Performance Improvements and Energy Efficiency Efforts at Jackson Pike WWTP

2011 – OWEA Plant Operations and Laboratory Analysis Workshop

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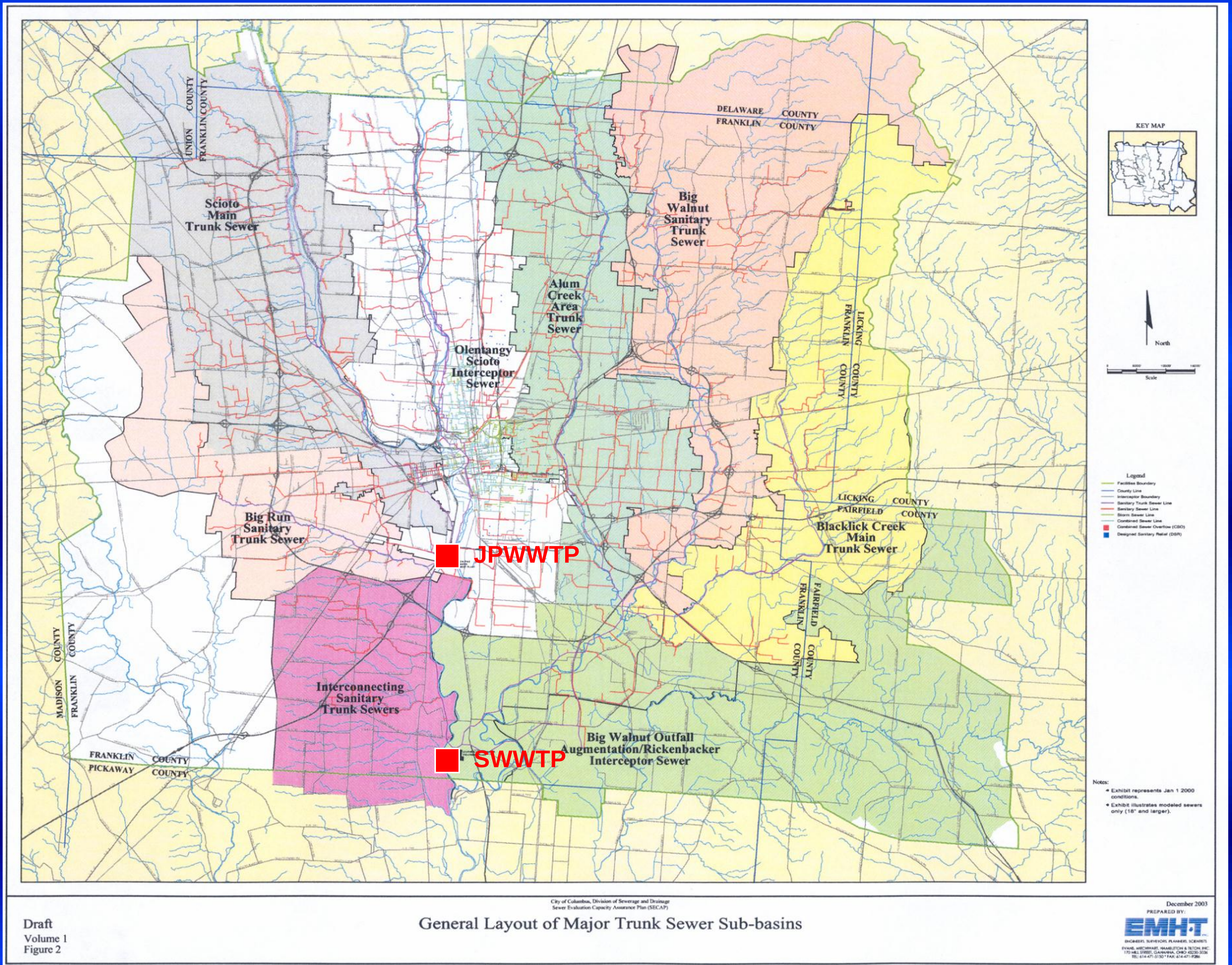
Jackson Pike Goals

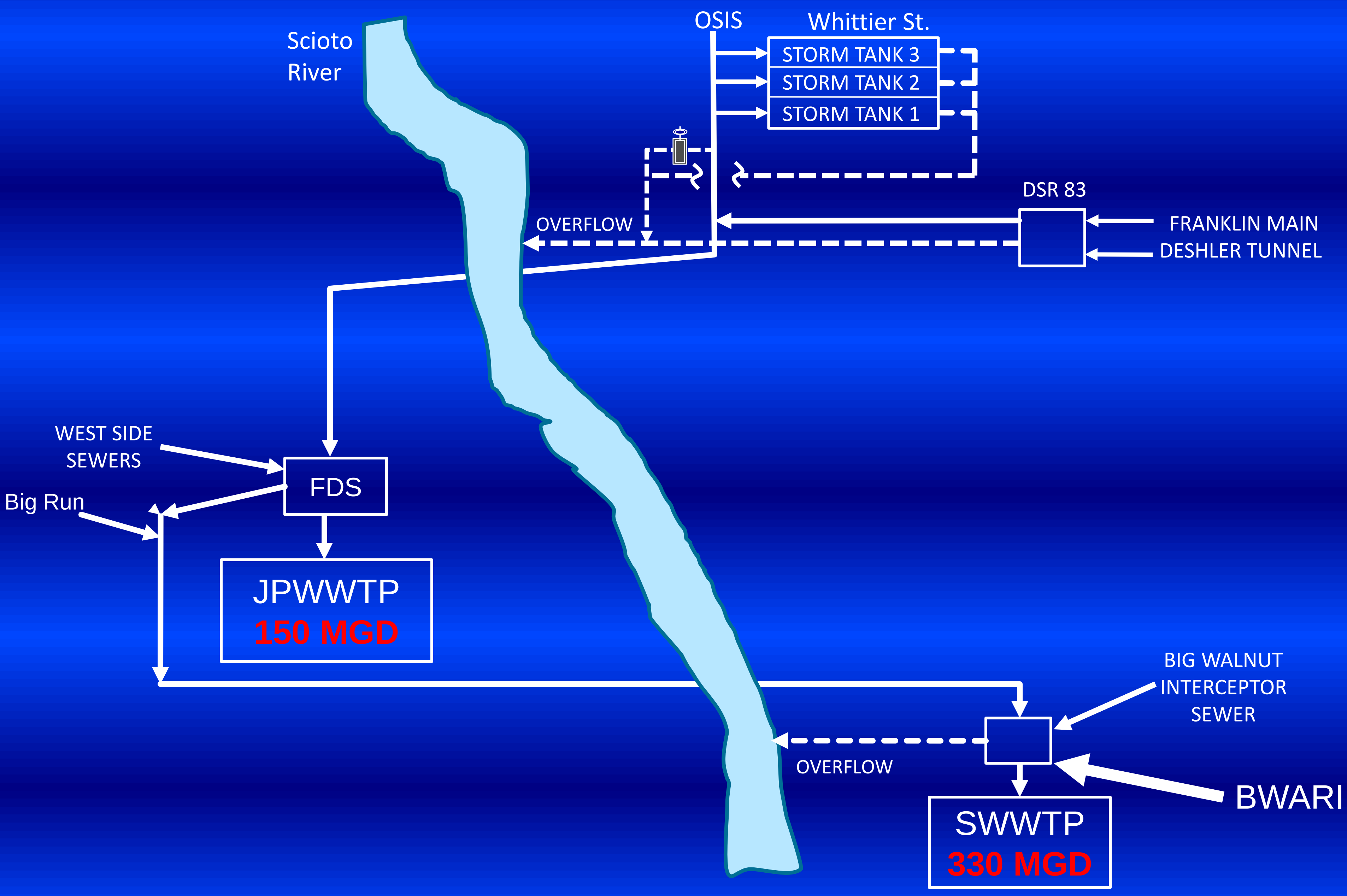
- To have as much excess treatment capacity as possible at all times under any circumstance.

- Remove wastewater treatment residuals from the wastewater as quickly and efficiently as possible and to direct them to the lowest cost beneficial reuse options available while maintaining as much excess treatment capacity as possible.

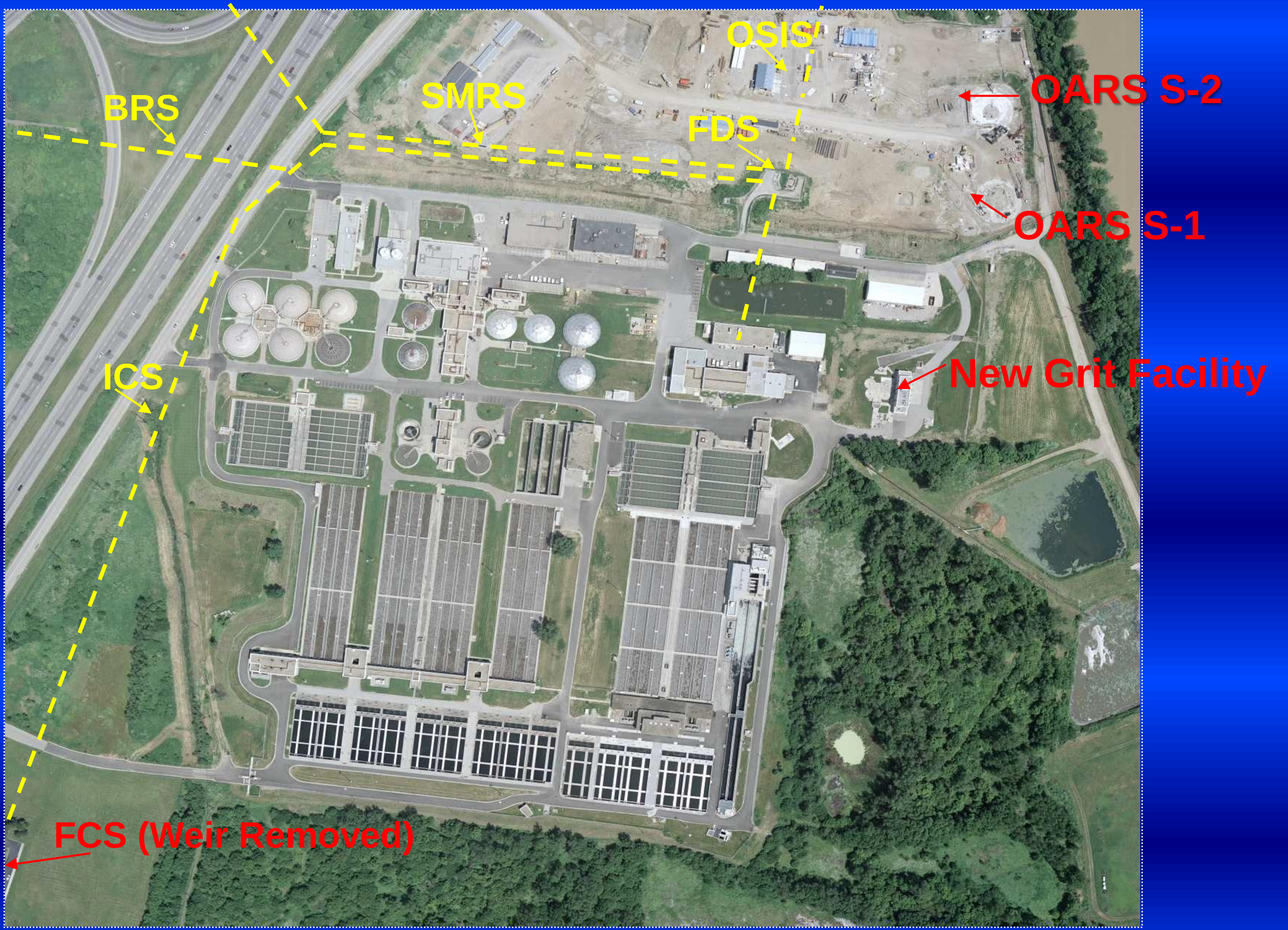
Columbus Area Collection System Overview



Plant Capacity Improvements



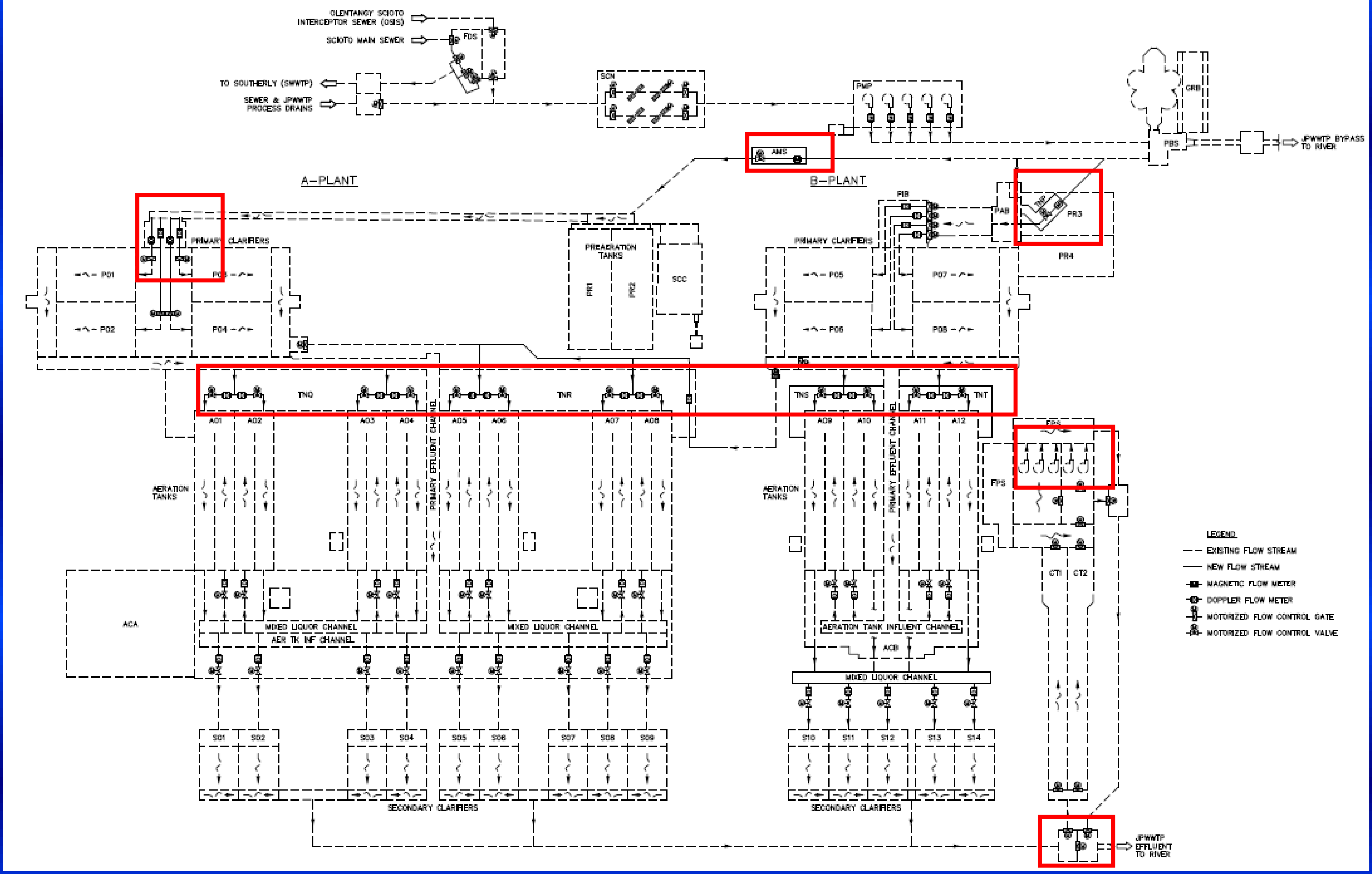
Jackson Pike Wastewater Treatment Plant



Improvements At JPWWTP

- New Influent Pumps with AFDs
- Simplified Flow Split between A-Plant and B-Plant
- Larger Conduits into and out of Process tankage.
- Modification of Aeration Process from Plug-Flow to Step Feed
- Modification and Expansion of Effluent Pump Station/Flushing Water System

Plant Hydraulic Improvements

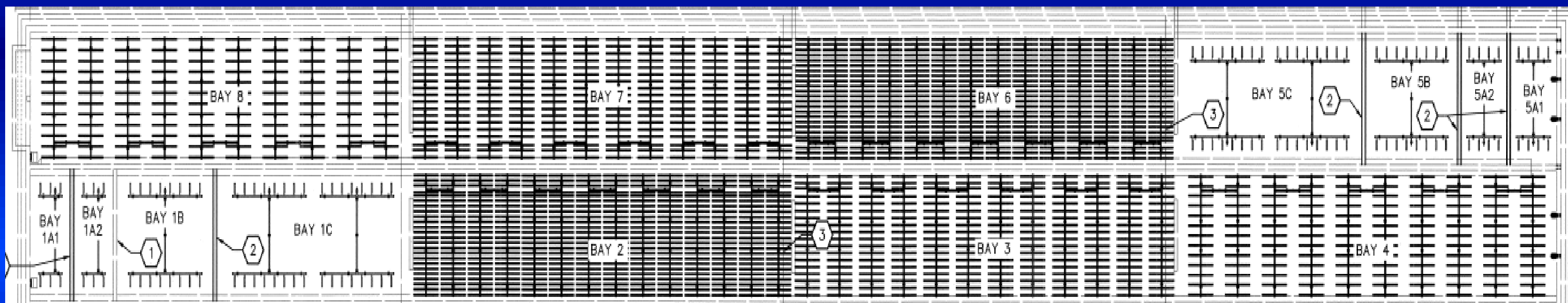


Modification of Aeration Process from Plug-Flow to Step Feed

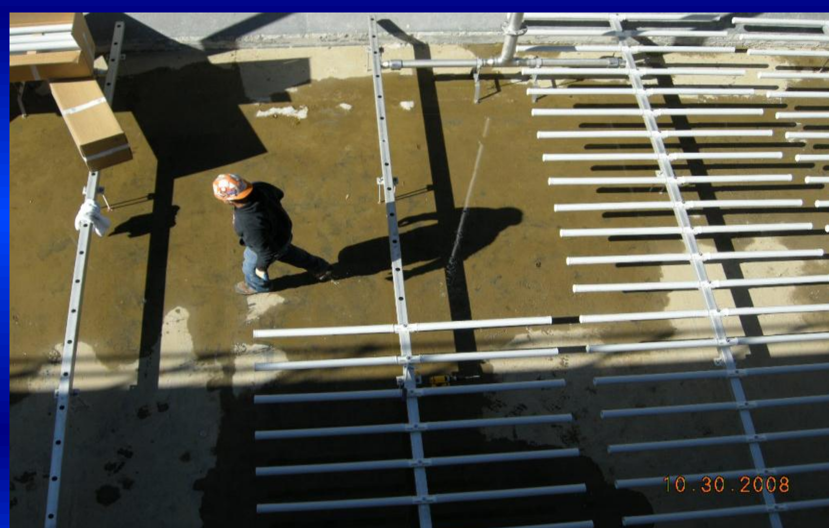
- New Aeration System Piping
- Second Anoxic Selector with additional Baffle walls to mid point of aeration tanks.
- Step-Feed System added to mid-point of aeration tanks.
- Use of OTT- fine bubble diffusers instead of traditional panel or disc type diffusers

New Aeration System Piping

BAY 8 **BAY 7** **BAY 6** **BAY 5**



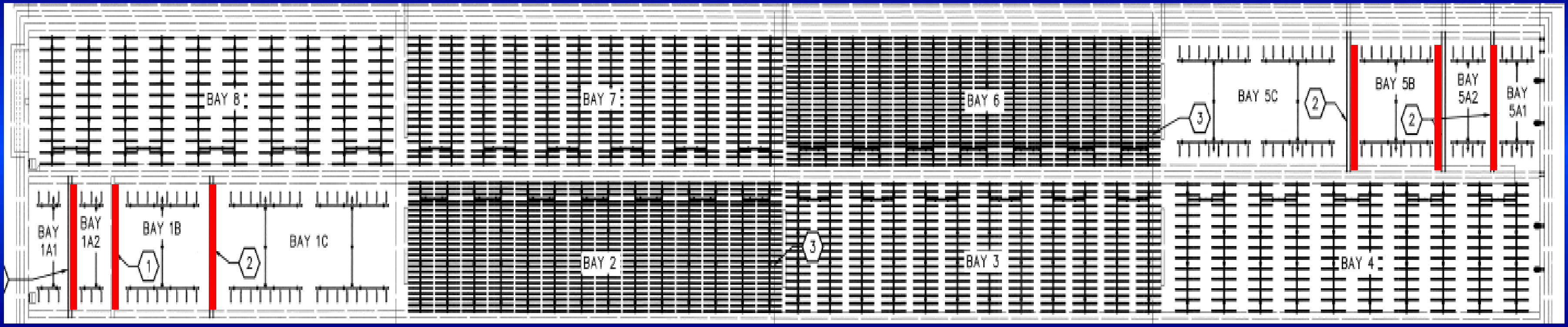
BAY 1 **BAY 2** **BAY 3** **BAY 4**



Use of OTT- fine bubble diffusers instead of traditional panel or disc type diffusers

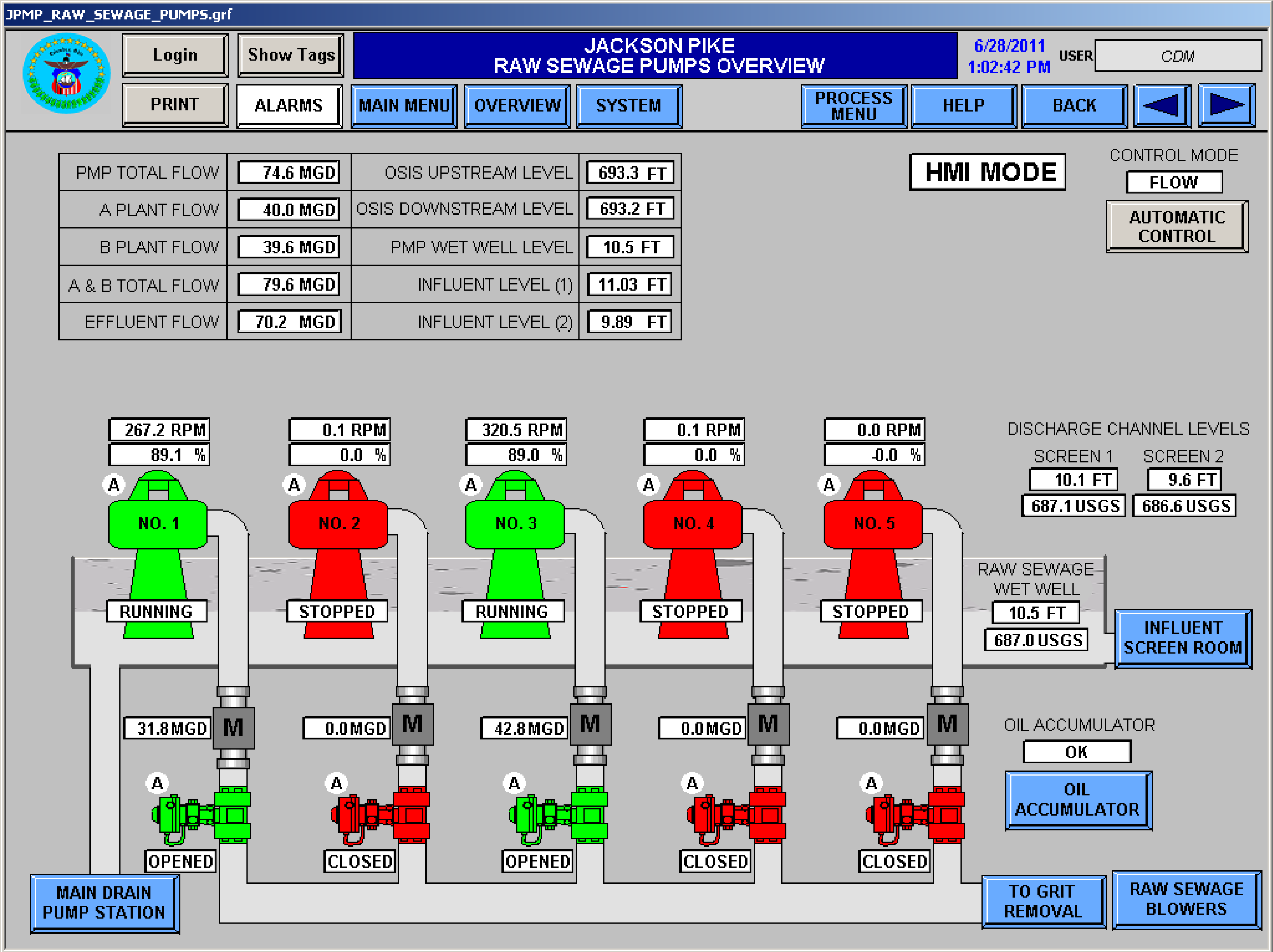
Second Anoxic Selector with additional Baffle walls to mid point of aeration tanks.

BAY 8 BAY 7 BAY 6 BAY 5

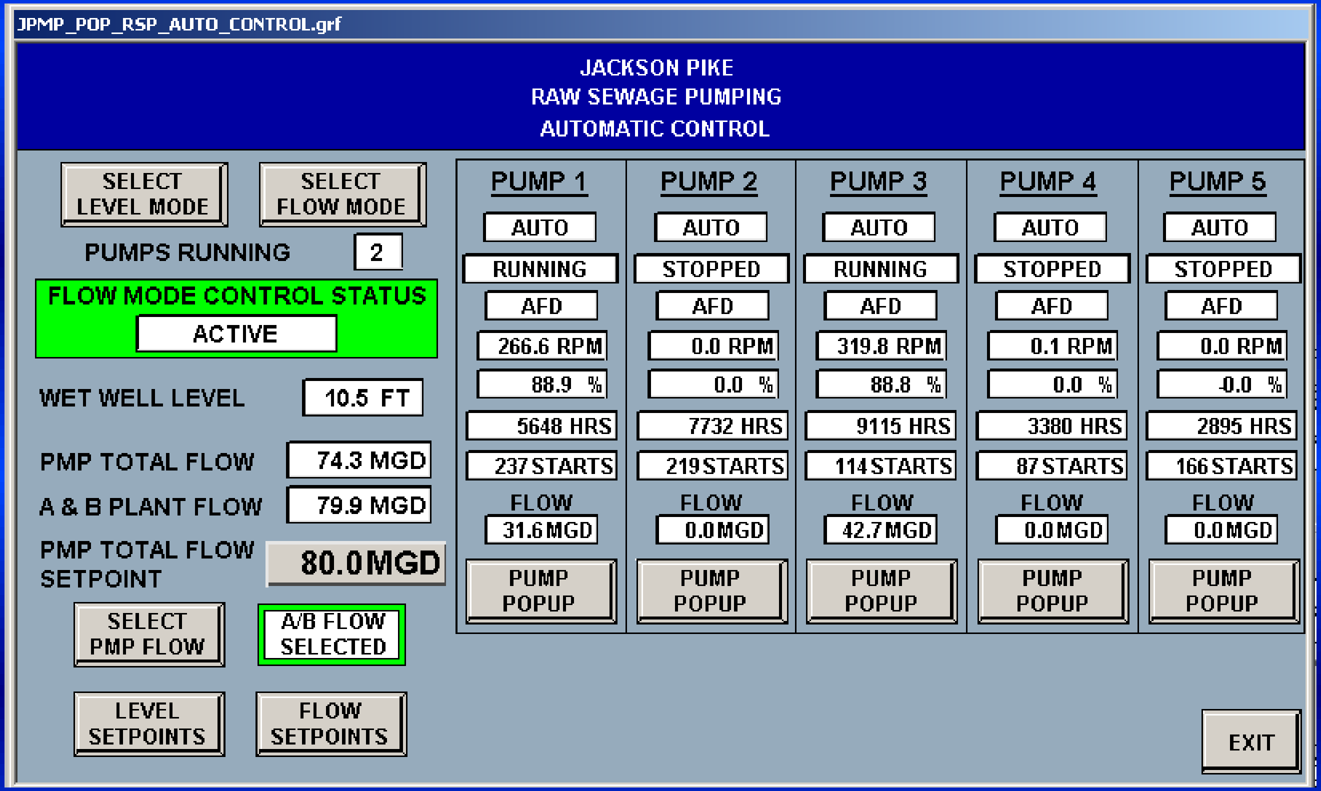


BAY 1 BAY 2 BAY 3 BAY 4

Automatic Control of Raw Sewage Pumping

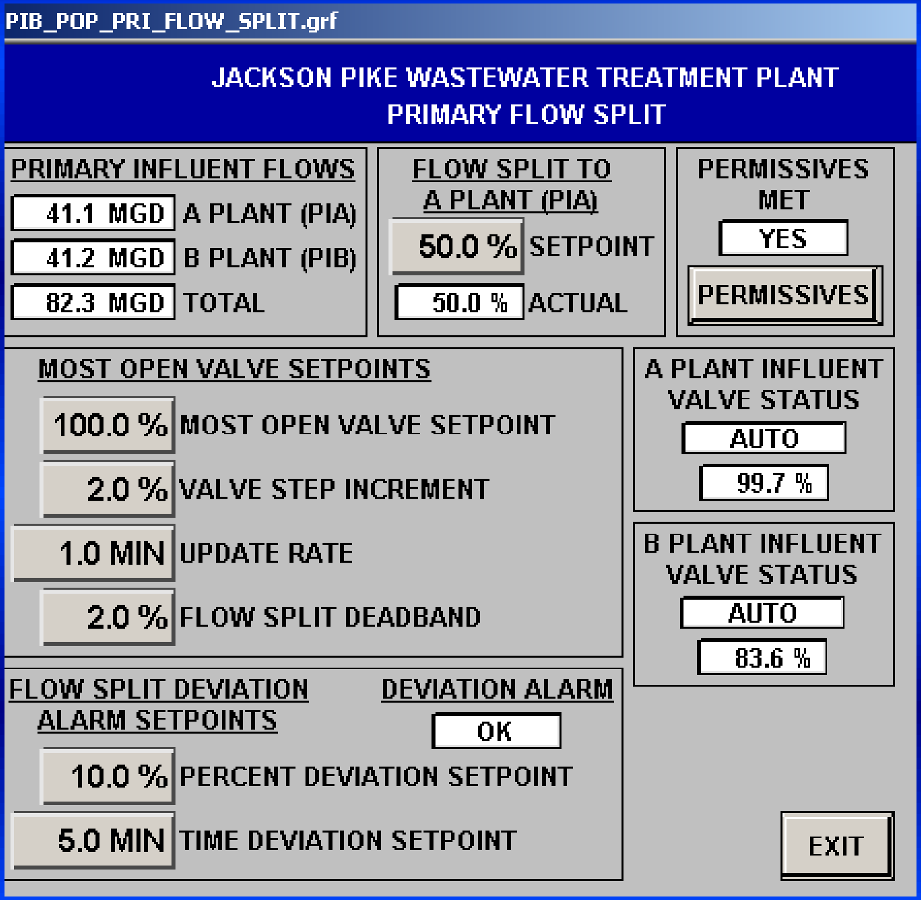


Automatic Control of Raw Sewage Pumping



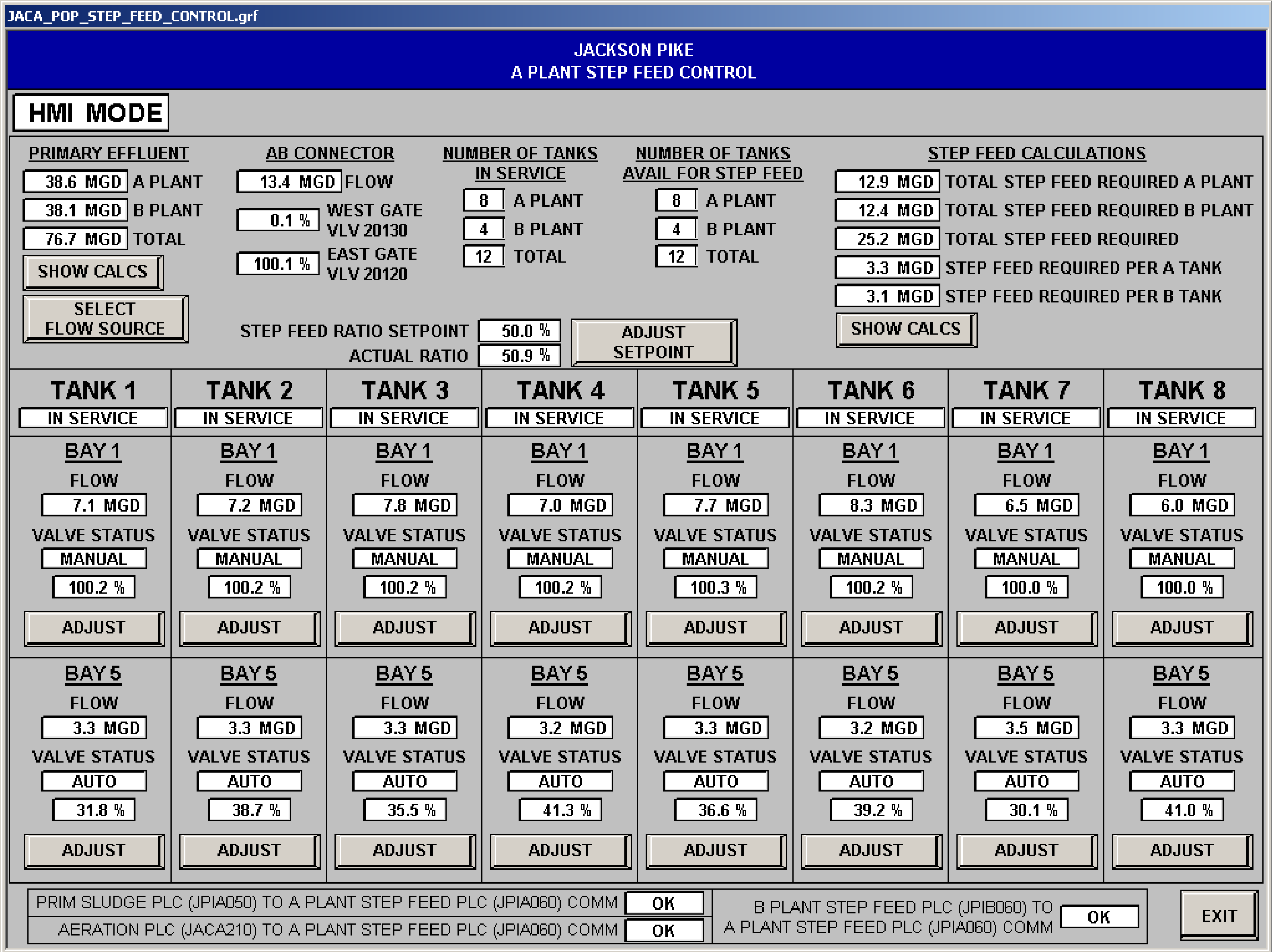
- Can choose automatic Flow or Level control
- Smooth out daily flow variations
- Saves energy by avoiding starting additional raw sewage pumps

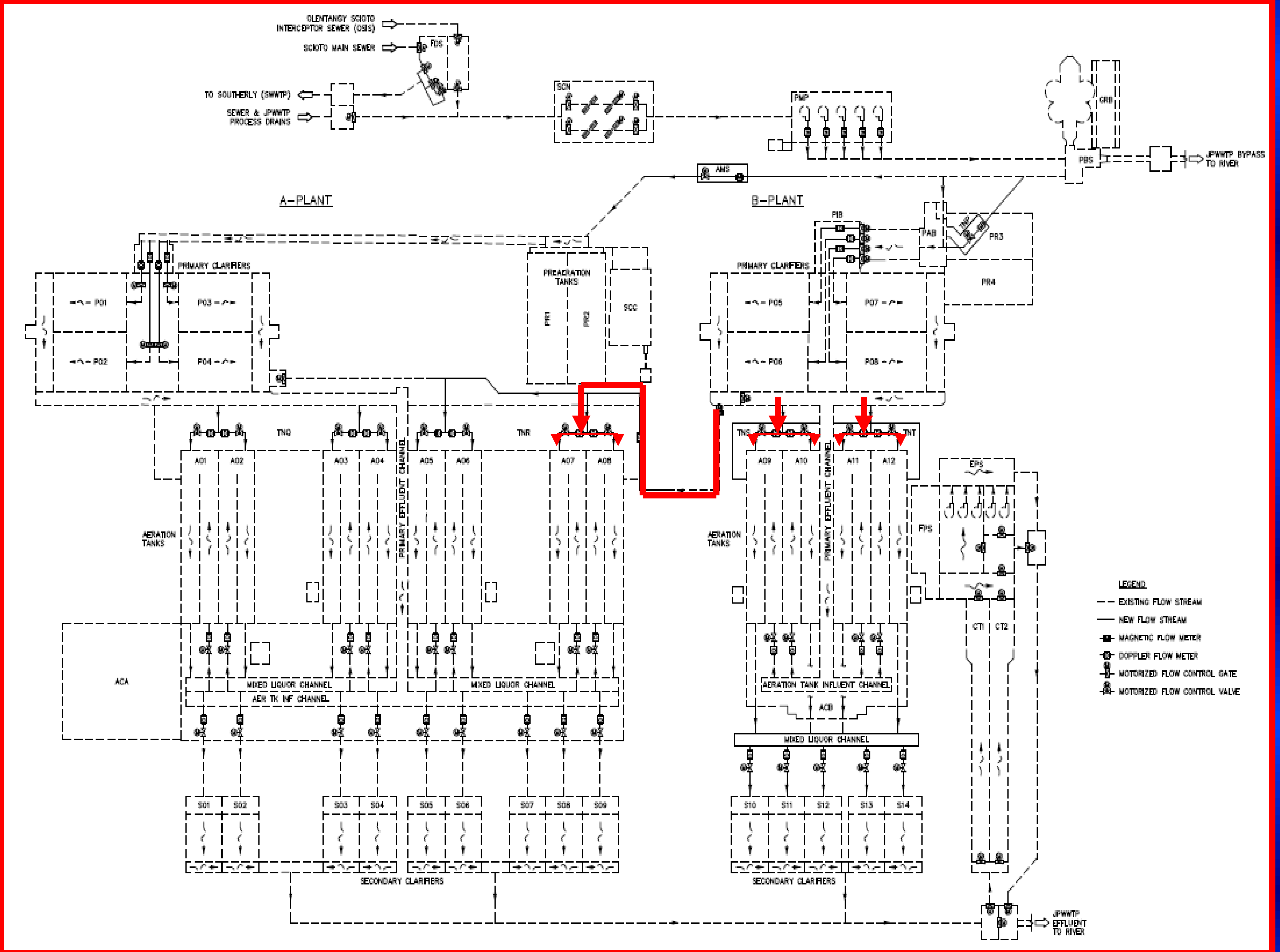
Automatic A-Plant and B-Plant Flow Split



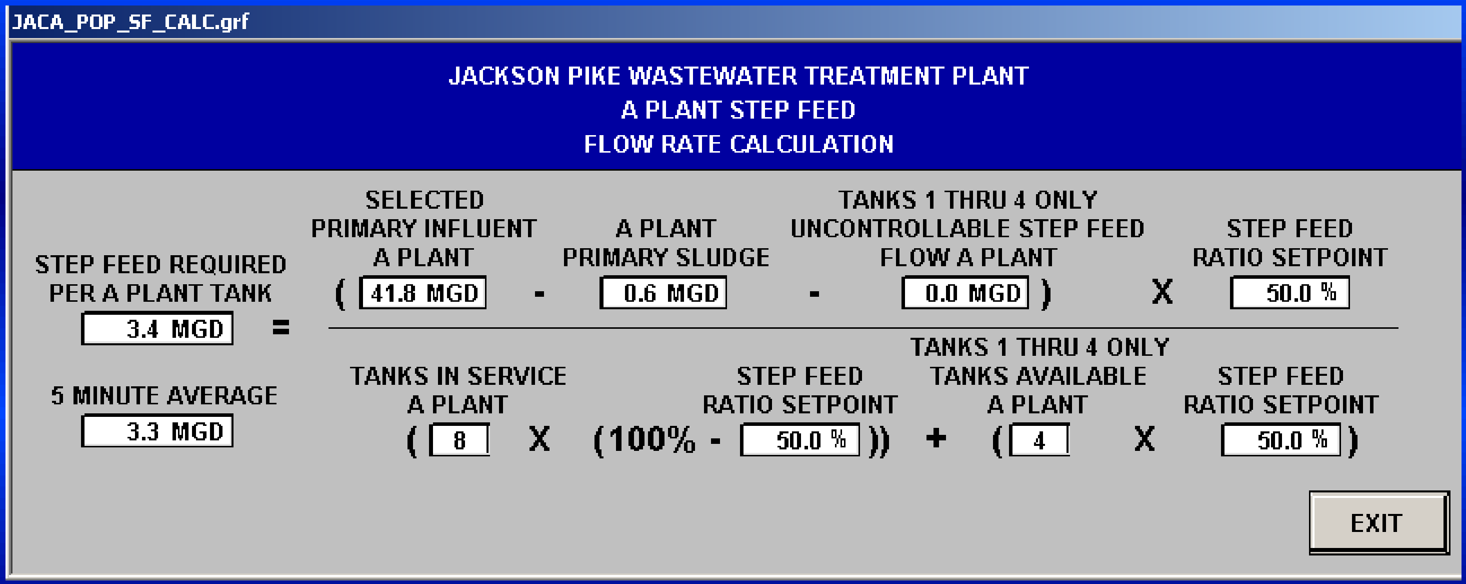
- Most open valve strategy to prevent extra hydraulic head loss and wasting of energy
- Can be adjusted for splits other than 50/50 between A-Plant and B-Plant

Automatic Step Feed Flow Control




OLENTANGY SCIOTO INTERCEPTOR SEWER (OSIS)
SCIOTO MAIN SEWER
TO SOUTHERLY (SWWTP)
SEWER & JPWWTP PROCESS DRAINS
FDS
SCN
PMP
GRB
PBS
JPWWTP BYPASS TO RIVER
AMS
A–PLANT
B–PLANT
PIB
PAB
PR3
PR4
PRIMARY CLARIFIERS
P01
P02
P03
P04
P05
P06
P07
P08
PREAERATION TANKS
PR1
PR2
SCC
TNQ
TNR
TNS
TNT
A01
A02
A03
A04
A05
A06
A07
A08
A09
A10
A11
A12
PRIMARY EFFLUENT CHANNEL
AERATION TANKS
EPS
FPS
CT1
CT2
ACA
MIXED LIQUOR CHANNEL
AER TK INF CHANNEL
AERATION TANK INFLUENT CHANNEL
ACB
S01
S02
S03
S04
S05
S06
S07
S08
S09
S10
S11
S12
S13
S14
SECONDARY CLARIFIERS
JPWWTP EFFLUENT TO RIVER
LEGEND
EXISTING FLOW STREAM
NEW FLOW STREAM
MAGNETIC FLOW METER
DOPPLER FLOW METER
MOTORIZED FLOW CONTROL GATE
MOTORIZED FLOW CONTROL VALVE

Automatic Step Feed Flow Control Calculations



- Flow sharing between A-Plant and B-Plant complicated calculations for set points
- Exposed so operations can spot check control system performance

Wet Stream Improvement Goal

- To have as much excess treatment capacity as possible at all times under any circumstance.

Process Optimization

- Influent Pumping – Two large diameter sewers immediately upstream of Jackson Pike Headworks.
  - Flow Control
  - Level Control

Flow Split Optimization

- Because of the design, the 50-50 flow split between A-Plant and B-Plant seems to be the most stable and controllable mode of operation.

Aeration Optimization

- High efficiency OTT diffusers installed
- Aeration Blowers Optimized
- Mix Liquor levels and MCRT adjusted upwards to account for "halving" of detention time in aerators
- Dissolved Oxygen levels in aeration monitored.
  - Adjustments made to individual drop legs into each bay.
  - Air flow into each tank between 2750 scfm – 3700 scfm
  - Bay 2 Dissolved Oxygen is primarily utilized for monitoring effectiveness.

Secondary Clarifiers

- Return rates are typically fixed at 90% of design flow.
- Minimal or no blankets in Secondary Clarifiers. (bugs need to be working in aeration, not relaxing in the secondary clarifiers.)

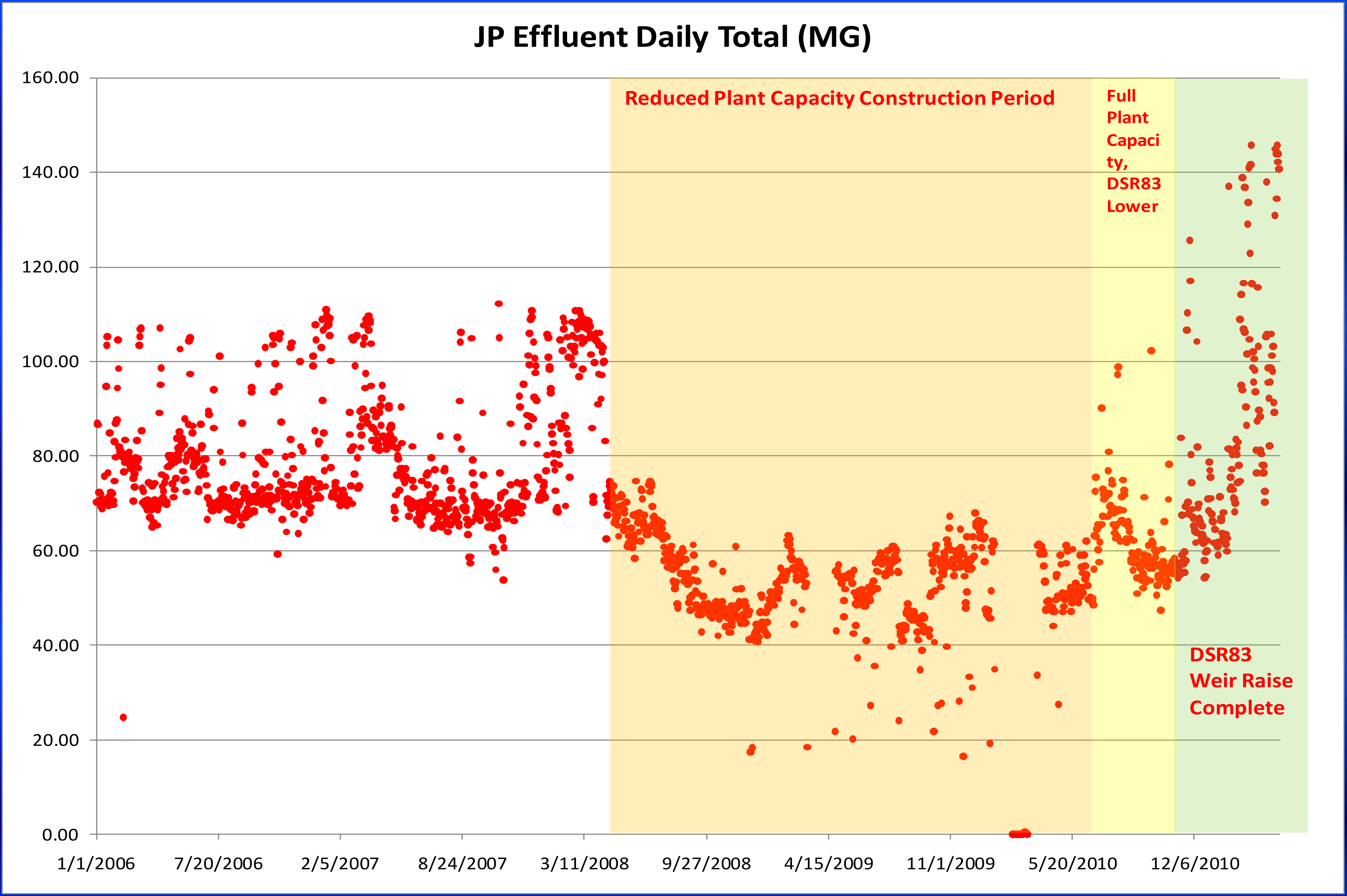
Chlorination/Dechlorination/Post-Aeration, Effluent Pumping

- Chemical dosing is substantially higher this year, than years past as new E. coli limits were implemented.
  - 30 day limit 126 colonies/100 ml (geomean)
  - 7 day limit 284 colonies/100 ml (geomean)
- Post – Aeration Blowers were reduced from two on-line to one on-line with a trigger of Dissolved Oxygen below 7.5 mg/l used to determine if a second blower was warranted. (Discharge minimum limit of 7.0 mg/l)
- Effluent Pumping system was designed to be shutdown completely (including AFDs) when not in use.

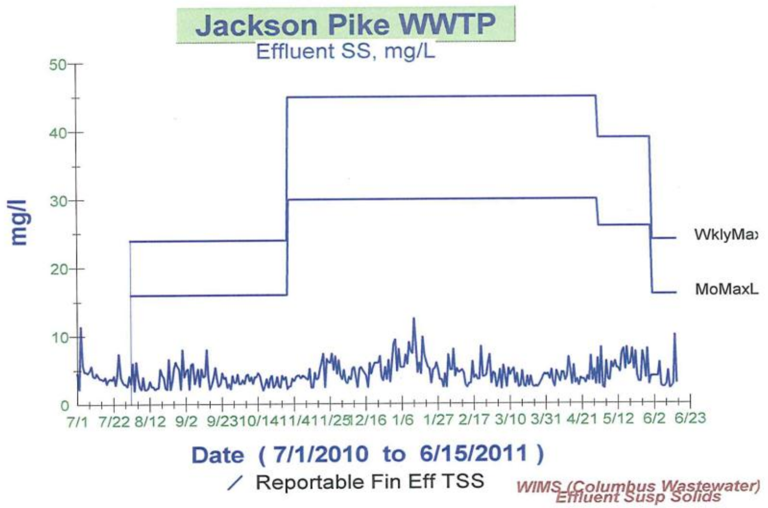
Results

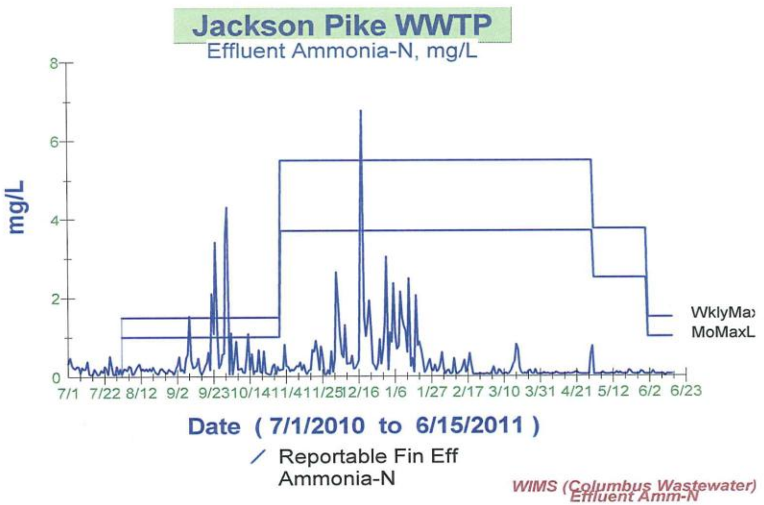
- Improved Peak Treatment Capacity
- Continued Compliance with NPDES Permit Limitations
- Significant Reduction in Power usage in Aeration

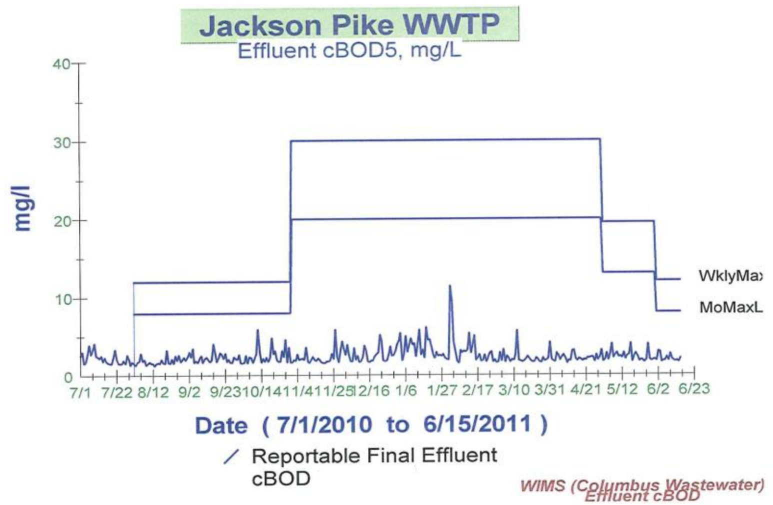
Improved Peak Treatment Capacity



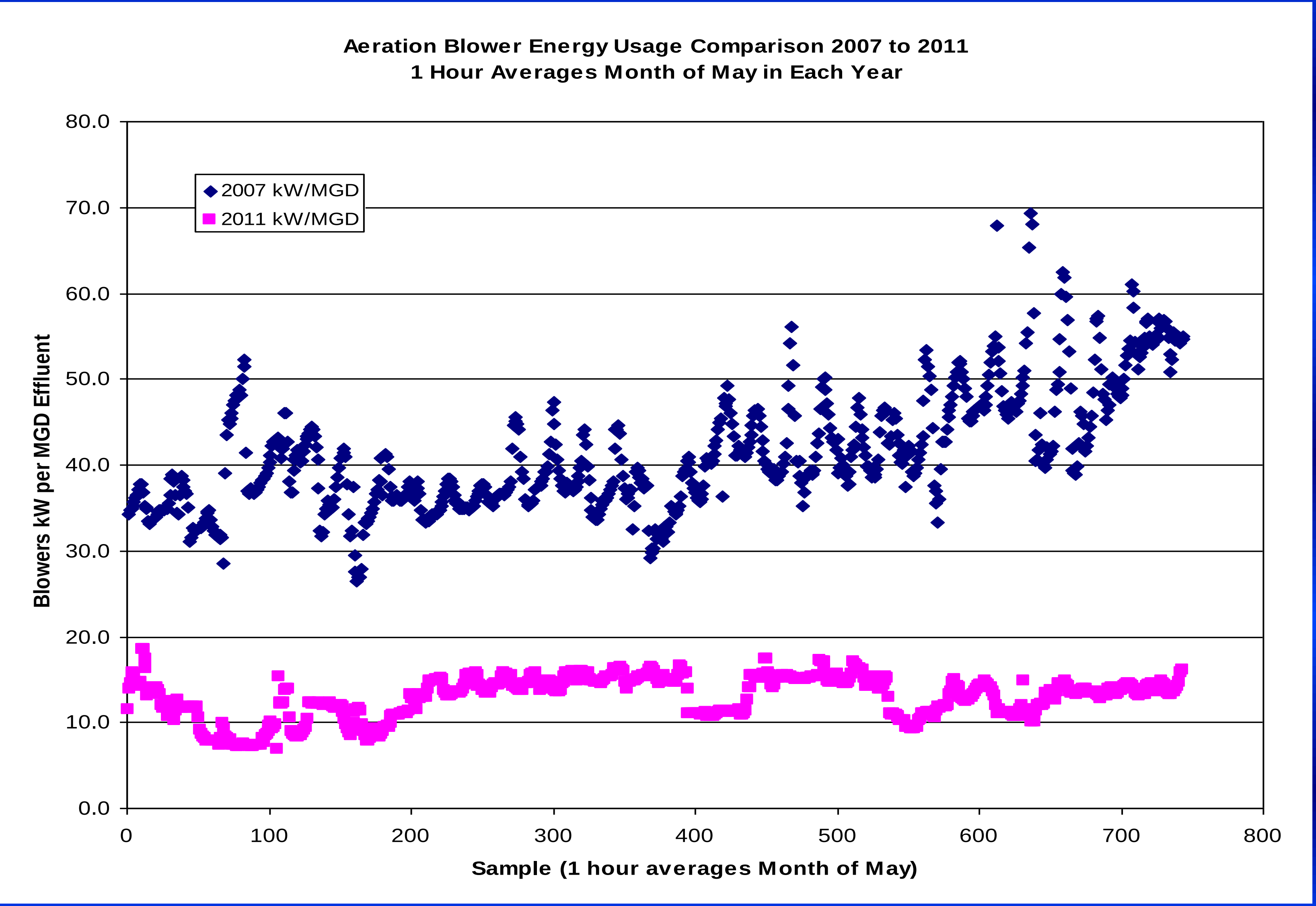
Continued Compliance with NPDES Permit Limitations







Energy Reduction in Aeration Power Usage



Wet Stream Improvements Summary

- Reduction in hydraulic limitations
- Aeration Step Feed
- OTT fine bubble diffuser performance
- Operational fine tuning

Solids Handling Improvements

- **Goal**: Remove wastewater treatment residuals from the wastewater as quickly and efficiently as possible and to direct them to the lowest cost beneficial reuse options available while maintaining as much excess treatment capacity as possible.

Primary Operations

- Sludge is continually drawn off the bottom of the primary clarifiers, minimal - no blankets are maintained in primary clarifiers during normal operations (< 12”).
- Sludge from primaries is thickened in two of four gravity thickeners during dry weather flows. Additional GTs are added during first flush as needed.
- Thickened Primary sludge is pumped to a dedicated holding tank at @ 6% TS.

Wasting from Aeration

- WAS is pumped directly to Westvalia Thickening Centrifuge
- Flow rate is variable between ~ 600 – 900 gpm. Feed solids ~ 4,500 mg/l.
- Thicken sludge is pumped to a holding tank @ 6% TS.

Westfalia Thickening Operations

Anaerobic Digestion

- Two separate Feed tanks to six mesophilic anaerobic digesters, through a common line. Flow rates to digesters controlled through most open valve logic.
- Incoming sludge co-mixed with digesting sludge and put through a sludge to water heat exchanger prior to entering the digester.
- Independent trombone valve provides for mixing of sludge contents in 10 discrete zones in the digester. Gas production assists in vertical mixing as well.

Sludge Solids Dewatering Operations

- Andritz DL5-L Centrifuges are used for dewatering operations.
- Operation of Centrifuges is adjusted for disposal options.
  - Incinerator Operations
  - Composting Operations
  - Kurtz Brothers/Quasar High Solids Digestion
  - Land Application/Liquid Program

Dewatering Operation

Incineration Optimization

- Understanding the function of a Multiple Hearth Furnace (MHF) Incinerator
- MHF like constant feed at or near the maximum design loading rate for optimal performance.
- Associated scrubbing equipment is also optimized to this condition
- MHF is more correctly a “thermo-dryer/oxidizer”

MHF Incineration Optimization (continued)

- Controls for operation
- Feed rate
  - Solids distribution on the drying hearths controlled by load and rabble pattern
- Detention time in furnace is controlled by number of rabble arms per hearth and the rabbling speed of the center shaft
- Oxygen levels and airflow admittance control
- Temperature Profiles throughout the furnace
  - Heat in the furnace is controlled by draft created by Induced Draft fan, use of inlet air dampers and number of combustion burners firing.
- Combustion Zone location and control

Jackson Pike MHF System

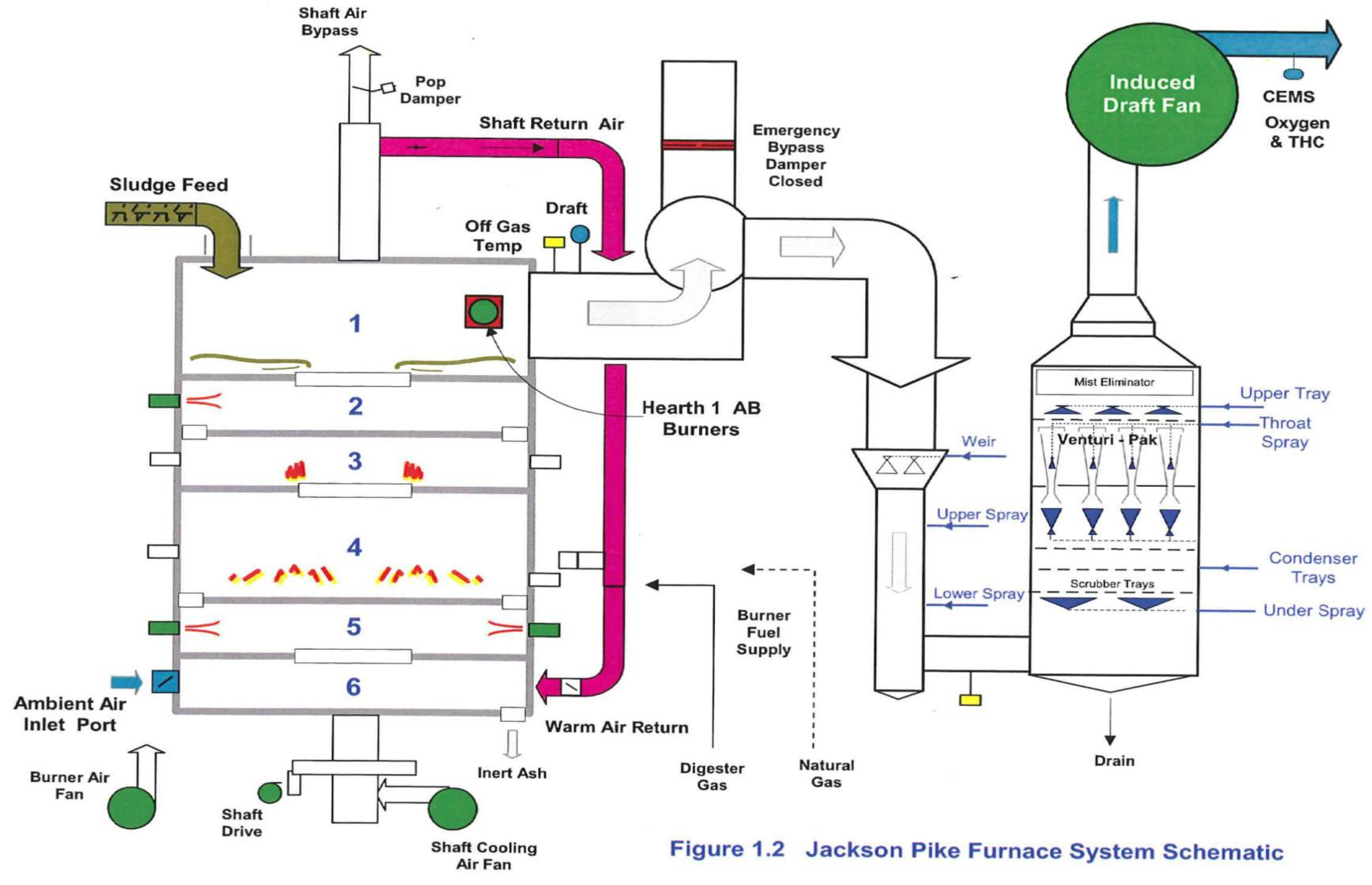


Figure 1.2 Jackson Pike Furnace System Schematic

Ash Handling

- Typical ash handling is through a lagoon system.
- Ash is typically transported to the lagoons by an ash slurry line.
- Columbus' ash lagoons have periodically had issues with elevated metals in the decant discharge.
- New Permit conditions require the City to explore alternatives.

Direct decanting into a dumpster

Cake Disposal Program

- Current Sludge Cake Disposal Operations include:
  - – Quasar High Solids Digester System.
  - – Compost Operation
- Proposed High Solids Cake Land Application include:
    - Regional Storage
    - Strip Mine reclamation utilizing hybrid poplar trees

Cake Load-out Facility

Sometimes even the best plans have execution issues.

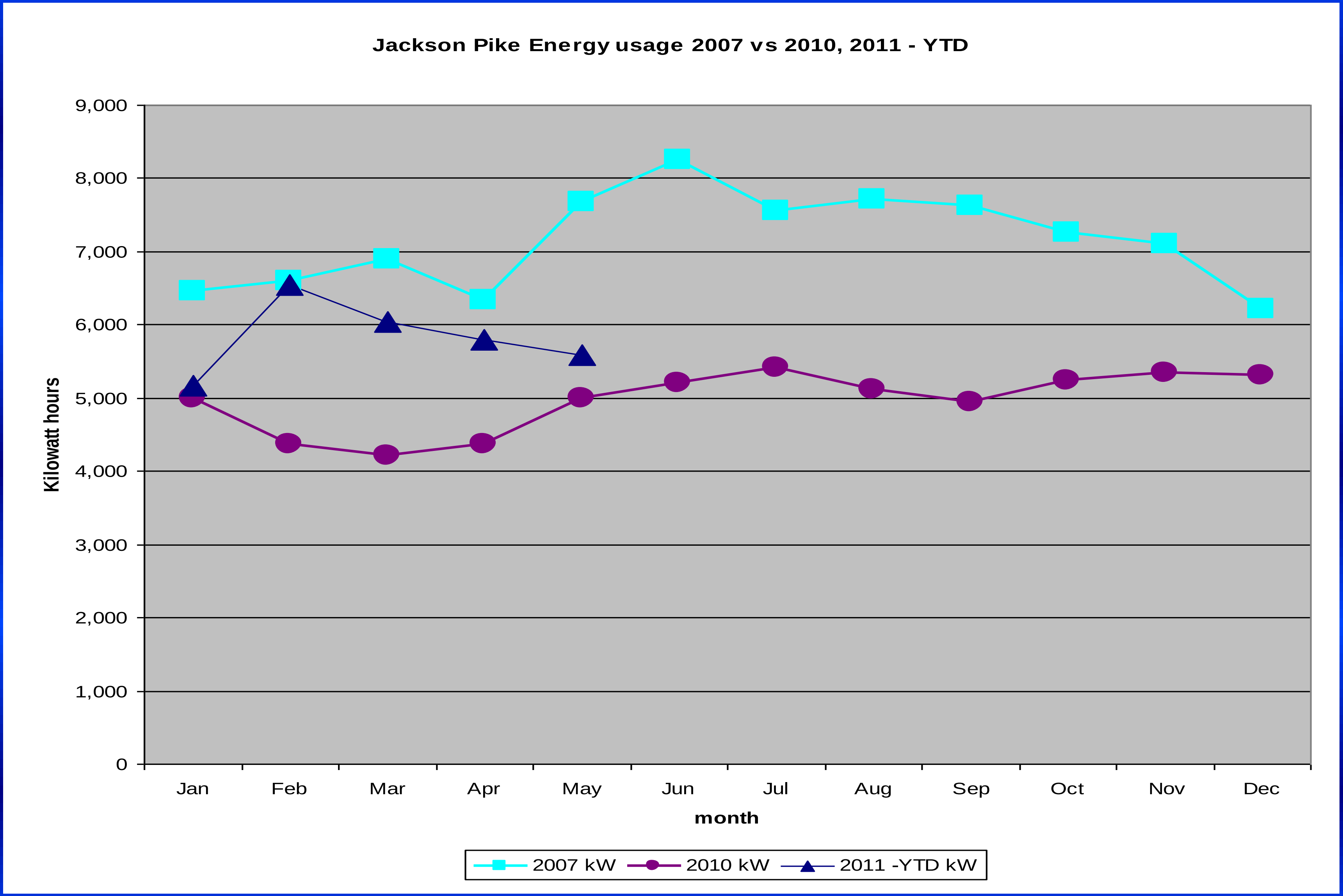
High Solids Organic Waste Reuse Recycle System

Composting Operations

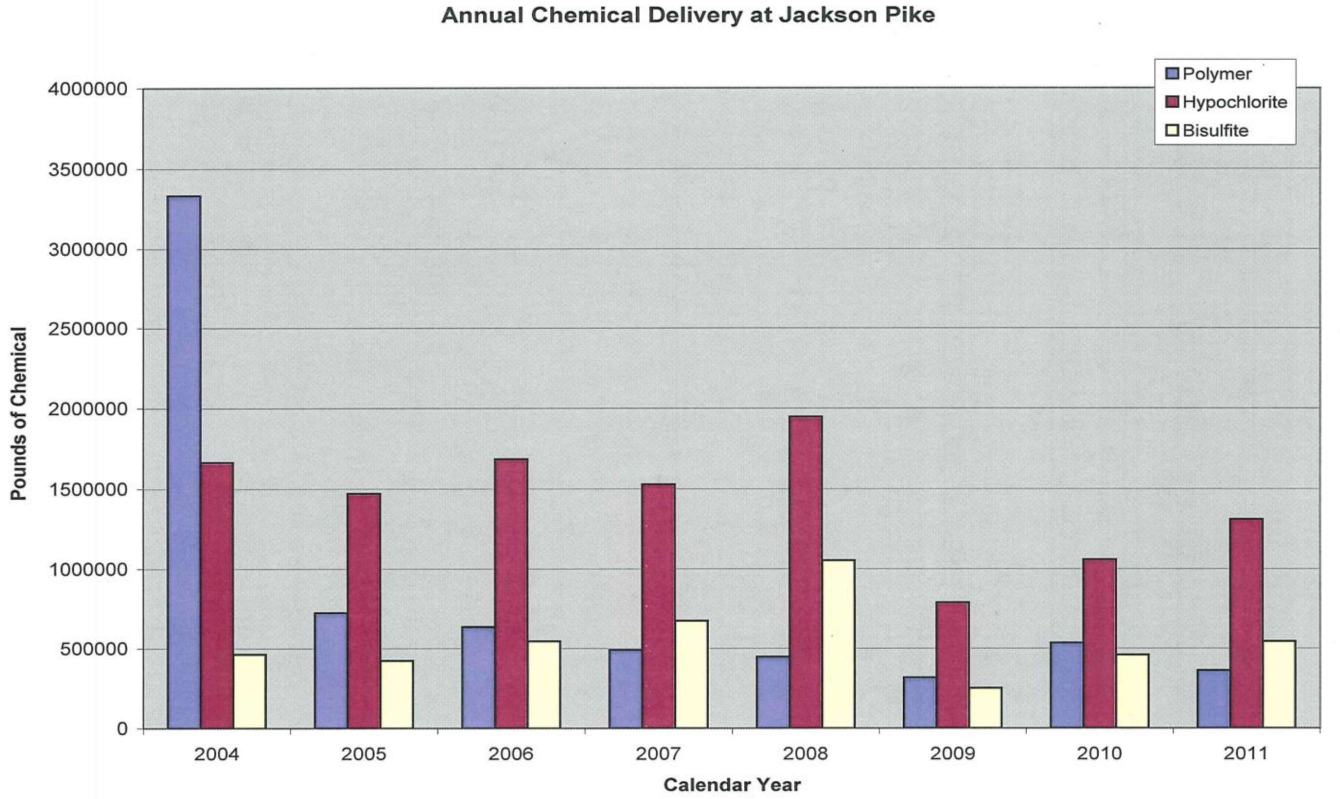
Land Application Storage & Load-out

Subsurface Injection program

Significant Reduction in Plant Power Usage



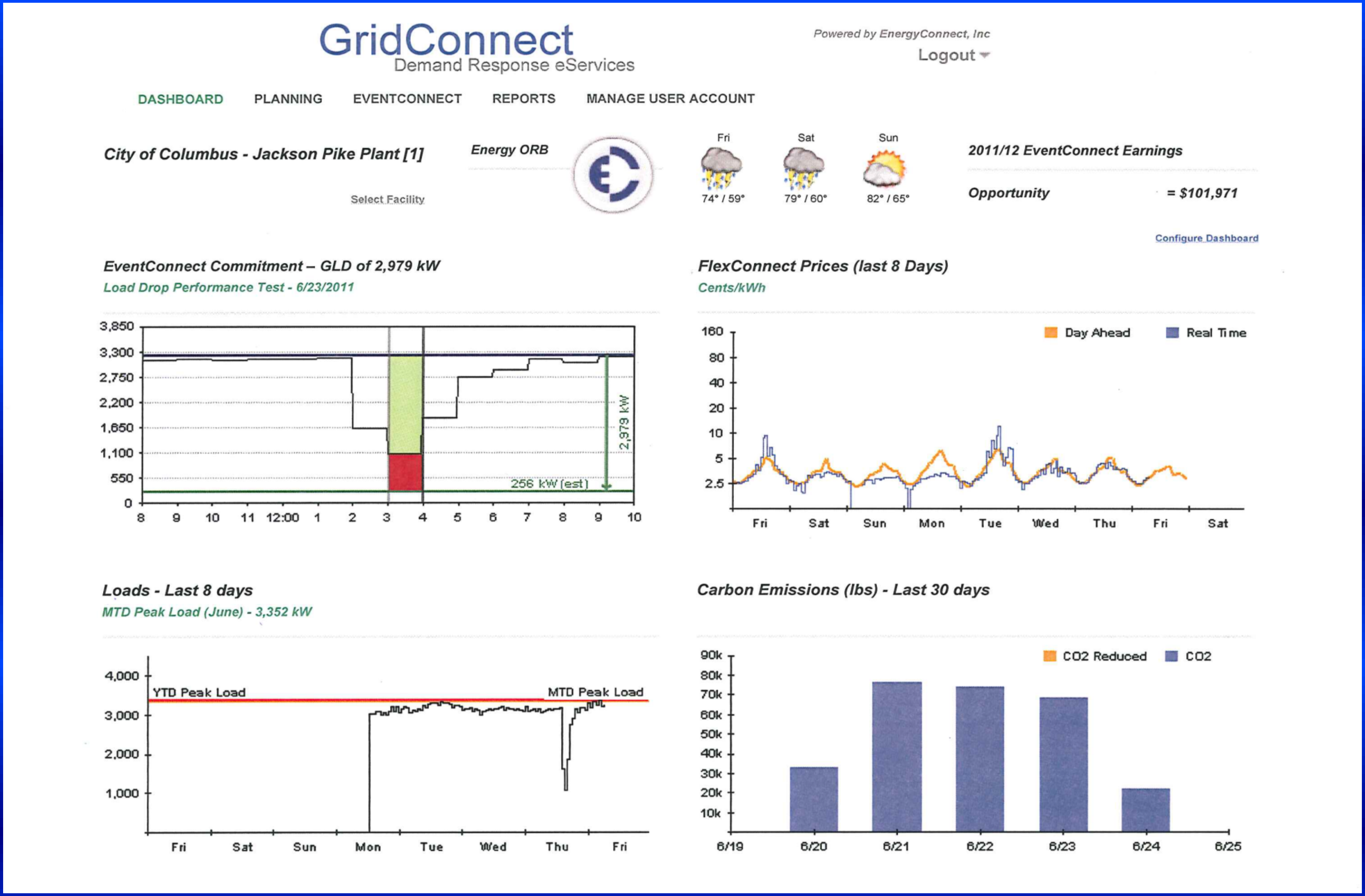
Chemical Usage



Chemical Costs

As of 9/27/2011

Future Efforts



Additional Improvements

- Improve Communications with Line Staff
  - Make sure Operating Strategies are understood
- Evaluate how Emergency Preparedness may impact/influence Daily Operations
  - Are you operating in anticipation of severe wet weather even during normal dry weather days?
- Make Sure Operator Training is current and SOPs reflect current practice

Additional Improvements

- Flow Leveling and/or load balancing
  - Recycle Streams, batch operations off-peak
  - Powering down AFDs and other electrical equipment when not needed
  - Start up Electrical Equipment One unit or process at a time, spreading out start-ups over 30 minute intervals per component when possible to minimize peak demand.
- Optimize pump selection and operating levels for raw sewage pumps
- Evaluate Building Systems HVAC for Temperature Control
- Evaluate Lighting Systems for Efficiency and motion/occupancy sensors

Additional Improvements

- Computer control improvements
  - Automatic Dissolved Oxygen Control in Aeration
  - Aeration Blower Pressure Controls
  - Return Activated Sludge flow pacing
  - Utilize power monitoring capabilities built into AFDs that are networked to PLCs


Any Questions?