

New England Biosolids Case Studies*

Massachusetts Water Resources Authority: National Demand for Fertilizer Pellets

***biosolid** n. (1990): solid organic matter recovered from a sewage treatment process and used esp. as fertilizer.

--*Merriam-Webster's Collegiate Dictionary*

Background

The Massachusetts Water Resource Authority (MWRA) manages the wastewater system for the greater Boston area - serving over two million people in 43 communities. Prior to 1991, MWRA discharged hundreds of thousands of gallons of liquid sludge directly into Boston Harbor on a daily basis. In December 1991, meeting a federal Clean Water Act court order to abate pollution of the harbor, MWRA ceased the sludge discharges to the harbor and began to treat the solids with an advanced process to create a recyclable biosolids fertilizer product.

MWRA operates a secondary wastewater treatment facility at Deer Island, and a wastewater solids (sewage sludge) recycling plant -- the Fore River facility -- in Quincy, Massachusetts. The solids collected from the Deer Island treatment facility are dried at the Fore River facility to produce millet-seed-sized pellets. The recycling facility produces an average of 75 dry tons of biosolids fertilizer per day and as much as 120 dry tons per day during periods of peak production. By converting its sludge for beneficial use as a fertilizer in agriculture and landscaping, MWRA has become one of the largest recyclers of organic matter in the United States.



MWRA biosolids fertilize Newton Commonwealth Golf Course, Newton, MA. All photos: MWRA.

The Recycling Process

MWRA uses a combination of primary and secondary wastewater treatment processes to separate the solids and dissolved nutrients from the wastewater. During the primary treatment process, the solids settle at the bottom of tanks, forming primary sludge. In the secondary treatment process, oxygen is infused into the wastewater to promote the growth of naturally occurring microorganisms. These microorganisms feed on fine organic matter

and dissolved substances in the wastewater. As the organisms die, they sink to the bottom of the tanks and form secondary sludge. The primary and secondary solids are then pumped to state-of-the-art digester equipment at Deer Island for further biological treatment. For 20 days, the solids are processed in the twelve digesters. Each digester is a 140 foot high egg-shaped vessel that creates a warm, well circulated, oxygen-free (anaerobic) environment. Here, more natural microorganisms feed on the raw sludge, reducing its volume, killing most pathogens, and producing methane gas that is captured and used to help fuel the treatment facility's thermal power plant.

After the digestion process, the wastewater sludge, which is still over 95% water, is shipped from Deer Island on tanker barges to the Fore River facility for further treatment. Beginning in 2003, the solids will be transported to the Fore River Plant via a pipeline that is currently under construction. Once at the

Fore River facility, the sludge is further de-watered in high-pressure centrifuges to form sludge cake. This cake is still about 72% water and has the appearance and consistency of damp soil. The cake travels on conveyor belts to rotary drums where it is mixed with previously dried biosolids and heated in temperatures of 600 degrees Fahrenheit for about 30 minutes. These high temperatures kill any remaining bacteria and pathogens in the biosolids pellets, making the product safe for general gardening and landscaping use.

When the pellets leave the dryer, they vary widely in size. Screens sort the pellets and the desired product-sized pellets are set aside. Pellets that are not the suitable size for the end product are broken up and sent back through the process. The product-sized pellets are sent through air-pressure tubes to storage silos. Rail cars are positioned under the silos to load the fertilizer pellets for shipment to customers.

Exceptional Quality Product

The MWRA fertilizer pellets contain 60 percent organic matter, including nitrogen, phosphorus, iron, and many micronutrients. The fertilizer's organic nitrogen must be broken down by soil microbes before it can be taken up by plants. This is a desirable feature in many agricultural applications, where this slow release nitrogen feeds the plants at a gradual rate and minimizes the risk of nitrate pollution of groundwater posed by some other types of fertilizers. The organic matter in the biosolids is also valuable because it helps improve the moisture-holding capacity of some soils.



Grass at the famous Esplanade along the Charles River is fertilized with MWRA biosolids.

The MWRA pellets are classified by the U.S. Environmental Protection Agency as exceptional quality and by the Massachusetts Department of Environmental Protection (DEP) as Type 1 biosolids (the highest quality classification). The recycled product meets strict pathogen reduction standards and testing shows that it meets all federal and state regulated levels of trace constituents that require monitoring. In fact, pathogens are non-detectable in the MWRA material following processing. Testing protocols are extensive to ensure all standards are consistently met. Grab samples of the sludge cake and pellets are routinely collected to test for all EPA-regulated metals and for nutrients, pesticides, PCBs, pathogens and trace organic chemicals. As an exceptional quality biosolids product, there are no restrictions on the use of MWRA pellets. They can be used for any type of land application - from fertilizer for a vegetable garden to application on golf courses and public parks.



The lawns at Castle Island, South Boston, are fertilized with MWRA biosolids.

To further enhance the quality of the fertilizer pellets, the MWRA Toxic Reduction and Control (TRAC) pretreatment program works to reduce the discharge of unwanted materials into the wastewater system. The TRAC program has been successful in reducing certain trace constituents in the biosolids, such as excess molybdenum and copper, which are important micronutrients but can be harmful to plants and animals in higher concentrations.

An example of a TRAC program success is the reduction of molybdenum, a metal element found in solutions commonly used to prevent corrosion in industrial, commercial, and residential cooling towers. At times during the hot summer months, higher levels of molybdenum from these cleaners were found

in the MWRA fertilizer pellets. While the higher levels of molybdenum still fell below federal standards, they at times exceeded the Massachusetts DEP highest-quality levels for unrestricted land application. TRAC implemented a voluntary program to encourage users of the molybdenum-containing solutions to use an alternative corrosion control agent. To date, this program has helped reduce molybdenum influent levels by about 40 percent.

MWRA has also reduced trace lead levels in the wastewater system and the resulting fertilizer pellets. Lead is leached from residential and other service pipes and eventually ends up in wastewater. It can also be discharged into the wastewater system from storm water runoff, as well as from some types of metal processing operations. In 1992, the MWRA decreased the allowable limit of lead for industrial dischargers from 0.4 milligrams per liter (mg/l) to 0.2 mg/l. In 1997, an Interim Corrosion Control Facility was added to the MWRA water system. At this facility, sodium carbonate (soda ash) and carbon dioxide (CO₂) are added to increase the drinking water's buffering capacity. MWRA has also adjusted the pH of drinking water. These changes have resulted in reductions of lead found in the drinking water and, thus, in the wastewater that is eventually discharged to Deer Island. During 2000-2001, further improvements to MWRA's corrosion control program reduced the levels of lead in the pellets to well below the most stringent state standards for unrestricted use.

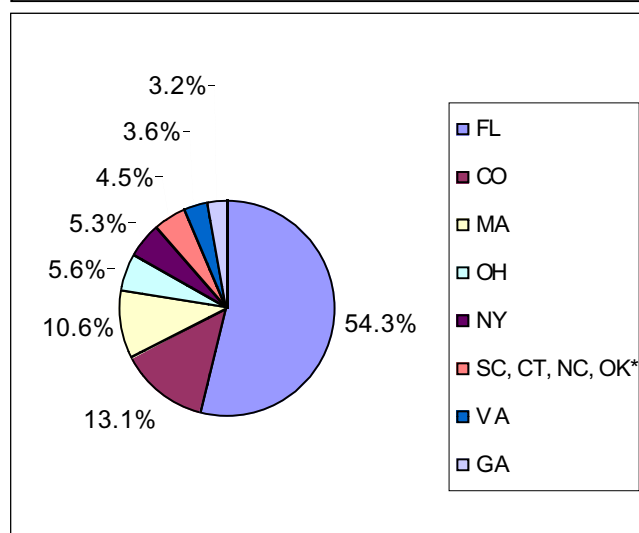
In fact, for the past three years, all of the MWRA biosolids that were converted to fertilizer pellets have met the strict federal standards and were beneficially reused.

Beneficial Use Throughout the U.S.

The New England Fertilizer Company (NEFCO) has operated the MWRA pelletizing facility under contract since it began operations in late 1991. NEFCO is the primary marketer of the fertilizer pellets, focusing primarily on large end users. NEFCO initially targeted sales efforts in Florida, where fertilizer

blenders and commercial citrus and vegetable growers were already familiar with similar biosolids products. Over time, NEFCO broadened sales efforts to other key customers such as blenders of dry agricultural fertilizers throughout the southeast and mid-Atlantic United States, as well as turf and garden fertilizer blenders on the East Coast and in the Midwest. For these customers, biosolids frequently replace limestone in fertilizer blends and provide the added benefits of slow release nutrients and organic matter. The MWRA fertilizer pellets also have been used on cotton crops in Arizona and wheat crops in Colorado, where the biosolids product provides high content organic matter to help improve water retention in the arid soil of these areas.

States Using MWRA Fertilizer in 2000



* These States each use less than 2%

MWRA sells the fertilizer under the name Bay State Fertilizer to local retailers, landscapers, and golf courses in the region. The fertilizer is packaged in attractive bags, with informative directions for use and a brochure explaining the origin and content of the material.

MWRA also offers this fertilizer free of charge to MWRA wastewater municipal customers for use on public lands. The product has been used on public lands throughout the MWRA wastewater service area. Areas fertilized with Bay State Fertilizer include the lawn at the Hatch Memorial Shell on the Esplanade

in Boston, flower beds in the Boston Public Garden, the Franklin Park in Roxbury, Castle Island in South Boston, parks in the Town of Framingham, and on the Newton Commonwealth Golf Course.

Overcoming challenges

Successfully implementing a biosolids recycling project of the scope and magnitude of the MWRA project requires a commitment to outreach and cooperation with local communities and stakeholders. MWRA has worked diligently over the years to establish a strong line of communication with the biosolids fertilizer facility's host community, the City of Quincy, to ensure that any issues of concern are immediately addressed. The MWRA frequently communicates with the Mayor, Fire Chief, the City's technical advisor, and other interested individuals in Quincy through meetings and correspondence regarding the operations and activities at the Fore River facility.

During the planning stage of the facility, some nearby residents expressed concern about the potential for odors. Extra attention was given to designing a system to treat and minimize odors at the facility. The entire inside of the building was designed to operate under negative pressure to prevent odorous air generated by the drying process from escaping untreated. The air is filtered and cleaned with after-burner technology. As an additional odor control measure, barges carrying sewage sludge from Deer Island to the Fore River facility are equipped with activated carbon filters that filter odors generated from the sludge material. These systems have virtually eliminated odors from the facility.

MWRA also offers a variety of programs to educate the public about wastewater treatment, the pelletizing process, and the uses and benefits of the fertilizer pellets. MWRA staff lead facility tours for school children, engineers, and public officials from around the world. MWRA also has developed an innovative and popular planter kit containing everything needed to grow marigolds with biosolids. Teachers use the kits to reinforce lessons about the MWRA wastewater treatment system presented by MWRA staff in classrooms throughout the MWRA wastewater communities.

MWRA has overcome many challenges and has successfully achieved its goal of converting 100 percent of greater Boston's sewage solids into marketable recycled fertilizer products. The MWRA sewage sludge management program has resulted in many benefits, not the least of which has been cleaning up Boston Harbor. Since ending the discharge of sludge into the Harbor, dramatic improvements have been made in the appearance, clarity, and smell of the Harbor waters. The nutrients and organic matter that used to harm the harbor are now being beneficially recycled to soils throughout the United States.

Applying MWRA biosolids "Bay State Fertilizer" at the Boston Public Gardens.

