2015 ANNUAL BIOSOLIDS REPORT

Introduction

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

The WLWPCF provides wastewater treatment for a population of approximately 229,000, including Salem, Keizer, Turner, and unincorporated parts of Marion County. In 2015, total annual rainfall recorded at the WLWPCF was 40.63 inches. The annual wastewater flow totaled 13.79 billion gallons. The proportional breakdown of the total annual flow was:

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

Septage is accepted at a receiving facility located at the City Shops approximately 8 miles from the WLWPCF. The facility received an annual total of 4,514,919 gallons of septage which was conveyed to the WLWPCF for treatment.

Salem also manages an Environmental Protection Agency (EPA) approved pretreatment program which oversees 36 permitted dischargers including several categorical industries (see Table 1: 2015 City of Salem - Permitted Industries).

The WLWPCF conducts land application of biosolids on local, authorized sites from early spring through October each year. During the winter months and periods of local inclement weather, dewatered biosolids are either stored locally in a multi-purpose agricultural building or transported to authorized land application sites in Eastern Oregon, which has an active contract until 2019.

Wastewater Processing Systems

The WLWPCF is sited on 40 acres between the City of Keizer's urban growth boundary and the Willamette River in Marion County, Oregon. The facility is designed for an average dry weather flow of 35 million gallons per day (mgd). Plant upgrades completed in 2010 increased the design peak wet weather flow to 155 mgd. Treated effluent is discharged to the Willamette River at River Mile 78.4.

Wastewater treatment processes include mechanical screening, primary and secondary treatment, sludge thickening, anaerobic digestion, solids dewatering, chlorine disinfection, and dechlorination. The facility can operate in a variety of secondary treatment modes, including trickling filter, conventional air activated sludge, and trickling filter/air activated sludge. These secondary treatment processes provide flexibility for wide variations in Biochemical Oxygen Demand (BOD) resulting from increased loading rates during vegetable canning season.

The RRWWTF is sited at River Road Park approximately 4 miles upstream from the WLWPCF on the 72-inch interceptor. The 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. The RRWWTF is designed for a nominal daily flow of 50 mgd and a peak hour flow of 60 mgd. Treated effluent is discharged to the Willamette River at River Mile 82.6.

The RRWWTF operates treatment processes include fine screening, high rate clarification (HRC) utilizing polymer and micro-sand for coagulation, and Ultraviolet (UV) 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.

The City's treatment plant staff works collectively to prevent Sanitary Sewer Overflows (SSOs) by utilizing flow routing options for optimum conveyance and effective treatment capacity. The combined design peak wet weather flow for the WLWPCF and the RRWWTF is 205 mgd.

Solids Treatment Processes

Solids from primary treatment processes are thickened in one of three gravity thickeners. Solids from secondary treatment are thickened on a Gravity Belt Thickener. Typically, solids are thickened to approximately five percent prior to mesophillic primary/secondary anaerobic digestion.

The south digester facility is composed of two gas-mixed, fixed cover, primary digesters which overflow to two secondary digesters. The north digester facility is composed of two mechanically mixed, fixed cover, primary digesters which overflow to a floating dome, secondary digester. The digester facilities produce gas that provides 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. Both facilities are also equipped with boilers as a redundant heat source.

Annual Digester Feed Gallons

The WLWPCF produced a total of 38,771,594 gallons of thickened primary and secondary sludge in 2015 which 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 59.5 percent of the treatment plant's solids production was stabilized in the larger south primary digesters while the north facility received 40.5 percent.

Contracted Sludge and Waste Products Received

In 2015, the WLWPCF received sludge and biosolids products from two (2) other municipal wastewater treatment facilities in Oregon, each constituting 1.4 percent or less of the total digester volume, as follows:

- A total of 560,000 gallons of anaerobic digested biosolids, and primary and waste activated sludge from Silverton in May, June and July,
- A total of 126,000 gallons of aerobic digested biosolids and waste activated sludge from Aurora in May, June and July.

These solids were received, sampled, and sent directly to the digesters. Pumping was scheduled to

facilitate a standard 60/40 flow split between the two (North and South) digester complexes using the automated feed valves. Volatile solids concentrations were very similar to Salem's and within the typical range of domestic biosolids at about 80 percent of total solids.

Salem also contracted to receive SeQuential Bio Diesel waste product, with a total of 277,787 gallons delivered via tankers once or twice per week throughout the year. The product's total volatile solid loading was 284,394 lbs. The product was mixed at a one to one ratio with the WLWPCF's previously digested biosolids and pumped through magnetic flow meters to the north and south primary digesters.

Design organic loading on the primary digesters is approximately 0.23 pounds volatile solids/day/cubic feet of digester volume. The average organic loading on the primary digesters in 2015 was 0.066 volatile pounds/day/cubic feet of digester volume. This figure reflects the calculated sum of received and produced solids entering the primary digesters (see Table 2: 2015 Digester Volatile Feed Pounds).

Class B Biosolids – Pathogen Reduction

All biosolids produced in 2015 met the Class B Pathogen Reduction 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 (see signed Certification Statements in Section 2).

The annual average MCRT (four primary digesters) was 44 days and ranged between 35.1 and 56.4 days at an average temperature of 98.3 degrees Fahrenheit or 36.8 degrees Celsius (see Table 3: 2015 Digester Performances: Monthly and Annual Averages).

Class B Biosolids – Vector Attraction Reduction (VAR)

All biosolids produced in 2015 met the Class B Vector Attraction Reduction (VAR) requirements as specified in 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 signed Certification Statements in Section 2).

The average volatile solids reduction rate in the digesters ranged between 52.1 and 71.6 percent (see Table 4: 2015 Volatile Solids Reduction: Monthly and Annual Averages).

Biosolids Analyses

Samples of liquid, centrifuge dewatered and BFP dewatered biosolids were composited separately and analyzed for pollutants listed in 40 CFR §503.13, Table 1, and for Total Solids, Total Volatile Solids, pH, and nutrients, including Total Kjeldahl Nitrogen (TKN), Nitrate-nitrogen (NO_3-N), Ammonia-nitrogen (NH_3-N), Phosphorus (P), and Potassium (K). During the months that each biosolids product was generated, the biosolids sampling and analyses were conducted monthly or more often than the frequency of once per 60 days that is required in 40 CFR §503.16, Table 1, and is based on the annual amount of biosolids applied to the land. All biosolids analyses were performed in-house (see Tables 5a, 5b and 5c: 2015 Monthly Biosolids Analyses).

Raw digester feed and received solids were analyzed for total solids and total volatile solids daily. Primary digester feed rates and temperatures were also recorded daily. Primary digester alkalinity and pH were measured three 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 hours. During local liquid application, biosolids samples were taken when filling the tanker trucks.

Biosolids Production Quantity

A total of 38,771,594 gallons of digested biosolids were utilized to produce centrifuge dewatered, BFP dewatered, and liquid biosolids products in 2015. The proportions of each product were:

- Centrifuge dewatered biosolids: 56.22 percent or 18,645,070 gallons
- BFP dewatered biosolids: 34.75 percent or 11,524,157 gallons
- Liquid biosolids: 9.03 percent or 2,994,000 gallons

Based on the monthly composite sample analyses which were used to calculate monthly dry ton values for these biosolids products, a total of 3,061.32 dry tons was produced in 2015 (see Table 7: 2015 Biosolids Products Generated).

Dewatered Biosolids Production and Polymer Costs

Details of Salem's dewatered biosolids production in 2015, including polymer dosages, capture rates and costs, are provided in Table 8: 2015 Centrifuge and Belt Filter Press Production. Average daily total solids concentrations for the various flow streams (centrate, pressate, feed solids, and dewatered product) were used to estimate polymer costs in Table 8 rather than the monthly composite sample results. The combined polymer cost for dewatered biosolids (BFP and Centrifuge) production in 2015 was $334,819.

Biosolids Application and Storage Quantities

Salem land applied a total of 3191.37 dry tons of biosolids on a total of 1246 acres in 2015. These totals were comprised of 18 applications of Class B biosolids (liquid and dewatered) on all or part of 17 DEQ-authorized sites in hay, grass seed and flower seed production. Amounts that were land applied in 2015 included:

- 1,934 dry tons of centrifuge and BFP dewatered biosolids from 2014-15 winter storage applied on 629 acres,
- 946.39 dry tons of BFP dewatered biosolids applied on 345 acres, and
- 310.98 dry tons of liquid biosolids applied on 272 acres.

Between October 26 and December 31, 2015, a total of 583.35 dry tons of dewatered biosolids was transported to the agricultural building for 2015-16 winter storage (see Tables 9a, 9b and 9c: 2015 Site

Totals). The dewatered biosolids transported to winter storage during this winter season (2015-16) was CENT dewatered biosolids. From January 1 – 22 in 2015 the dewatered biosolids transported to winter storage for the 2014-15 winter season (Later applied during the summer of 2015) were BFP instead of CENT product due to the Centrifuge being fixed. The majority of the dewatered biosolids transported for winter storage in November and December of 2014 were also mainly BFP dewatered biosolids. This required more storage capacity then there was available at the main winter storage sight. For additional storage capacity, the WLWPCF Biosolids Program requested authorization from DEQ for winter storage in a third multi-purpose agricultural building. This third building was authorized for use staring January 2015 and was used from March till June. It has not been used for the 2015-16 winter storage season nor is it currently projected to be used.

Biosolids Application Rates and Nutrient Loads

The WLWPCF certifies that all biosolids products were applied to the DEQ-authorized sites in 2015 at rates consistent with the allowable rates of plant available nitrogen (PAN) specified in the DEQ site authorization letters (see signed Certification Statements in Section 2). Site restrictions identified in the DEQ site authorization letters specifically and those outlined in 40 CFR §503.32 (b) (5) were also followed.

Liquid biosolids were applied using 6,000 gallon pressurized tanker trucks at application rates pre-approved by the DEQ. The average annual application rate of 1.09 dry tons per acre yielded an average of 105.26 pounds of PAN per 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 2.87 dry tons per acre provided approximately 117.2 pounds of PAN per acre.

The total pounds of nutrients applied to the fields in 2015 were:

- 141,836.80 pounds of PAN
- 105,253.50 pounds of P
- 18,134.95 pounds of K

Application Site Management

Setback distances, restrictions and site management conditions are specified in the DEQ authorization letters for each site that received biosolids through land application. The WLWPCF Biosolids Program staff use a Global Positioning System (GPS) to accurately measure acreage and to mark setbacks or buffer zones around wells, structures, surface water features, roads, and property lines. A minimum setback of 50 feet to surface waters is required, as is a setback of 200 feet to wells. Application site worksheets and maps were completed daily for each site during land application. Biosolids Program staff and augment contract service staff carry route maps and a copy of the DEQ site authorization letters when in transport to application sites and during field applications.

Soil samples collected from the sites each year are analyzed for percent organic matter, pH, cation (Ca, Mg, Na and K) concentrations, cation exchange capacity (CEC), NO_3-N, and available P (using the Bray 1 or "weak" Bray method). Domestic wells on the sites and on adjoining properties are analyzed for

NO3-N as requested by property owner(s). To date, the City's monitoring of site soils and wells on properties adjacent to Salem's authorized sites have not revealed any problems related to the beneficial reuse of biosolids via land application at agronomic rates.

The results of soil and well testing are included in the reports to farmers along with an estimate of the economic value of biosolids applications. In 2015, these values were based on prices for fuel and fertilizers obtained from Wilco Agronomy in Mt. Angel, Oregon, on January 8 , 2016, and an assumed hourly wage of $14 for labor (see Section 5: Application Site Reports). In 2015, the WLWPCF Biosolids Program saved its participating farmers a total of $160,125.44.

Biosolids Spill Incidents

The City of Salem's Biogro Program had no biosolids spill incidents in 2015.

Anticipated Biosolids Production and Acreage Requirements For 2016

Salem anticipates very little change concerning biosolids production and acreage requirements in 2016. Annual biosolids production is anticipated to fall within the range of 3,100 and 3,400 dry tons. Although the acreage of authorized sites is sufficient at this time, a few farmers have indicated a desire to have more acreage authorized in the future.