



Massachusetts Water Resources Authority

MWRA Advisory Board Meeting January 17, 2013

The State of Residuals Treatment at MWRA

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Presentation Agenda

- Industry Overview
- Current Deer Island and NEFCO Operation
- Long-Range Planning Steps
 - Condition Assessment of Pellet Plant
 - Technology Options Assessment
 - Special Study – Co-Digestion
 - Pilot Studies Leading to Detailed Design
- Questions/Answers



Basic Statistics for US WWTP (EPA, NACWA & NEBRA)

- 16,583 wastewater treatment facilities in US
- Only 41 (2.5%) are over 100 MGD capacity
- Deer Island Flow – 365 MGD avg., 1,310 MGD max.
 - Detroit largest on max daily flow basis (DI - 2nd)
 - Chicago largest based on avg. daily basis (DI - 4th)
- 2,000 centralized sludge processing facilities
- 544 have anaerobic digestion; only 106 use the methane gas
- Ultimate disposal approaches:
 - 45% of facilities use land application
 - 29% of facilities use landfills
 - 17% of facilities use incineration
 - 9% of facilities practice beneficial use (including MWRA)



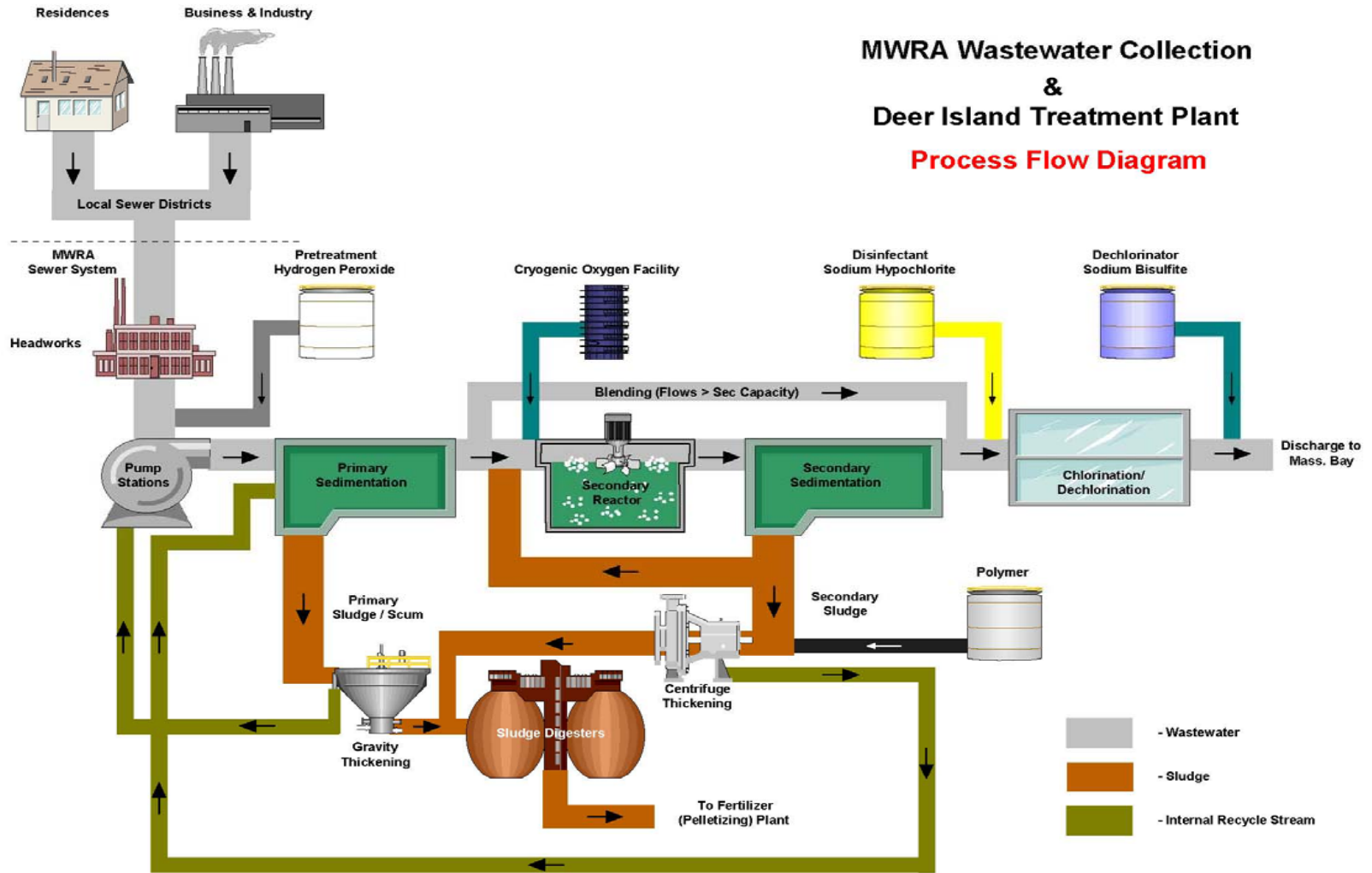
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Deer Island Treatment Facility





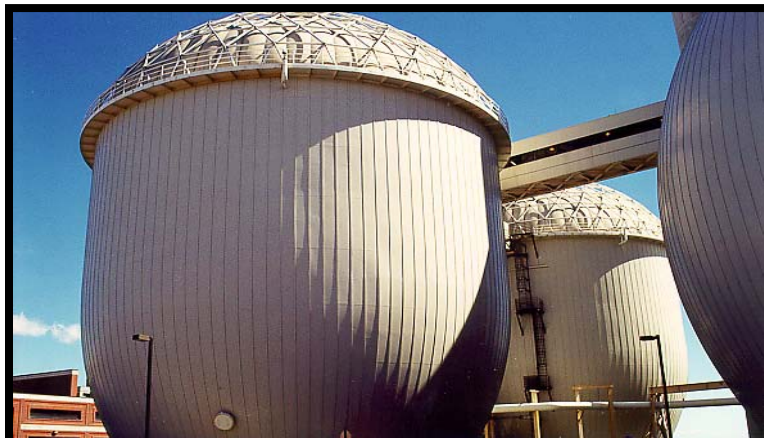
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Residuals Processing Statistics for Deer Island

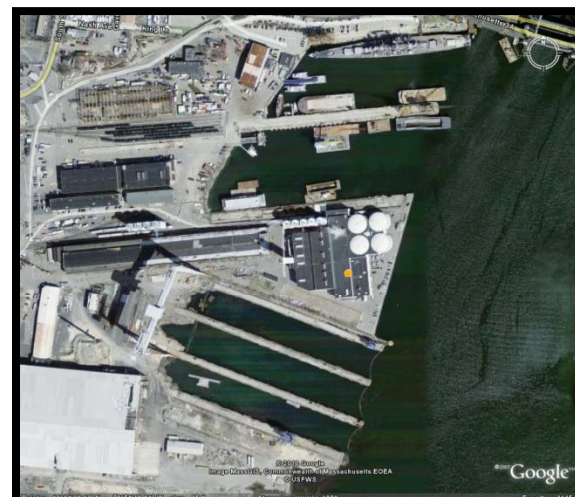
- Annual average sludge to digestion – 246 dry TPD
- Annual average sludge to NEFCO – 106 dry TPD (or 742 TPW)
- FY12 Annual digester gas production – 189.5 kscfh
- % of gas beneficially used in boilers – 97.3%
- % of days that digester gas met all DI heating requirements – 76%
- % of total boiler heat attributable to Digas – 98.4%
- FY12 value of gas utilization - \$15-20M (heat) & \$2.8M (power)





Overview of Current Residuals Processing

- Primary sludge – gravity thickening (70% of quantity)
- Secondary sludge – centrifuge thickening (30% of quantity)
- Combined sludge to digestion -15-20 days detention time
- DI Volatile solids destruction – 62% (industry ave. is 45-55%)
- Digested sludge stored, then pumped to NEFCO
- Methane gas captured, stored, used in boilers
- NEFCO dewateres, dries, pelletizes all digested sludge
- All pellets go to beneficial re-use:
 - turf farms
 - golf courses
 - fertilizer blenders
 - cement kiln





Overview of Contract S345 – NEFCO

- Term – March 1, 2001-December 31, 2015
- NEFCO responsible for all O&M including utilities & capital repairs
- NEFCO “owns” the sludge once it arrives at its facility
- NEFCO responsible for marketing and disposal
- “Fixed” price for annual sludge quantities up to 90 dry tons per day
- “Variable” price for incremental sludge quantities over 90 tons
- FY12 Costs - \$380/ton (\$412 Fixed; \$280 Variable)
- Labor and Capital are only major costs not in variable rate
- Monthly billing is uniform;
“true-up” in January
- Escalation indices applied
to base bid for all major costs





Pelletizing Plant Condition Assessment

- Objective – Conduct an independent assessment of the facility condition
- 700 “critical” and 1,600 “non-critical” assets evaluated
- Review Reliability of Facility Structure and Support Systems
- Assessment Completed in 2009
- At end of contract, NEFCo required to turn over the facility in a condition capable of meeting performance standards



Condition Assessment - Results



- Overall - Facility in excellent condition
- Three core systems identified as centrifuges, dryer trains, and regenerative thermal oxidizers
- Remaining life of three core systems can be 10 to 20 more years provided same level of preventive and corrective maintenance
- Support utilities – need to consider adding redundancy



Condition Assessment - Recommendations



- Continue with aggressive preventive maintenance program already in place
- Continue with existing equipment monitoring program
- Modernize or replace existing centrifuge and RTO control panels



Condition Assessment - Action Taken



- Six of twelve centrifuge control panels completely replaced; six more planned this year
- Two of four RTO programmable logic controllers (PLCs) replaced; one additional PLC onsite and awaiting installation
- Dryer train SCADA system upgrade commencing this spring
- Dryer Drum No. 2 replaced with new unit



Condition Assessment – Capital Budget Impacts



- Expected major equipment replacement projections scaled back
- Cost “savings” could be directed to other investments/upgrades
- Capital focus shift towards modernization and upgrades recommended by Technology Assessment



Facilities Technology Options Assessment (2012-2013)

- **Goals:**
 - Improve process efficiency, optimize existing facility
 - Recommend long-term residual processes
 - Increase Digas volumes and increase green energy production,
 - Reduce sludge volumes
- **Evaluate Residuals Facilities & Processes**
 - Deer Island & Fore River
- **Assess and Rank Technology Options**
- **Develop “Short-List” of Most Viable Options**
- **Perform Co-Digestion Feasibility Special Study**



Considerations in Long-Range Planning

- Previous Capital investments (“sunk costs”)
- Location of existing facilities – split operation – DI and Quincy
- Prior permit, environmental or mitigation obligations
- Available land area for facility expansion
- Logistics - access for construction, O&M needs – e.g. chemicals
- Regulatory/Legislative – local, state, federal
- Scale of MWRA operation – need proven technologies
- Drivers – volume reduction, gas production, energy recovery, cost
- TBL Assessment – economic, environmental, social



Proven/Emerging Technologies in Residuals Processing (partial listing)

- **Scum Treatment – alternate screening methods**
- **WAS Sludge Pre-treatment**
 - Cambi (thermal hydrolysis)
 - OpenCEL (pulsed electric field, cell lysis)
- **Alternate Anaerobic Digestion Methods**
 - Thermophylic (131-149 deg F)
 - Temperature Phased
 - Acid/Gas Digestion
 - Dual (Aerobic/Anaerobic) Digestion
- **Struvite Recovery - Pearl Process**



WAS Sludge Pretreatment Enhanced Gas Production – Cambi or BioThelys

- **Sludge subjected to high pressure and high temperature**
- **Cell walls rupture resulting in easier digestion**
- **Increased gas production, greater energy recovery**
- **Cambi**
 - Number of overseas installations
 - DC WASA will be first U.S. Installation
 - 50% increase in gas, moderately complex, odors
- **BioThelys (Veolia Water patent)**
 - Two full-scale facilities in France
 - On-line for 10 years; no data available



Struvite Recovery - Pearl™ Process

- **Proprietary controlled chemical precipitation in fluidized bed reactors (only 4 installations to date)**
- **Recover struvite in highly pure crystalline pellet**
 - Helps avoid “uncontrolled” struvite formation in downstream AD processes
 - Output marketed as a commercial fertilizer
 - Helps reduce downstream dissolved nitrogen & phosphorus that could recycle back to DITP



Post Digestion Alternatives (representative list)

- Following the digestion step, the following technologies were identified and are being considered:
 - Drying (current approach and alternate drying methods)
 - Pyrolysis
 - Gasification
 - Slurry Carb
 - Vitrification
 - Deep Well Injection
 - Chemical Stabilization
 - Composting
 - Land Application



Co-Digestion Feasibility Study

- **Co-Digestion: the introduction of additional organic waste material in the wastewater anaerobic digestion process**
- **Organic waste material:**
 - Source Separate Organic Food Wastes (“SSO”)
 - Fats, Oils & Grease
 - Other materials –
 - airport deicing fluids,
 - off-spec beverages (dairy, brewery, soda bottling)
- **MaDEP – estimates 950,000 wet tons organic waste (only 100,000 wet tons annually are currently diverted.)**
 - 2020 State Goal: Divert additional 350,000 wet tons per year to AD units



Co-Digestion Feasibility Study

- **MA DEP Regulation:**
 - Summer 2014 ban on source separated organics to landfill for commercial/industrial sources > 1 wtpd
 - Encourages diversion to AD units with digas recovery
- **MWRA Benefits:**
 - Increased Digester Gas for increased Green Energy Production
 - Decrease purchase of electricity
- **MWRA Impacts:**
 - Need facilities on DITP to receive, store & feed material to digester
 - Increase sludge to NEFCo, \$ (digestion is never 100%)
 - Additional CHP facilities to handle increased gas production if significant volumes are accepted



Co-Digestion Feasibility Study

- **How?**
 - DITP would receive the material to a new storage facility
 - Material could then be blended with normal thickened WW sludges at varying levels into the existing digesters
 - current planning - up to 20% of normal sludge volume (~50 dtpd TS)*
 - Digas could be used in either the existing boilers/co-gen units up to trial volumes or newly constructed CHP facilities might be needed (for volumes greater than trial volumes) to overcome existing digas utilization restrictions and improve electrical generation efficiencies.



Co-Digestion Feasibility Study

- **Issues to be Addressed:**

- Will this new waste stream negatively impact the current operation (digesters, sludge quality or effluent quality)? **MWRA operates a very successful residuals management program, we will not do anything to compromise that program.**
- Will co-digestion create the potential for odors and/or pests
- Logistics – how is the material going to get to DITP?
- Net financial Impact



Co-Digestion Feasibility Study

- **How are these issues being addressed? Next Steps...**
 - **Digas System Capacity Analysis** (complete)
 - MWRA Contract 7274A Task Order #6 with FST
 - Determine bottlenecks in existing Digas Utilization Processes
 - **Co-Digestion Bench Scale Pilot Study** (in progress)
 - MWRA Contract 7274A Task Order #7 with FST/UMass
 - **Refine performance parameters to improve cost analysis**
 - **Co-Digestion Feasibility Study** (in progress)
 - MWRA Contract 7147A Subtask 7, CDM-Smith
 - Evaluate overall Co-Digestion Feasibility & Costs
 - **Co-Digestion 1 Digester Scale Pilot** (future)
 - Further refine performance parameters and operational impacts



Summary To Date

- **MWRA is evaluating various residuals treatment technologies**
- **MWRA is also working to optimize performance of its residuals processing operation**
- **Independent assessment concluded FRSA Pellet Plant to be in excellent condition**
- **Co-Digestion is a viable future treatment enhancement that should increase digas/green energy production requiring further investigation**