Stone, Larry	20767 S Lower Highland Rd	Beavercreek	1/15/2008	Hay	33E33 00202
CCSD	S05501	Stone, Walt	20909 S Lower Highland Rd	Beavercreek	1/15/2008	Hay	33E33 00201
CCSD	S05601	Schmidt, Mark	21201 S Yeoman Rd	Beavercreek	2/2/2007	Hay	32E24 00600
CCSD	S05602	Schmidt, Mark	21201 S Yeoman Rd	Beavercreek	2/2/2007	Hay	32E24 00600
CCSD	S06101	Suzukawa, Rei	23055 S Beavercreek Rd	Beavercreek	2/4/2008	Hay	32E35 00100
CCSD	S06301	Schoenbeck, David	PO Box 255	Beavercreek	1/22/2010	Hay	33E31 01001
CCSD	S06302	Schoenbeck, David	PO Box 255	Beavercreek	1/22/2010	Hay	33E31 01200
CCSD	S06401	Stevens, Tammy	PO Box 736	Beavercreek	3/5/2010	Hay	42E14 00400
CCSD	S06402	Stevens, Tammy	PO Box 736	Beavercreek	3/5/2010	Hay	43E14 00700
HCSD	T00901	Teuscher, Kenneth	6022 SE 136th Ave	Portland	9/6/1991	Hay	25E14 01400
HCSD	T00902	Teuscher, Kenneth	6022 SE 136th Ave	Portland	9/6/1991	Hay	25E14 01400
HCSD	T00903	Teuscher, Kenneth	6022 SE 136th Ave	Portland	9/6/1991	Hay	25E14 01400
HCSD	T00904	Teuscher, Kenneth	6022 SE 136th Ave	Portland	9/6/1991	Hay	25E14 01400
HCSD	T00905	Teuscher, Kenneth	6022 SE 136th Ave	Portland	9/6/1991	Hay	25E14 01500
HCSD	T00906	Teuscher, Kenneth	6022 SE 136th Ave	Portland	9/6/1991	Hay	25E13 00500
CCSD	T01701	Thommen, Jerry	PO Box 92	Beavercreek	11/1/1994	Hay	32E27 00406
CCSD	T02002	Tri-City Treatment Plant	15941 S Agnes Ave	Oregon City		Hay	
TCSD	V00401	Valley Landfills Inc.	28972 Coffin Butte Rd	Corvallis		Hay	
CCSD	W01701	Kennedy, Janice	1917 SE Washougal River Rd	Washougal	2/17/2010	Hay	32E21 00200
CCSD	W01702	Kennedy, Janice	1917 SE Washougal River Rd	Washougal	2/17/2010	Hay	32E21 00200
TCSD	W01901	Weedman, Guy	PO Box 376	Wasco	11/6/2003	Dryland Wheat	TL102 ;S07; T1N; R18E WM
TCSD	W01902	Weedman, Guy	PO Box 376	Wasco	11/7/2003	Dryland Wheat	TL3800; S21; T1N; R18E WM
TCSD	W01903	Weedman, Guy	PO Box 376	Wasco	11/7/2003	Dryland Wheat	TL3103; S21 & S22; T1N; R18E WM
TCSD	W01904	Weedman, Guy	PO Box 376	Wasco	11/7/2003	Dryland Wheat	TL2900; S15;T1N; R18E WM
TCSD	W01905	Weedman, Guy	PO Box 376	Wasco	11/10/2003	Dryland Wheat	TL 3103 (SPO); S22 & 27 & TL 4500 (NWPO); S26; T1
TCSD	W01906	Weedman, Guy	PO Box 376	Wasco	11/10/2003	Dryland Wheat	117E 27&26 TL 3103 & 4500
TCSD	W01907	Weedman, Guy	PO Box 376	Wasco	12/12/2003	Dryland Wheat	TL3700; S12 & S13; T1N; R17E WM
TCSD	W01908	Weedman, Guy	PO Box 376	Wasco	12/12/2003	Dryland Wheat	24E21 00500
TCSD	W01909	Weedman, Guy	PO Box 376	Wasco	12/12/2003	Dryland Wheat	24E21 00500
TCSD	W01910	Weedman, Guy	PO Box 376	Wasco	12/12/2003	Dryland Wheat	24E16 02200
TCSD	W01920	Dutton Ranch Trust	1604 X Avenue	LaGrande	6/15/2011	DryLand Wheat	T1NR18ES8&S17 TL 1900
CCSD	W01921	Dutton Ranch Trust	1604 X Avenue	LaGrande	6/15/2011	DryLand Wheat	T1N R18E S8 & S17 TL 1900
CCSD	W01923	Dutton Ranch Trust	1604 X Avenue	LaGrande	6/22/2011	DryLand Wheat	T1N R18E S11 TL 2300
TCSD	W01925	Weedman Ranches, Inc	PO Box 386	Wasco	7/7/2011	DryLand Wheat	T1N R18E S35 &S36 TL6600
TCSD	W01926	Weedman Ranches, Inc.	PO Box 386	Wasco	7/7/2011	DryLand Wheat	T1N R18E S35 & S36 TL 6600
CCSD	W01927	Weedman Ranches, Inc	PO Box 386	Wasco	7/6/2011	DryLand Wheat	T1N R18E S36 TL 6600

Appendix B: Active DEQ Authorized Biosolids Land Application Sites

Service District	Field Number	Owner Name	Owner Address	City	DEQ Approval Date	Crop	Taxlot
CCSD	W01928	Weedman Ranches, Inc	PO Box 386	Wasco	7/7/2011	DryLand Wheat	T1N R18E S6 TL 1100
TCSD	W01930	Weedman Ranches			8/29/2011	DryLand Wheat	
TCSD	W01931	Mildred Moore	PO Box 233	Moro	7/6/2011	DryLand Wheat	T1S R19E S4, S5, & S6 TL 1000
CCSD	W02101	Weaver, Ronald	25282 S Beavercreek Rd	Beavercreek	3/23/2006	Hay	43E07 00101
CCSD	X00101	Vue, Xy	21036 S Lower Highland Rd	Beavercreek	1/15/2008	Hay	33E33 00200

Appendix C

Example Neighbor Notification Letter

<WES Letterhead>
<Date>

To maintain the protection of wells and other sensitive features, please notify us immediately if you have added new wells or buildings to your property within the last 24 months.

<To>
<ADDRESS>
<CITY STATE ZIP>

Re: Notification of Biosolids Application

The Oregon Department of Environmental Quality (DEQ) requires notification of property owners/occupants adjacent to sites receiving biosolids as a soil amendment. This letter is to inform you that Water Environment Services (WES), a Department of Clackamas County, intends to apply biosolids to property owned by <PROPERTY OWNER'S NAME> and located at <SITE ADDRESS> (Tax Lot # <TAX LOT ID>) within the next six months.

Biosolids are the nutrient-rich organic solids that result from the treatment of domestic wastewater at municipal water reclamation facilities. Approximately 95% of the biosolids generated in Oregon are land-applied on DEQ-authorized sites for agricultural purposes such as grass for hay/pasture and dry land wheat.

The U.S. Environmental Protection Agency (EPA) and the Oregon Department of Environmental Quality (DEQ) regulate the land application of biosolids for the protection of public health and the environment. The DEQ inspects all sites prior to issuing a site authorization to land apply biosolids. DEQ- authorized sites must meet certain criteria and standards and are managed by WES in accordance with the requirements of the DEQ site authorization.

For general information on biosolids, visit the DEQ website at
http://www.deq.state.or.us/wq/pubs/factsheets/biosolids/05wq002abiosolids.pdf.
Information specific to WES' biosolids program can be found at:
http://www.tri-cityservicedistrict.org/biosolids
If you have any questions or concerns about WES' biosolids program or this land application, please contact me or Bob Watson at 503-557-2815.

Sincerely,

Kathryn Spencer

Kathryn Spencer
Environmental Programs Coordinator
503/742-4608
kspencer@co.clackamas.or.us

Form Ltr No. L10-05, version 5, May 2011

Appendix D

Worksheet for Calculating Biosolids Application Rates in Agriculture

PNW0511e

Worksheet for Calculating Biosolids Application Rates in Agriculture

Overview

This bulletin will walk you through the calculations that yield the biosolids agronomic rate. This rate is based on biosolids quality (determined by analytical results), site and crop nitrogen (N) requirements, and regulatory limits for trace element application. In almost all cases, nitrogen controls the biosolids application rate. Calculating the agronomic rate allows managers to match the plant-available N supplied by biosolids with crop N needs.

The calculations consist of 6 steps:

1. Collect information on the site and crop, including crop N requirement.
2. Estimate the plant-available N needed from the biosolids application.
3. Collect biosolids nutrient data.
4. Estimate plant-available N per dry ton of biosolids.
5. Calculate the agronomic biosolids application rate on a dry ton basis.
6. Convert the application rate to an “as is” basis.

To learn more about the use and management of biosolids as a fertilizer, refer to publication PNW0508, “Fertilizing with Biosolids,” which is the companion to this bulletin.

Worksheet

Step 1. Collect Site Information.

Soil and crop information:

Line No.		Your Information	Example
1.1	Soil series and texture (NRCS soil survey)		Puyallup sandy loam
1.2	Yield goal (grower, agronomist) (units/acre*)		5 tons/acre/yr
1.3	Crop rotation (grower; e.g., wheat/fallow/wheat)		perennial grass
1.4	Plant-available N needed to produce yield goal (fertilizer guide; agronomist) (lb N/acre/yr)		200

Plant-available N provided by other sources:

Line No.		Your Calculation	Example	Units
	Pre-application testing			
1.5	Nitrate-N applied in irrigation water		10	lb N/acre
1.6	Preplant nitrate-N in root zone (east of Cascades)**		—	lb N/acre
	Adjustments to typical soil N mineralization			
1.7	Plowdown of cover or green manure crop**		—	lb N/acre
1.8	Previous biosolids applications (Table 1, page 8)		30	lb N/acre
1.9	Previous manure applications		—	lb N/acre
	Grower information			
1.10	N applied at seeding (starter fertilizer)		—	lb N/acre

1.11	Total plant-available N from other sources (sum of lines 1.5 through 1.10)		40	lb N/acre

*Yield goals may be expressed as a weight (tons, lb, etc.) or as a volume (bushels).
**Do not list here if these N sources were accounted for in the nitrogen fertilizer recommendation from a university fertilizer guide.

Step 2. Estimate the Amount of Plant-Available N Needed from Biosolids.

Line No.		Your Calculation	Example	Units
2.1	Plant-available N needed to produce yield goal (from line 1.4)		200	lb N/acre
2.2	Plant-available N from other sources (from line 1.11)		40	lb N/acre
2.3	Amount of plant-available N needed from biosolids (line 2.1–line 2.2)		160	lb N/acre

Step 3. Collect Biosolids Data.

Application Information:

Line No.		Your Information	Example
3.1	Moisture content of biosolids (liquid or solid; see Table 3, pg. 11)		liquid
3.2	Biosolids processing method (see Table 3, pg. 11)		anaerobic
3.3	Method of application (surface or injected)		surface
3.4	Number of days to incorporation of biosolids		no incorporation
3.5	Expected application season		Mar. - Sept.

Laboratory Biosolids Analysis (dry weight basis):

If your biosolids analysis is on an "as is" or wet weight basis, you will need to divide your analysis by the percent solids (line 3.10) and multiply the result by 100 to convert to a dry weight basis.

Line No.		Your Calculation	Example	Units
3.6	Total Kjeldahl N (TKN)*		50,000	mg/kg
3.7	Ammonium N*		10,000	mg/kg
3.8	Nitrate N *,**		not analyzed	mg/kg
3.9	Organic N*,*** (line 3.6 - line 3.7)		40,000	mg/kg
3.10	Total solids		2.5	percent

*If your analysis is in percent, multiply by 10,000 to convert to mg/kg.
**Nitrate-N analysis required for composted or aerobically-digested biosolids, but not for anaerobically-digested biosolids.
***Organic N = total Kjeldahl N - ammonium N.

Step 4. Estimate Plant-Available N Per Dry Ton of Biosolids.

Convert biosolids N analysis to lb per dry ton:

Line No.		Your Calculation	Example	Units
4.1	Total Kjeldahl N (TKN)*		100	lb N/dry ton
4.2	Ammonium N*		20	lb N/dry ton
4.3	Nitrate N*		not analyzed	lb N/dry ton
4.4	Organic N (line 4.1 - line 4.2)		80	lb N/dry ton

*Multiply mg/kg (from lines 3.6 through 3.9) x 0.002. If your analyses are expressed in percent, multiply by 20 instead of 0.002.

Estimate Inorganic N Retained:

4.5	Percent of ammonium-N retained after application (Table 2, pg. 10)		55	percent
4.6	Ammonium-N retained after application (line 4.2 x line 4.5/100)		11	lb N/dry ton
4.7	Calculate biosolids inorganic N retained (line 4.3 + line 4.6)		11	lb N/dry ton

Estimate Organic N Mineralized:

4.8	Percent of organic N that is plant-available in Year 1 (Table 3, pg. 11)		35	percent
4.9	First year plant-available organic N (line 4.4 x line 4.8/100)		28	lb N/dry ton

Plant-available N:

4.10	Estimated plant-available N. Add available inorganic N and available organic N (line 4.7 + line 4.9)		39	lb N/dry ton

Step 5. Calculate the Agronomic Biosolids Application Rate.

Line No.		Your Calculation	Example	Units
5.1	Amount of plant-available N needed from biosolids (from line 2.3)		160	lb N/acre
5.2	Estimated plant-available N in biosolids (from line 4.10)		39	lb N/dry ton
5.3	Agronomic biosolids application rate (line 5.1/line 5.2)		4.1	dry ton/acre

Step 6. Convert to "As Is" Biosolids Basis.

Desired Units		Your Calculation	Example
Gallons per acre =	(line 5.3/line 3.10) x 24,000		39,400
Acre-inches per acre =	(line 5.3/line 3.10) x 0.88		1.44
Wet tons per acre =	(line 5.3/line 3.10) x 100		164

How to Use the Worksheet

Step 1. Collect Site Information.

Soil Series and Surface Soil Texture (Line 1.1)

Find the location on the county NRCS soil survey. Record the series name and surface texture of the predominant soil.

Crop Yield Goal (Line 1.2)

Field records are the best source for crop yield estimates. You can find proven yields for most grain farms from the local Farm Service Agency office. For most other cropping systems, grower records are the only source available. Be sure to note whether the yield records are on an "as is" or dry matter basis. Where field records are not available, you can make first-year estimates for a project using NRCS soil surveys, county production averages, or other local data sources.

A site used repeatedly for biosolids application should have yield data collected each year. Use this accumulated data for determining crop nitrogen requirement. If crop yield data is not kept, you may need to conduct additional monitoring (e.g., post-harvest soil nitrate testing) to be sure biosolids are applied at an agronomic rate.

Yield data is typically not available for grazed pastures because grazing animals consume the crop in the field. In these cases omit the yield goal, and go directly to Line 1.4. Estimate plant nitrogen needs from the appropriate pasture fertilizer guide, based on the level of pasture management.

Crop Rotation (Line 1.3)

Consult with the grower and discuss possible crop rotations. Rotations that include root crops or other crops with long post-application waiting periods are not suitable for Class B biosolids applications.

Plant-Available N Needed to Produce Yield Goal (Line 1.4)

You can estimate plant-available N needs by referring to university fertilizer guides or consulting a qualified agronomist.

<u>University Fertilizer Guides</u>

Land grant universities (for example, Washington State University, Oregon State University, and the University of Idaho) publish fertilizer guides that estimate plant-available N needs. Use the fertilizer guide most appropriate for the site and crop. For major crops, guides may cover irrigated or rainfed (dryland) cropping and different geographic areas. Don't use guides produced for irrigated sites when evaluating dryland sites. When appropriate guides do not exist, consult the local Extension or Natural Resources Conservation Service office, or a qualified agronomist for assistance.

Nitrogen fertilizer application rates listed in the fertilizer or nutrient management guides are based on field trials under the specified climate and cultural conditions. Growth trial results are averaged over a variety of soil types and years. Note that guide recommendations are not the same as crop uptake. This is because the guides account for N available from mineralization of soil organic matter and the efficiency of N removal by the crop.

The N rate recommended in fertilizer or nutrient management guides assumes average yields, good management practices, and removal of N from the field through crop harvest or grazing. In terms of satisfying crop N needs, plant-available N from biosolids application is considered equal to fertilizer N.

Agronomist Calculations

Because of the general nature of university fertilizer and nutrient management guides, it may be worthwhile to have a qualified agronomist calculate how much plant-available N is needed for a specific field. Always use the same method to calculate the N requirements. You will need to document your reasons for using agronomist calculations instead of the university guide.

Plant-available N provided by other sources (Lines 1.5-1.11)

To make sure there isn't too much nitrogen applied to a crop, you must determine how much nitrogen comes from sources other than biosolids and soil organic matter. These sources of N are grouped into three categories in the worksheet:

- Plant-available N estimated by pre-application testing
- Adjustments to typical soil organic N mineralization (usually obtained from an agronomist)
- Information supplied by the grower

N estimated by pre-application testing (Lines 1.5-1.6)

Irrigation Water
Since the amount of nitrate-N in irrigation water varies, it should be determined by water testing. Irrigation water containing 5 mg nitrate-N per liter will contribute 1.1 pounds of nitrogen per acre inch applied; irrigation water containing 10 mg nitrate-N per liter will contribute 2.3 pounds of N per acre inch.

Preplant Nitrate-N in the Root Zone (east of Cascades)
You can estimate the preplant nitrate-N in the root zone by testing the soil in early spring. Sample in one-foot increments to a depth of at least two feet. University of Idaho Extension Bulletin EXT 704, "Soil Sampling," is a good reference for soil sampling procedures.

Some fertilizer guides use preplant soil nitrate-N when calculating N fertilizer application rates. If you use these guides, don't count soil test nitrate-N in our worksheet—it has already been accounted for in the recommended fertilizer N rate prescribed in the guide.

In dryland cropping systems, soil testing below three feet is used to assess long term N management. Accumulation of nitrate below 3 feet indicates that past N applications were not efficiently utilized by the crop. However, soil nitrate-N below 3 feet is typically not included as a credit when making a N fertilizer recommendation.

Adjustments to typical soil N mineralization (Lines 1.7-1.9)

Nitrogen mineralization is the release of nitrogen from organic forms to plant-available inorganic forms (ammonium and nitrate). Soil organic matter supplies plant-available N through mineralization, but this is accounted for in the fertilizer guides. Sites with a history of cover crops, biosolids applications, or manure applications supply more plant-available N than do sites without a history of these inputs, and biosolids recommendations must be adjusted based on this additional supply of N.

Plowdown of Cover or Green Manure Crops

Green manures and cover crops are not removed from the field, but are recycled back into the soil by tillage. You can get an estimate of the N contributed from this plowdown by referring to the university fertilizer guides, or by estimating the yield and nitrogen concentration of the cover crop. Recovery of green manure N by the next crop ranges from 10-50% of the total N added to the soil by the cover crop. Estimates of plant-available N contributed by green manure crops should be made by a qualified agronomist.

Previous Biosolids Applications

Previous biosolids applications contribute to plant-available nitrogen in the years after the initial application. In the worksheet, they are considered as "N from other sources." We estimate that 8, 3, 1 and 1 percent of the organic N originally applied mineralizes in Years 2, 3, 4 and 5 after application (Table 1). After Year 5, biosolids N is considered part of stable soil organic matter and is not included in calculations.

Table 1. Estimated nitrogen credits for previous biosolids applications at a site.

	Years After Biosolids Application			
	Year 2	Year 3	Year 4 and 5	Cumulative (Years 2, 3, 4 , and 5)
Biosolids Organic N as applied	Percent of Organic N Applied First Year			
	8	3	1	13
mg/kg (dry wt basis)	Plant-available N released, lb N per dry ton			
10000	1.6	0.6	0.2	2.6
20000	3.2	1.2	0.4	5.2
30000	4.8	1.8	0.6	7.8
40000	6.4	2.4	0.8	10.4
50000	8.0	3.0	1.0	13.0
60000	9.6	3.6	1.2	15.6

In using Table 1, consider the following example. Suppose:

- You applied biosolids with an average organic N content of 30,000 mg/kg
- Applications were made the previous 2 years
- The application rate was 4 dry tons per acre

Table 1 gives estimates of nitrogen credits in terms of the organic N originally applied. Look up 30,000 mg/kg under Year 2 and Year 3 columns in the table. The table estimates 4.8 lb plant-available N per dry ton for year 2, and 1.8 lb plant-available N for year 3 (two-year credit of 6.6 lb N per dry ton). To calculate the N credit in units of lb/acre, multiply your application rate (4 dry ton/acre) by the N credit per ton (6.6 lb N/dry ton). The N credit is 26.4 lb plant-available N per acre.

Previous Manure Applications

Previous manure applications contribute to plant-available nitrogen in a similar manner to previous biosolids applications. To estimate this contribution, consult an agronomist.

Information supplied by the grower (Line 1.10)

N Applied at Seeding
Some crops need a starter fertilizer (N applied at seeding) for best growth. These fertilizers usually supply N, P and S. Examples are 16-20-0, 10-34-0. Starters are usually applied at rates that supply 10–30 lb N per acre. Enter all N supplied by starter fertilizer on line 1.10 in the worksheet.

Step 2. Estimate Plant-Available N Needed from Biosolids.

Next you will estimate the amount of plant-available N the biosolids must provide. This is the difference between the total plant-available N needed to produce the yield goal and the plant-available N from other sources.

Step. 3. Collect Biosolids Data.

To make the calculation, managers will need the following analyses:

- Total Kjeldahl N (TKN)
- Ammonium-N (NH_4-N)
- Nitrate-N (NO_3-N; composted or aerobically digested biosolids only)
- Percent total solids

If your laboratory results are on an "as is" or wet weight basis, you must convert them to a dry weight basis. To convert from an "as-is" to a dry weight basis, divide your analysis by the percent solids in the biosolids and multiply the result by 100. Total Kjeldahl N includes over 95% of the total N in biosolids. In using the worksheet, we will assume that total Kjeldahl N equals total N.

Ammonium-N usually makes up over 95% of the total NH_4^+ inorganic N in most biosolids. Ammonium-N includes both ammonia (NH_3) and ammonium (NH_4^+). Depending on your laboratory, results for ammonium-N may be expressed as either ammonia-N (NH_3-N) or ammonium-N (NH_4^+-N). Make sure that the laboratory determines ammonium-N on a fresh (not dried) biosolids sample. Ammonia-N is lost when samples are oven-dried.

There may be significant amounts of nitrate in aerobically digested biosolids or in composts. There is little nitrate in anaerobically digested biosolids; therefore nitrate analysis is not needed for these materials.

Determine biosolids organic N by subtracting ammonium-N from total Kjeldahl N (line 3.6 –line 3.7). Percent total solids analyses are used to calculate application rates. Biosolids applications are calculated as the dry weight of solids applied per acre (e.g., dry tons per acre).

Step 4. Estimate Plant-Available N Per Dry Ton of Biosolids.

The estimate of plant-available N per dry ton of biosolids includes:

- Some of the ammonium-N
- All of the nitrate-N
- Some of the organic N

Inorganic N Retained (Lines 4.5-4.7)

Ammonium-N (Lines 4.5-4.6)

Under some conditions, ammonium is readily transformed to ammonia and lost as a gas. This gaseous ammonia loss reduces the amount of plant-available N supplied by biosolids. The following section explains the factors used to estimate ammonia-N retained in plant-available form after application.

Biosolids processing
Some types of biosolids processing cause most of the ammonia-N to be lost as ammonia gas or converted to organic forms before application:

- Drying beds
- Alkaline stabilization at pH 12
- Composting

Application method
Ammonia loss occurs only with surface application. Injecting liquid biosolids eliminates most ammonia loss, since the injected liquid is not exposed to the air. Surface applications of liquid biosolids lose less ammonia than do dewatered biosolids. For liquid biosolids, the ammonia is less concentrated and is held as NH_4^+ on negatively-charged soil surfaces after the liquid contacts the soil.

Ammonia loss is fastest just after application to the field. As ammonia is lost, the remaining biosolids are acidified—that is, each molecule of NH_3 lost generates one molecule of H+ (acidity). Acidification gradually slows ammonia loss. Biosolids that remain on the soil surface will eventually reach a pH near 7, and further ammonia losses will be small. Ammonia loss takes place very rapidly after application, with most of the loss occurring during the first two days after application.

Time to soil incorporation
Tillage to cover biosolids can reduce ammonia loss by adsorption of ammonium-N onto soil particles.

Table 2 estimates the amount of ammonium-N retained after field application. To use this table, you will need information on biosolids stabilization processes, method of application (surface or injected), and the number of days to soil incorporation.

Table 2. Estimates of ammonium-N retained after biosolids application.

Time to Incorporation by Tillage	Surface-Applied			Injected
	Liquid Biosolids	Dewatered Biosolids	Composted, air-dried, or heat-dried biosolids	All biosolids
	Ammonium-N retained, percent of applied			
Incorporated immediately	95	95	100	100
After 1 day	70	50	100	100
After 2 days	60	30	100	100
No incorporation	55	20	100	100

Nitrate-N (Line 4.3)

We assume 100% availability of biosolids nitrate-N.

Organic N Mineralized (Lines 4.8-4.9)

Biosolids organic N, which includes proteins, amino acids, and other organic N compounds, is not available to plants at the time of application. Plant-available N is released from organic N through microbial activity in soil. This process is called mineralization. This process is more rapid in soils that are warm and moist, and is slower in soils that are cold or dry. Biosolids organic N mineralization rates in soil also depend on the treatment plant processes that produced the biosolids. Use Table 3 to estimate biosolids mineralization rates based on processing. Use the middle of the range presented, unless you have information specific to the site or biosolids that justify using higher or lower values within the range.

Table 3. First year mineralization estimates for organic N in biosolids.

Processing	First-year organic N mineralization rate
	Percent of organic N
Fresh*	
Anaerobic Digestion, liquid or dewatered	30–40
Aerobic Digestion, liquid or dewatered	30–40
Drying Bed	30–40
Heat-dried	30–40
Lagoon	
< 6 months	30–40
6 months to 2 years	20–25
2 to 10 years	10–20
> 10 years	5–10
Composting	0–10
Blends and soil products	†

*"Fresh" includes all biosolids that have not been stabilized by long-term storage in lagoons or composting.
†Because blends (with woody materials) and soil products that contain biosolids vary widely in composition and age depending on intended use, available N may vary widely among products. For blends, available N can be estimated through laboratory incubation studies.

Step 5. Calculate the Agronomic Biosolids Application Rate.

Perform this calculation using the results of the previous sections, as shown in lines 5.1 through 5.3.

Step 6. Convert Agronomic Biosolids Application Rate to “As Is” Basis.

Use the appropriate conversion factors (given in Table 5) to convert to gallons, acre-inches, or wet tons per acre.

Other Considerations for Calculations

- Small acreage sites without a reliable yield history. Some communities apply biosolids to small acreages managed by “hobby farmers.” In many of these cases, there is no reliable yield history for the site, and the goal of management is not to make the highest economic returns. You can be sure of maintaining agronomic use of biosolids nitrogen on these sites by applying at a rate substantially below that estimated for maximum yield.

- Equipment limitations at low application rates. At some low-rainfall dryland cropping locations east of the Cascades, the agronomic rate calculated with the worksheet will be lower than can be spread with manure spreaders (usually about 3 dry tons per acre). At these locations, you may be able to apply the dewatered biosolids at the equipment limit, but check with your permitting agency for local requirements.

Cumulative Loading of Trace Elements

Under EPA regulations (40 CFR Part 503.13), managers must maintain records on cumulative loading of trace elements only when bulk biosolids do not meet EPA Exceptional Quality Standards for trace elements (Table 4). Contact your regulatory agency for details on record keeping if your biosolids do not meet the standards in Table 4.

Table 4. Trace elements concentration limits for land application.

		Concentration Limit	
Element	Symbol	Exceptional Quality Standard (EPA Table 3)* mg/kg	Ceiling Limit (EPA Table 1)* mg/kg
Arsenic	As	41	75
Cadmium	Cd	39	85
Copper	Cu	1500	4300
Lead	Pb	300	840
Mercury	Hg	17	57
Molybdenum	Mo	**	75
Nickel	Ni	420	420
Selenium	Se	100	100
Zinc	Zn	2800	7500

Source: EPA 40 CFR Part 503.
*EPA Table 3 and Table 1 refer to tables in EPA biosolids rule (40 CFR Part 503).
**Molybdenum concentration standard level is under review by the EPA.

Table 5. Conversion Factors.

1%	=	10,000 mg/kg or ppm
	=	20 lb/ton
1 mg/kg	=	1 ppm
		.0001 %
		.002 lb/ton
1 wet ton	=	1 dry ton / (per cent solids x 0.01)
1 dry ton	=	1 wet ton x (per cent solids x 0.01)
1 acre-inch	=	27,000 gallons

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