# 2011: ANNUAL BIOSOLIDS REPORT

## Introduction
The City of Salem, Oregon, is located in the Willamette Valley, an area of rich agricultural production. The local climate is characterized by cool, moist winters and warm, dry summers, with an average annual precipitation of 40 to 45 inches. Snowfall and extended periods of freezing weather are infrequent.

The soil conditions, agricultural practices and the mild climate allow local biosolids application during fair weather, from early spring through mid-October. Locally, soils are dominated by silty-clay deposits of Willamette River bottom sediments. Eastward of Salem the soils are predominantly clay, while to the northeast loamy soils predominate. During the winter months and periods of local inclement weather, the City of Salem stores dewatered biosolids products locally in a multi-purpose agricultural building or transports dewatered biosolids products to application sites in Eastern Oregon.

## Wastewater Processing Systems
The City of Salem owns and operates a municipal sewage collection system and two wastewater treatment facilities; Willow Lake Water Pollution Control Facility (WLWPCF) and River Road Wet Weather Treatment Facility (RRWWTF), under the National Pollutant Discharge Elimination System (NPDES) Permit Number 101145, Department of Environmental Quality (DEQ) File No. 78140.

Salem provides wastewater treatment for a population center of approximately 229,000, including Salem, Keizer, Turner, and unincorporated parts of Marion County. Salem's annual wastewater flow totaled 14.305 billion gallons. The proportional breakdown of the total annual flow was:

- 94 percent residential
- < 1 percent commercial
- 5 percent light industrial and institutional dischargers

Septage is accepted at a receiving facility located at the City Shops approximately 8 miles from the WLWPCF. The receiving facility received an annual total of 3,182,773 gallons of septage which was conveyed to WLWPCF for treatment.

Salem also manages an Environmental Protection Agency (EPA) approved pretreatment program which oversees 34 permitted dischargers, including seven categorical industries.
(See Table 1: 2011 City of Salem - Permitted Industries)

## Willow Lake Water Pollution Control Facility
The Willow Lake Facility is sited on 40 acres between the City of Keizer's urban growth boundary and the Willamette River. Treatment processes include mechanical screening, primary and secondary treatment, sludge thickening, anaerobic digestion, cogeneration, solids dewatering, chlorine disinfection, and dechlorination.

WLWPCF is designed for an average dry weather flow of 35 million gallons per day (mgd). Plant upgrades completed in 2010 have increased the designed peak wet weather flow to 155 mgd.

WLWPCF can operate in a variety of secondary modes, including; trickling filter, conventional air activated sludge, high purity oxygen activated sludge, trickling filter/air activated sludge, and trickling filter/high purity oxygen activated sludge in parallel. WLWPCF secondary process flexibility provides excellent treatment for wide variations in Biochemical Oxygen Demand (BOD) resulting from increased loading rates during canning season. Primary solids are thickened in one of three (3) gravity thickeners. Secondary solids are thickened on a Gravity Belt Thickener. Typically, solids are thickened to approximately five percent prior to mesophilic primary/secondary anaerobic digestion. Treated effluent is discharged to the Willamette River (78.4 River Mile) in Marion County, Oregon.

**River Road Wet Weather Treatment Facility**
The River Road Facility is sited at River Road Park approximately 4 miles upstream from the WLWPCF on the 72-inch interceptor. RRWWTF is designed to receive flows which exceed the hydraulic capacity of WLWPCF. Utilizing interceptor diversion gates for flow control, the facility provides secondary treatment and disinfection for excessive flows during storm events. RRWWTF is designed for a nominal daily flow of 50 mgd and a one hour peak of 60 mgd.

RRWWTF operates as a high-rate, chemical/physical treatment plant. Processes include fine screening, high rate clarification (HRC) utilizing polymer, and micro-sand for coagulation, and ultraviolet disinfection. Influent flow is passed through screening channels prior to coagulation treatment. Solids in excess of 6 mm in diameter are returned to the 72-inch interceptor sewer for transport to the WLWPCF. Treated effluent is discharged to the Willamette River at River Mile 82.6.

**WLWPCF & RRWWTF Wastewater Treatment Strategy**
The combination of WLWPCF system upgrades and the implementation of the RRWWTF are designed to eliminate sanitary sewer overflows (SSO's) under certain conditions. In December 2010 Salem submitted an evaluation of the effectiveness of overflow reduction and elimination efforts to DEQ as part of the Mutual Agreement and Order (filed in January 1998).

The combined designed peak wet weather flow for both facilities is 205 mgd. Salem staff work collectively to prevent SSO's, by utilizing flow routing options for optimum conveyance capacity, and effective treatment strategy for maximum combined treatment capacity.

**Biogro Management Description**
The City of Salem's biosolids program (Biogro) oversees the coordination of biosolids reuse, including staffing, augment service contracts, regulatory reporting, documentation procedures, budget issues, and active participation with regards to the program's future needs. WLWPCF dewatering processes and distribution methods have continually evolved since the formal beginning of the Biogro program in 1975. Today the Biogro Program can be easily divided into two distinct seasons:

- Spring & Summer Season - Local transport and application from May through October
- Wet Season - Local storage and/or eastern Oregon transport from November through April

During the wet season, Salem utilizes a multi-purpose agricultural building located in Marion County to store dewatered biosolids products during winter months. Stored biosolids are applied on nearby application sites the following July and August. Salem also retains 720 leased acres on Madison Ranch located near Hermiston, in eastern Oregon, through the year 2020 for biosolids reuse.

Biogro staff has strong farming backgrounds and excel in farm-relations, equipment operation, truck transport, and liquid biosolids application. During the wet season, in addition to transport duties, Biogro staff assists with plant operations as certified Wastewater Treatment Operators.

**Class B Biosolids Digester Components & Statistics**

The south digester facility is composed of two (2) gas mixed, fixed cover, primary digesters which overflow to two (2) secondary digesters. The north digester facility is composed of two (2) mechanically mixed, fixed cover, primary digesters which overflow to a floating dome, secondary digester. The digester facilities gas systems are common and provide fuel for the cogeneration system. Each primary digester is externally heated with coiled heat exchangers using a modified hot water loop from the cogeneration system as a heat source. Additionally, both facilities are equipped with boilers as a redundant heat source.

The North Primary Digesters (NPD 1 & 2) and the North Secondary Digester (NSD 3) were emptied for piping maintenance as noted:
NPD 2: O/S from 08-07-10 to 09-17-10
NPD 1: O/S from 10-03-10 to 11-06-10
NSD 3: O/S from 11-15-10 to 12-21-10

An annual total of 37,415,558 gallons of primary and thickened secondary sludge were fed to the primary digesters. The primary and secondary sludge flow streams were divided between the north and south digester facilities using magnetic flow meters and automated feed valves. Approximately 60.1 percent of the treatment plant's solids production was stabilized in the larger south primary digesters while the north facility received 39.9 percent.

Design organic loading on the primary digesters is approximately 0.23 pounds volatile solids/day/cubic feet of digester volume. The annual averaged organic loading on the primary digesters was 0.063 volatile pounds/day/cubic feet of digester volume.
(See Table 2: Digester Volatile Feed Pounds Loading Rates)

**Class B Biosolids Treatment Description**

All biosolids produced met the Class B pathogen and Vector Attraction Reduction (VAR) requirements as specified in:

- 40 CFR 503.32(b) (3), Appendix B; Processes to Significantly Reduce Pathogens (PSRP), Item 3, which states: Anaerobic digestion - Sewage sludge is treated in the absence of air for a specific Mean Cell Residence Time (MCRT) at a specific temperature. Values for the MCRT and temperature shall be between 15 days at 35 to 55 degrees Celsius and 60 days at 15 degrees Celsius
- 40 CFR 503.33(b) (1) which states: The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38 percent (see calculation procedures in "Environmental Regulations and Technology-Control of Pathogens and Vector Attraction in Sewage Sludge," EPA-625/R-92/013, 1992, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268)

The annual averaged MCRT (four primary digesters) was between 33.8 and 58.0 days at an average temperature of 98.9 degrees Fahrenheit (37.2 degrees Celsius).
(See Table 3: Annual Bioedge Digester Performance Report: Monthly & Annual Averages)

**Biosolids Analysis Reporting**

Biosolids were analyzed for metals and nutrient characteristics more frequently than the minimum requirements listed in 40 CFR 503.16, Table 1. All biosolids analysis was performed in-house. (See Table 4 a, b, & c: Monthly Biosolids Analysis)

Total and volatile solids of raw digester feed were measured daily. Primary digester feed rates and temperatures were also measured daily. Primary digester alkalinity and pH were measured three (3) times per week. Monthly averages were used to calculate total volatile solids reduction.

When producing dewatered products, biosolids samples (centrate, pressate, feed solids, and dewatered product) were collected every four (4) hours. During local liquid application, biosolids samples were taken when filling each tanker load. Samples from the centrifuge, belt filter press and liquid biosolids products were composited separately and analyzed monthly for all pollutants listed in 40 CFR 503.13, Table 1, as well as Total Solids, Total Volatile Solids, pH, Total Kjeldahl Nitrogen (TKN), Nitrate Nitrogen (NO3) and Ammonia Nitrogen (NH3), Phosphorus (P), and Potassium (K).

The average volatile content of biosolids utilized for production of dewatered and liquid biosolids products was 63.6 percent. The average volatile solids reduction rate in the digesters ranged between 54.3 and 63.6 percent.
(See Table 5: Volatile Solids Reduction: Monthly & Annual Averages)

**Class B Biosolids Products: Centrifuge, BFP, and Liquid:**

An annual total of 34,002,064 gallons of digested biosolids were utilized for the production of centrifuge, belt filter press, and liquid biosolids products. Biosolids production was limited several times in 2011 due a wetter than usual June (which prohibited belt filter press and liquid product applications, and the reduced dewatered cake production while the belt filter press was used in October and November while facilitating centrifuge repairs. The proportional breakdown of the total annual biosolids production (in gallons) was:

- 63.3 percent centrifuge product (21,515,960 gallons)
- 21.8 percent belt filter press product (7,410,204 gallons)
- 14.9 percent liquid product (5,075,900 gallons)

(See Table 6: Digester Balance – In versus Out)

Biosolids feed concentrations, either applied as a liquid application or sent to the dewatering processes vary insignificantly from year to year. The annual biosolids feed concentration averaged between 1.63 percent and 3.01 percent by weight.

The combined (BFP & Centrifuge) polymer costs for dewatered production was $266,910 which was an increase of 14.5 percent from the previous year. The cost increase reflected higher polymer prices; however, centrifuge production is still cost effective because it reduces costs associated with winter storage, transport, and land application. BFP production was down slightly due to a late summer application season, while Centrifuge production remained consistent with 2010.

The 21 inch diameter bowl centrifuge provided an annual average cake dryness of 24.9 percent utilizing an average polymer dosage of 95.7 lbs/ton of dry feed solids and yielding an average capture rate of 88.79 percent. Centrifuge polymer consumption totaled 21,669 gallons at a cost of $234,890.

The three meter belt filter press provided an annual average cake dryness of 16.6 percent utilizing an average polymer dosage of 39.2 lbs/ton of dry feed solids and yielding an average capture rate of 89.26 percent. Belt filter press polymer consumption was 2,954 gallons at a cost of $32,020. (See Table 7: Centrifuge/Belt Filter Press Production)

NOTE: For polymer cost estimates, Table 7 utilizes the averaged daily total solids concentrations for the various flow streams (feed, cake, and pressate/centrate) rather than monthly composite samples.

**Biosolids Production and Transport Quantity**
Salem produced and transported an annual total of 2993.50 dry US tons of biosolids products. This value represents Salem's annual biosolids production. Monthly dry ton values are calculated using the monthly composite sample analysis. Tons transported utilize the daily transport data records. (See Table 8: Total Annual Wet Tons & Gallons Produced & Transported)

**Biosolids Application & Storage Quantities**
Including dewatered cake product stored during the winter of 2010-11, Salem applied an annual total of 3730.72 dry US tons of biosolids product. This significantly higher value represents local storage tons from the previous winter (2010-11) which were applied this summer (2011) and the present biosolids in storage from October through December of 2011. A summary follows below:

Winter 2010-11: Stored – Local application

- 2078.52 dry US tons winter stored BFP and centrifuge product on 623 acres

Summer 2011: Season production - local application:

- 538.51 dry US tons summer production of dewatered BFP product on 212 acres
- 526.20 dry US tons liquid Biogro application on 434 acres

Winter 2011: Storage Oct-Nov-Dec

- 587.50 dry US tons centrifuge product

(See Table 9 a, & b: Application Site Totals – Acreage, Tonnage & Nutrient Values)

**Biosolids Application Sites & Acreage**
Salem managed 25 applications of Class B biosolids (liquid and dewatered) on various sections of 25 DEQ authorized sites consisting of livestock pasture, hay, grass seed, and flower seed on lands totaling 1,269 acres. (See Table 9 a, b, & c: Application Site Totals – Acreage, Tonnage & Nutrient Values)

**Biosolids Annual Nutrient Pounds Applied and Average Application Rates**
Control of application rates was the responsibility of the City of Salem. All applications were consistent with site restrictions outlined in 40 CFR 503.32 (b)(5) and application rates specified in DEQ site authorization letters. DEQ site approval letters approved Plant Available Nitrogen (PAN) application rates from 100 pounds to 150 pounds per acre.

Liquid biosolids were applied using 5,500 and 6,000 gallon pressurized tanker trucks at application rates pre-approved by the DEQ. The average annual application rate of 1.28 dry tons per acre provided an average of 114 pounds of (PAN) per acre.
(See Table 9 b: Liquid Application Site Totals & Averages – Average Dry Tons/Acre and Average PAN lbs/acre)

Dewatered biosolids were transported to sites using tarp-covered semi-end dump trailers. Dewatered product was applied using a tractor and manure spreader. The average annual application rate of 2.98 dry tons per acre provided approximately 115 pounds of PAN.
(See Table 9 a, b, & c: Application Site Totals – Acreage, Tonnage & Nutrient Values)

NOTE: The following conditions can produce a slight variance between annual application tonnage and the monthly production/transport tonnage:

- When biosolids applications at specific sites extended into a second month, the composite sample data from the month with the largest production tonnage was used for application estimates.
- Biosolids applications utilizing a combination of centrifuge and belt filter press products on a specific site required a calculated weighted average to determine dry tons applied.

The total pounds of nutrients applied for PAN, phosphorus (P), and potassium (K) were:

- 148,695 pounds of PAN
- 122,775 pounds of P
- 23,027 pounds of K

(See Table 9 a, b, & c: Application Site Totals – Acreage, Tonnage & Nutrient Values)

**Application Site Management**
This year DEQ approved one new reuse site totaling 120 acres for Salem's Biogro Program. Additionally, older application sites continue to be re-authorized as owners and acreages are adjusted.

Biogro staff used a Global Positioning System (GPS) to measure acreage and lay out buffer zones around wells, structures, sensitive areas, and the perimeter of the property. A minimum buffer zone of 50 feet was required around property perimeters and near surface water. A buffer zone of at least 200 feet was required around all residences and wells. Application site worksheets and daily application maps were completed for each site. Salem staff and associated biosolids augment contract service staff carried route maps and a copy of the site authorization letter when in transport to application sites and during field application.

Well and soil samples were collected at all local application sites. Wells adjoining beneficial reuse sites were analyzed for NO3. Application site soils were analyzed for background levels of pH, Cation Exchange Capacity (CEC), total NO3, P, K and 40 CFR 503.13, Table 1 pollutants. The Bray 1 method was used to determine available soil phosphorus. Additionally, the organic content of application site soils was analyzed to evaluate increases in the soil's organic content as a result of biosolids applications. Cumulative loading for nutrients and pollutants were recorded for each site. A Farmer's Report was also generated to evaluate the economic value of biosolids applications.

**Biosolids Spill Incidents**
The City of Salem's Biogro Program had no biosolids spill incidents in 2011.

**Anticipated Biosolids Production & Acreage Requirements For 2011**
Salem anticipates very little change concerning biosolids production and acreage requirements in 2011. Biogro staff anticipates future annual biosolids production to be between 3,100 and 3,400 dry tons and acreage requirements to be between 1,300 and 1,600 based on an annual average

application rate of 2.13 dry tons per acre.
(See Table 9 a: Application Site Averages & Totals)

**Application Record Management**
All record keeping and reporting practices including the NPDES Discharge Monitoring Report, Site Monitoring Reports, and the EPA 503 Annual Compliance Report comply with 40 CFR 503.17 and 503.18.

All analytical results were incorporated into the Biogro program database and shared with the farmer. In addition, the cumulative loading of nutrients and pollutants were recorded. To date, the City's monitoring of site soils and domestic wells adjacent to application sites have not revealed any problems related to the City of Salem's beneficial reuse of biosolids for land application.

In August 2011, Salem terminated the DEQ authorization of its site known as Ted Klopfenstein 1. This was done as a courtesy, in order to assist the City of Silverton in its search for additional beneficial reuse acreage. Upon Salem's termination of the site, Silverton requested and received authorization for biosolids land application on the Ted Klopfenstein 1 site. The termination document is on file in the Biogro Program files.

In July 2011, Salem agreed to allow its authorized sites known as Jimmy Gross Fields 6 & 7 for a one time use by the City of Jefferson for biosolids application. The site was returned upon completion at the end of the project in November 2011. Documents are on file with the Cities of Salem (Biogro Program) and Jefferson and the DEQ.

**Oregon Administrative Rules (OAR) 340 – 050 – 0006**
**Policy**
The Environmental Quality Commission (EQC) encourages the land application of treated domestic wastewater biosolids, biosolids derived products, and domestic septage which are managed in a manner which protects the public health and maintains or improves environmental quality. These beneficial recyclable materials improve soil tilth, fertility, and stability and their use enhances the growth of agricultural, silvicultural, and horticultural crops.