BIOSOLIDS PROGRAM PLAN OF OPERATION

Lake County Public Works Department

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Lake County is converting its Class B biosolids program to a Class A Exceptional Quality (EQ) biosolids program. This memorandum describes the new Class A biosolids program from an operational standpoint.

INTRODUCTION

Lake County Public Works Department (LCPWD) has a long history of recycling its biosolids back to the land, specifically application on agricultural lands. Lake County initiated planning for the biosolids program in a 2012 report, "Lake County Regional Biosolids Handling", which recommended that a regional biosolids drying system producing a Class A EQ biosolids product be considered as the most cost-effective alternative. This alternative was further developed in the Facilities Plan Amendment in 2013. The Facilities Plan Amendment recommended constructing a regional biosolids drying facility at the Des Plaines River WRF to stabilize and dry biosolids produced from all three of Lake County's WRFs. Thermal drying greatly reduces the weight and volume of the biosolids product to be handled, while upgrading and improving the quality of the biosolids product to Class A EQ standards as defined by the U.S. Environmental Protection Agency (USEPA). Thermal drying improves upon Lake County's current recycling practice by producing a Class A EQ biosolids that can be used with minimal restrictions per USEPA regulations. The thermally dried product is used as a soil conditioner and topsoil supplement in landscaping and agricultural applications.

PROCESS DESCRIPTION

Waste sludge from the activated sludge process is dewatered and passed through the thermal drying process. The dryer facilities, located at the Des Plaines River WRF, are sized to serve as a regional facility for all three Lake County WRFs; a sludge receiving station at the Dryer Building accepts deliveries of biosolids from Lake County's NCT-Vernon Hills WRF and Mill Creek WRF. The Lake County Class A biosolids drying process has been sized for the following production rates (assumes 92% solids):

- Current (2015) Production: 4,900 cubic yards/year (13 cubic yards/day, 8 tons/day)
- Future (2035) Production: 10,220 cubic yards/year (28 cubic yards/day, 17 tons/day)

In the thermal drying process the wet biosolids are dried by indirect contact with a heating fluid circulated through the dryer. The biosolids are dried to reduce the moisture content to 10 percent or less. To be a process to further reduce pathogens (PFRP) as listed in Part 503 rule requirements, either the temperature of the biosolids must exceed 80° C (176° F) or the wet bulb temperature of the gas in contact with the biosolids as the biosolids leave the dryer exceeds 80° C. By being a PFRP process, thermal drying produces Class A biosolids. To meet requirements for vector attraction reduction, Part 503 rule contains 12 options for demonstrating reduced vector attraction for biosolids. Under thermal drying, vector attraction reduction is met by drying unstabilized biosolids to at least 90 percent solids.

Lake County's new solids handling facilities include WAS storage, dewatering, sludge receiving, dryer feed, paddle dryer, and dry product storage and loading. Figure 1 is a process flow diagram of the solids handling system.

WAS Storage:

Biosolids Dewatering: Since the biosolids are stabilized by thermal drying, the aerobic digesters at the Des Plaines River WRF (Group 80) were converted to holding tanks for WAS prior to dewatering. The holding tanks provide equalizing storage for WAS.

The first step in the solids processing at Des Plaines River WRF is dewatering, where the liquid portion of the WAS that is easily drained and pressed from the WAS is removed. This reduces the volume of sludge and creates a sludge cake that behaves like a solid, but more importantly removes a large portion of the water prior to drying. Removing water from the biosolids through dewatering is less energy intensive than with a dryer. Four belt filter presses in the Sludge Dewatering Building remove water from the WAS with the assistance of polymer, increasing the concentration from an estimated 1.0% solids to approximately 15% solids.

Dryer Feed Silo: The dewatered sludge cake is normally conveyed to the Biosolids Drying Building into the dryer feed silo. The conveyor system is also configured to allow cake to be loaded directly into haul trucks, as a backup disposal route.

Truck Receiving Silo: Biosolids from Lake County's NCT-Vernon Hills and Mill Creek WRFs are dewatered, loaded into haul trucks, and hauled to the Des Plaines River WRF where the biosolids are deposited into the truck receiving silo at the Biosolids Drying Building.

Dryer Feed: The dryer feed silo and biosolids receiving station provide storage prior to the dryer to allow the dryer to be operated continuously and independently of dewatering during the processing period. The dryer feed pumps and cake transfer pumps are used to feed the biosolids into the dryer either by operating a cake transfer pump and dryer feed pump in parallel or by using a transfer pump to transfer hauled cake to the feed storage silo and pumping to the dryer with a dryer feed pump. These pumps are designed to transport the biosolids at rates of 27 to 30 gpm of wet solids (approximately 10,500 to 12,500 lbs/hr) from the silo to the dryer.

Drying Operation: In the dryer operation the dewatered biosolids are continuously fed directly into the dryer from the feed storage silo and/or truck receiving silo. The drying of the biosolids occurs as the temperature of the wet feed biosolids is raised by contact with the hot metal surfaces of the dryer.

The paddle dryer consists of a stationary horizontal jacketed vessel containing two intermeshing, counter-rotating agitator shafts with paddles. The rotors and paddles are hollow, allowing heating oil to circulate through the hollow core. Heating oil is also circulated through the jacketed vessel. Heat is transferred to the biosolids by conduction through the surfaces of the paddles and vessel. Wet biosolids enter the dryer at one end and dried material exits at the other end. The counter rotating paddle shafts provide additional heating surface as well as mixing of the wet biosolids, cleaning of the heating surfaces, and thorough contact of the wet biosolids with the heated surfaces. A weir at the discharge end of the dryer helps submerge the heat-transfer surface in the material being dried. The biosolids are conveyed through the dryer by volume displacement and by the action of the paddles.

As the wet biosolids contact the metal heating surfaces of the dryer, the temperature of the wet biosolids increases above 220°F, and moisture is evaporated. The evaporated moisture is collected in the head space above the rotors and paddles, and exhausted from the dryer with exhaust air. Moisture evaporated from the biosolids is collected in the head above the rotors and paddles, and exhausted from the dryer as off-gas. Off-gas treatment involves condensing the water vapor from the gas and scrubbing dust particles. The gas is cooled and scrubbed with a plant water spray, then is compressed and aerated through the mixed liquor in the aeration basin for odor control.

The dried product from the dryer is first cooled in the product cooling conveyor to reduce the product temperature to about 120° F. The cooled product is then screened to remove fines and over-sized particles, which are recycled back into the dryer feed. The resulting dried granules are irregular in shape and size.

Dried Product Conveying: A drag conveyor system conveys the dried biosolids product from the second cooling conveyor to biosolids storage.

Biosolids Storage Silos: Storage silos adjacent to the Dryer Building store 30 - 60 days of dried biosolids production. The post-drying storage is intended to accommodate seasonal fluctuations in demand and product hauling schedules. The dried product storage system consists of three silos, each with a volume of 7,500 cubic feet. The silos are equipped with safety features including a nitrogen purge system to maintain oxygen levels inside the silos below smoldering levels (less than 10% oxygen), to prevent combustion inside of the silo. The silos are also equipped with filtered vents to control dust from the silo exhaust. The silos discharge product to haul trucks parked below.

Truck Loading: Dried biosolids product is loaded out directly from each storage silo. Each silo is equipped with a load out spout and dust collection system to control the generation of dust emissions during truck loading.

BIOSOLIDS PRODUCT SPECIFICATIONS

The dried biosolids product is an organic fertilizer, meaning that the nutrients are derived from the natural organic content of the microbes that make up the product. The organic matter in the product is beneficial to soils, serving as a food source for the soil bacteria and expanding the soil structure to increase the water holding capacity. The nutrient content of the product is primarily organic, which means that the product acts as a slow release fertilizer. The organic fertilizer releases the nutrients slowly, consistently in the presence of soil moisture at temperatures above 55ºF, as the soil microbes breakdown the biosolids pellets into a plant available form and the nutrients are then taken up by the roots. The biosolids are quite low in salts, so unlike synthetic fertilizers, the biosolids will not burn the plants. Thus, the biosolids product can be applied at any time during the growing season. Since the nutrients are tied up in an organic form at application, they are less likely to leach and runoff into waterways.

Lake County's dried biosolids product is a natural, organic fertilizer that compares with other commercially available biosolids products, as shown in the following table:

Product Constituent	Lake County Biosolids	Milorganite™ Milwaukee MSD
Organic Content	80%	85%
Total Nitrogen	5.7%	5.0%
Total Phosphorus	1.6%	2.0%
Iron	-	4.34%
Manganese	0.064%	0.133%
Potassium	0.23%	0.5%
Copper	0.063%	0.022%
Molybdenum	0.001%	Trace
Zinc	0.073%	0.045%

Although not explicitly defined in the Part 503 rule, *EPA Guide to Part 503 Rule* uses the term Exceptional Quality (EQ) to characterize biosolids that meet the criteria below. Once these requirements are met, EQ biosolids are considered a product that is virtually unregulated for use, whether used in bulk, or distributed in bags or other containers.

- Low-pollutant (all pollutants in the biosolids are less than the Pollutant Concentration Limit)
- Class A pathogen reduction (virtual absence of pathogens) limits
- Vector attraction reduction

Lake County's dried biosolids product meets the USEPA exceptional quality limits for metals as shown in the following table:

Table x-x Trace Metals in Biosolids US EPA Part 503 Exceptional Quality Pollutant Limits		
Pollutant	**Pollutant Concentration Limits (mg/Kg)**	**Lake County Biosolids (mg/Kg)**
Arsenic	41	8
Cadmium	39	5
Chromium	1,200	28
Copper	1,500	630
Lead	300	60
Mercury	17	1.1
Molybdenum	75	15
Nickel	420	30
Selenium	36	3.3
Zinc	2,800	727

Sampling and Testing

Lake County dried biosolids are intensively analyzed to ensure compliance with all applicable standards established by the U.S. Environmental Protection Agency (EPA), the Illinois Environmental Protection Agency (IEPA) and the state of Illinois. The sampling and testing requirements are established under Title 40, Code of Federal Regulations, Part 503 (Part 503 Rule).

Monitoring

The Part 503 Rule, Section 503.16, establishes the frequency of monitoring the biosolids. Lake County produces from 2,472 to 5,145 metric tons per 365-day period, requiring that monitoring be completed once per 60 days or six times per years for pollutant concentrations and for

pathogen density requirements. After two years of monitoring, the IEPA may reduce the frequency of monitoring requirements.

Monitoring frequency should anticipate the potential for changes in metals concentration, pathogen density, and vector attractiveness. Monitoring frequency also should take into account when biosolids are actually being used or disposed. The rule assumes that biosolids will be used or disposed consistently throughout the year. The Part 503 rule does not require analysis until the biosolids are used or disposed. For a large mass of biosolids being disposed, composite samples for analysis that represent biosolids throughout the storage period are recommended to produce a more representative sample for analysis.

Pathogens

The biosolids produced are sampled and tested for pathogens to ensure compliance with the pathogen requirements of the Part 503 Rule. Specifically the biosolids product must be sampled and tested for either fecal coliform or *Salmonella sp.* bacteria. Pathogens need to be monitored or sampled every 60 days or 6 times per year. However because regrowth of fecal coniform and *Salmonella sp.* can occur, monitoring should be completed close to the time of biosolids use or disposal per the following requirements:

- At the time the dried biosolids are used or disposed of.
- At the time the biosolids are prepared for sale or given away in a bag or other container for application to the land or other container for application to the land.
- Or at the time the biosolids are prepared to meet the Class A Exceptional Quality (EQ) requirements.

For the Lake County System, sampling occurs when biosolids product is being loaded into trucks. Grab samples can be taken from the trucks and composited together over the course of a 14-day period per EPA's guidance document (EPA/625/R-92/013) to form a representative sample of the dried product as follows:

- ***Fecal coliform:*** The geometric mean of a minimum of 7 individual grab samples taken over a 14-day period.
- ***Salmonella sp.:*** The arithmetic mean of a minimum of 7 individual grab samples taken over a 14-day period.

To comply with the 503 Rule for Class A biosolids, either the density of fecal coliform shall be less than 1000 Most Probable Number per gram of total solids (dry weight basis), or the density of *Salmonella sp.* bacteria shall be less than three Most Probable Number per four grams of total solids (dry weight basis). Note that fecal coliform is used as an indicator organism, as the levels and reduction of fecal coliforms correlates with *Salmonella sp.* and other pathogens. However

under some circumstances the level of fecal coliform may be overly conservative or high. In these cases, direct measurement of *Salmonella sp.* can be used.

Metals

As mentioned above, to comply with the 503 Rule for "Exceptional quality" (EQ) biosolids, the dried product must have less than the Part 503 pollutant concentration limits. The biosolids produced must be sampled and tested for trace metals to ensure that it complies with the EQ requirements of the Part 503 Rule. Specifically, the biosolids product must be sampled and tested for arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Metals need to be monitored or sampled every 60 days or 6 times per year. Unlike pathogens, the metals data remain valid for the biosolids as long as no significant change in volatile solids occurs.

Biosolids product sampling for metals takes place at the product screener prior to transport to the silos. Grab samples are taken as product enters the screener. The samples are composited together over the course of the 60-day period to form a representative sample of the dried product.

PFRP Monitoring Requirements

The following parameters must be monitored at sufficient frequency to show compliance with heat drying PFRP process:

- Moisture content of the biosolids product has been reduced to 10 percent or lower.
- The temperature of the biosolids particles exceeds 80°C (dryer bed temperature at exit).

The moisture content is monitored daily during operation. The dried product is sampled at the product screener, with grab samples taken as it enters the screener and analyzed for total solids. The temperature is monitored and recorded automatically as part of the dryer control system. The data are maintained for five (5) years after the biosolids are generated and made available to the IEPA.

USES FOR DRIED BIOSOLIDS

Heat dried biosolids product has qualities that make it desirable for application on land as soil conditioner, fertilizer, or fertilizer supplement. The material is suitable for application on agricultural lands, golf courses, nurseries, parks, and is marketed through retail outlets for residential use.

Applicable Regulations

Class A Exceptional Quality biosolids beneficially used by the public for soil augmentation are federally regulated by the USEPA under 40 CFR Part 503. In Illinois the Part 503 requirements for EQ biosolids were adopted in Public Act 099-0067, which amended Section 5 of the Environmental Protection Act (415 ILCS 5/3.560 and 5/22.56a). According to the rule, EQ biosolids shall not be subject to regulation as a sludge or other waste if all of the following requirements are met:

1. Documentation is maintained to demonstrate -
    a. Pollutant concentration limits in Part 503 are not exceeded
    b. Pathogen limits in Part 503 are met
    c. Vector attraction requirements are met
    d. A certification statement regarding pathogen and vector attraction limits being met
    e. The quantity of Class A EQ biosolids distributed per year
2. For EQ biosolids that have not been bagged (distributed in bulk) –
    a. Are not applied to snow-covered or frozen ground
    b. Are applied to agricultural land according to recommended application rates and applied on all land in a manner following best practices to protect water quality

Municipal biosolids products normally contain very low levels of radioactive materials. The USEPA has conducted survey work to determine the levels of radioactive materials found in municipal biosolids. USEPA has concluded that the levels of radioactive material in biosolids are such that exposure of workers and the general public through biosolids use is very low and consequently, is not likely to be a concern.

The radium levels in Lake County's biosolids average in the range of 7 – 8 pCi/gm, which would have been subject to rules set forth through Illinois Emergency Management Agency (IEMA).

IEMA rules (IL Administrative Code Section 330.40(d)) pertain to Class B agricultural land application of municipal biosolids that contain residuals from water treatment systems that remove radium from drinking water and exceed a radium level of 3 pCi/gm. The IEMA rules do not really cover Class A biosolids distributions. Despite all the research work done to date showing that municipal biosolids do not pose a radiation threat to workers or the public, the IEMA rules are still on the books and their applicability to Class A EQ biosolids remains in question. After Public Act 099-0067, the situation in Illinois related to radium seems to exempt Class A EQ biosolids from regulation as a sludge or other waste. Going forward with a Class A EQ biosolids program, it is recommended that Lake County mitigate the risks posed by the IEMA rules by eliminating the discharge of water treatment residuals containing radium from its collection system through sewer use ordinance. This would apply to all water treatment systems drawing from the deep aquifer underlying Lake County and employing a treatment system that is capable of removing radium and discharging the residuals to the wastewater collection system.

End Uses of Class A EQ Biosolids

Land application includes all forms of applying bulk or bagged biosolids to land for beneficial use including applications to areas such as:

- Agricultural land used for the production of food, feed, fiber crops, tree and shrub nurseries
- Pasture and range land
- Non-agricultural land such as forests
- Public contact sites such as parks and golf courses
- Turf restoration on disturbed lands such as building and roadway construction sites
- Home lawns and gardens

Biosolids that are classified as exceptional quality (EQ) may be distributed for land application without site restriction. EQ is an industry term rather than a regulatory term. Land application of EQ biosolids is not regulated by Part 503 once the material leaves the control of the product preparer. Therefore, soil blenders or other (non-preparer) users who take EQ biosolids may store the biosolids or mix the EQ biosolids with other (non-sewage sludge) materials without resampling the product. Conversely, if EQ biosolids remain within the control of the preparer, they are still considered biosolids and are still covered by Part 503. Like all Class A products, they must undergo microbiological testing at the last possible point before being distributed. In addition, if the preparer mixes the EQ biosolids or otherwise changes the quality of the biosolids, the new biosolids product must again comply with pathogen reduction, vector attraction reduction, and microbiological requirements.

Application rates for Class A EQ biosolids should generally be set at recommended application rates and applied following best practices to protect water quality.

Biosolids are used to fertilize fields for raising crops. Agricultural use of biosolids, that meet strict quality criteria and application rates, have been shown to produce significant improvements in crop growth and yield. Nutrients found in biosolids, such as nitrogen, phosphorus and potassium and trace elements such as calcium, copper, iron, magnesium, manganese, sulfur and zinc, are necessary for crop production and growth. The use of biosolids reduces the farmer's production costs and replenishes the organic matter that has been depleted over time. The organic matter improves soil structure by increasing the soil's ability to absorb and store moisture.

The organic nitrogen and phosphorous found in biosolids are used very efficiently by crops because these plant nutrients are released slowly throughout the growing season. This enables the crop to absorb these nutrients as the crop grows. This efficiency lessens the likelihood of groundwater pollution of nitrogen and phosphorous.

BIOSOLIDS COMMERCIAL CONSIDERATIONS