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Implementation of Nutrient Removal Upgrades in Cranston, RI

A Phased-Approach to Achieving Effluent Limits Entering the Pawtuxet River

Helps Control Capital Improvement Costs

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Presentation Overview

- Project Overview
- Facility Planning
- Technology Selections and Why?
- Design Challenges
- Costs
- Construction and Operation
- Questions & Discussion

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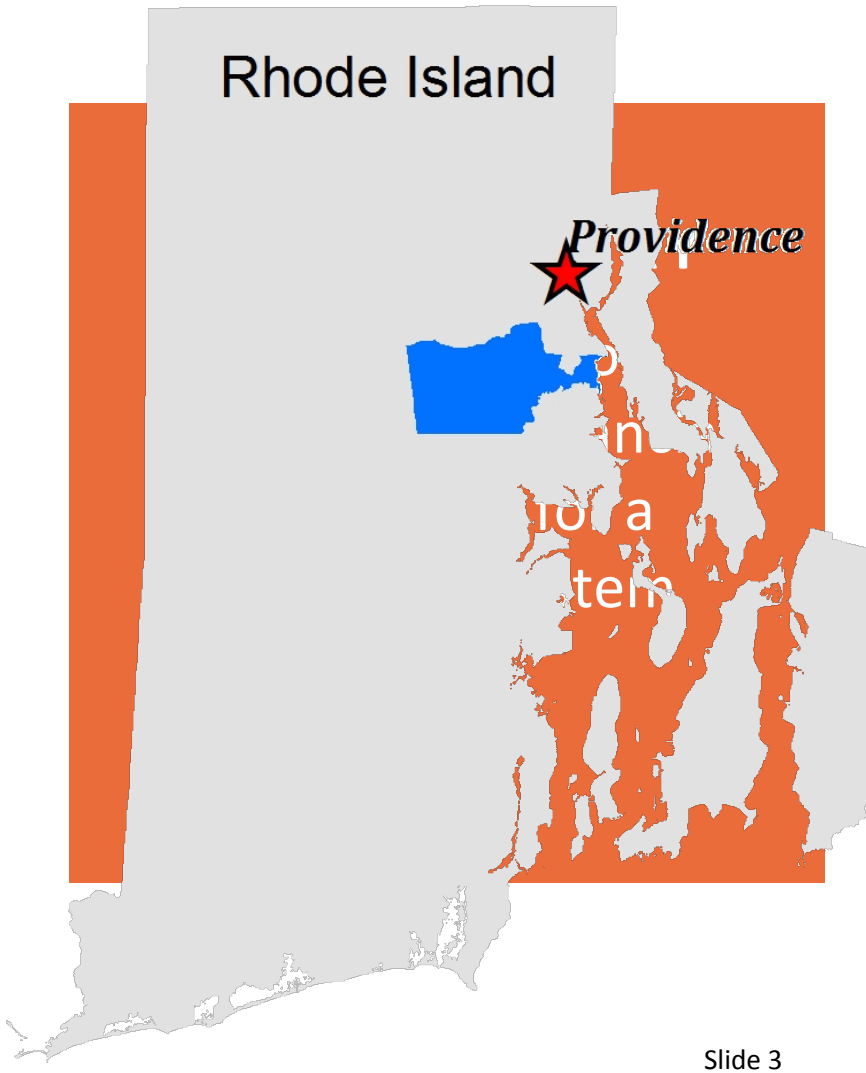
Water Pollution Control Facility (WPCF)

- 4th largest plant in Rhode Island
- Advanced secondary wastewater treatment facility
- Services the City and limited areas of Johnston and West Warwick
- Discharges to Pawtuxet River and Narragansett Bay



Project Overview
Existing Conditions

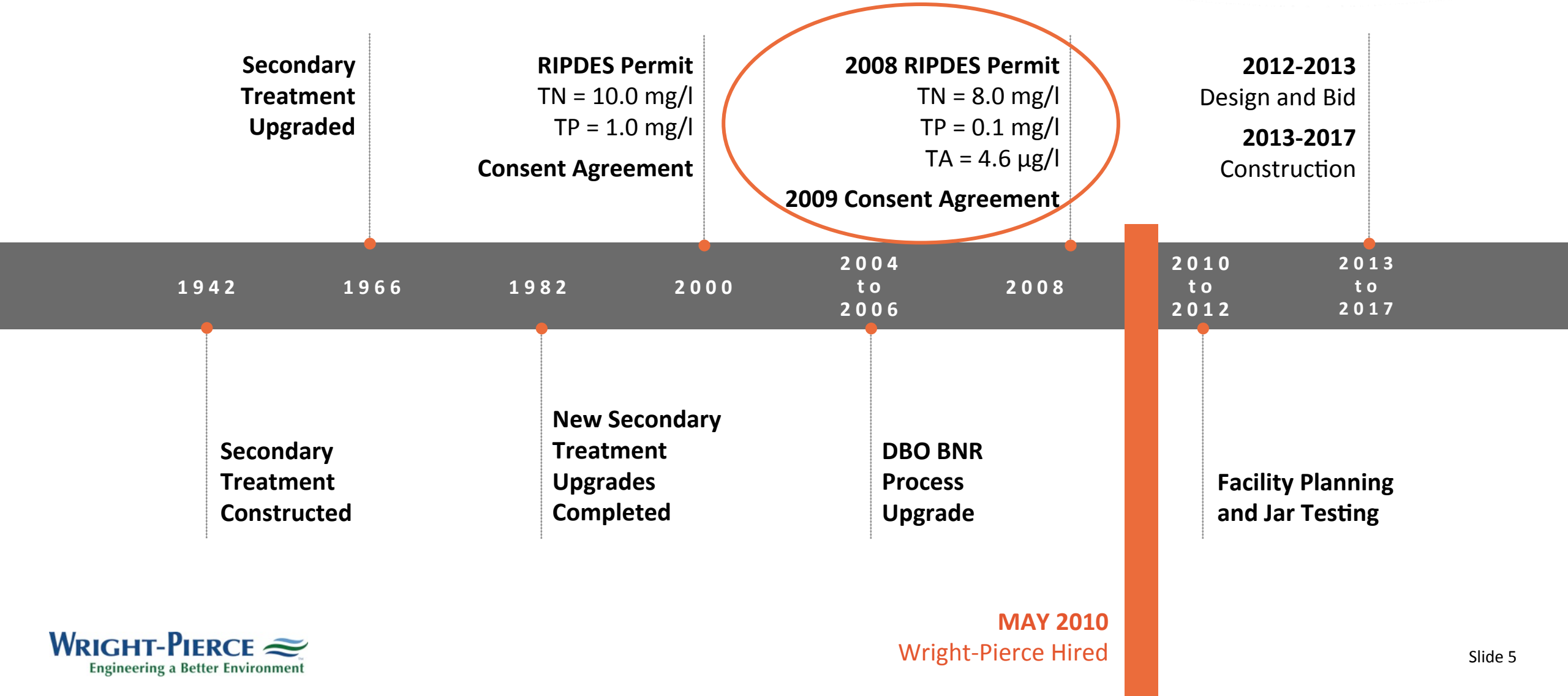
WPCF Flow Capacity

- Licensed Average Monthly Flow = 20.3 mgd
- Design Maximum Daily Flow = 36.0 mgd
- Design Peak Hourly Flow = 44.0 mgd
- Average Daily Flow = 14.4 mgd

Unique Features

- Merchant Sludge - $ Revenue
- Septage - ~40,000 gpd (average)
- Effluent reuse – FPL cooling tower (2 - 5 mgd)

Project Overview
History



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Project Overview
Key Issues

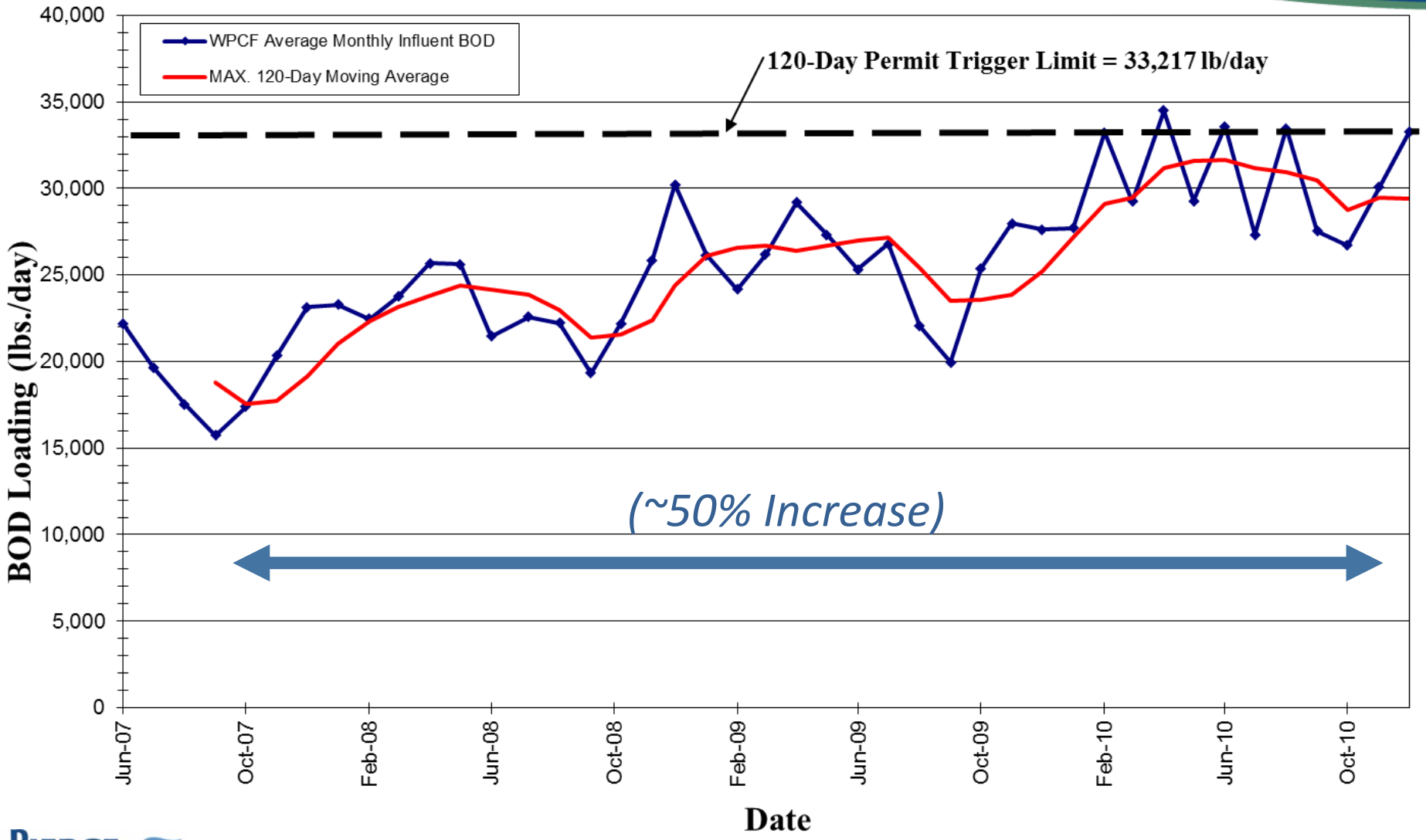
- **Secondary Processes Operating at/or slightly above design capacity (BOD_5 and TN)**
  - Stressed process operations!
- **Elevated wet weather flows**
- **Several SIUs have adverse impact on plant performance**
  - Landfill Leachate – no local limit for BOD_5 or TN
  - rDON concentration – future concern?

Prior cost estimate for needed WPCF improvements ~$50M

Influent Loads

- Significant influent BOD_5 loading increase
  - Near 50% increase from 2007 - 2010
- Significant influent TKN loading increase
  - Dec. 2009 rapid increase – loading nearly double in three years
- Supplemental Sampling Effort 2010- 2011
- Consent Agreement schedule
  - FPA due June 1, 2011
- Budgetary concerns

Project Overview
Influent BOD_5 Loading



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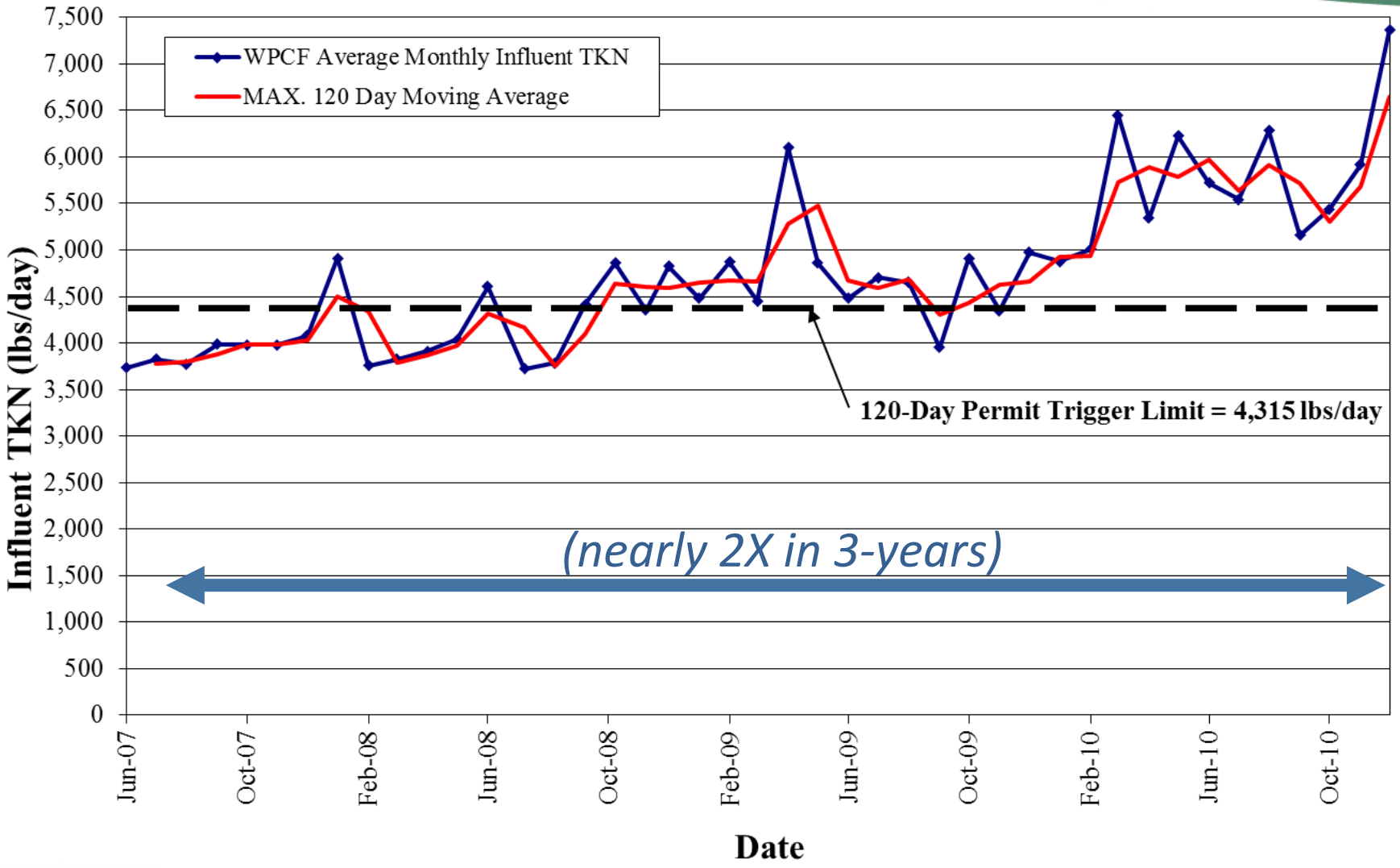
Project Overview
Influent TKN Loading



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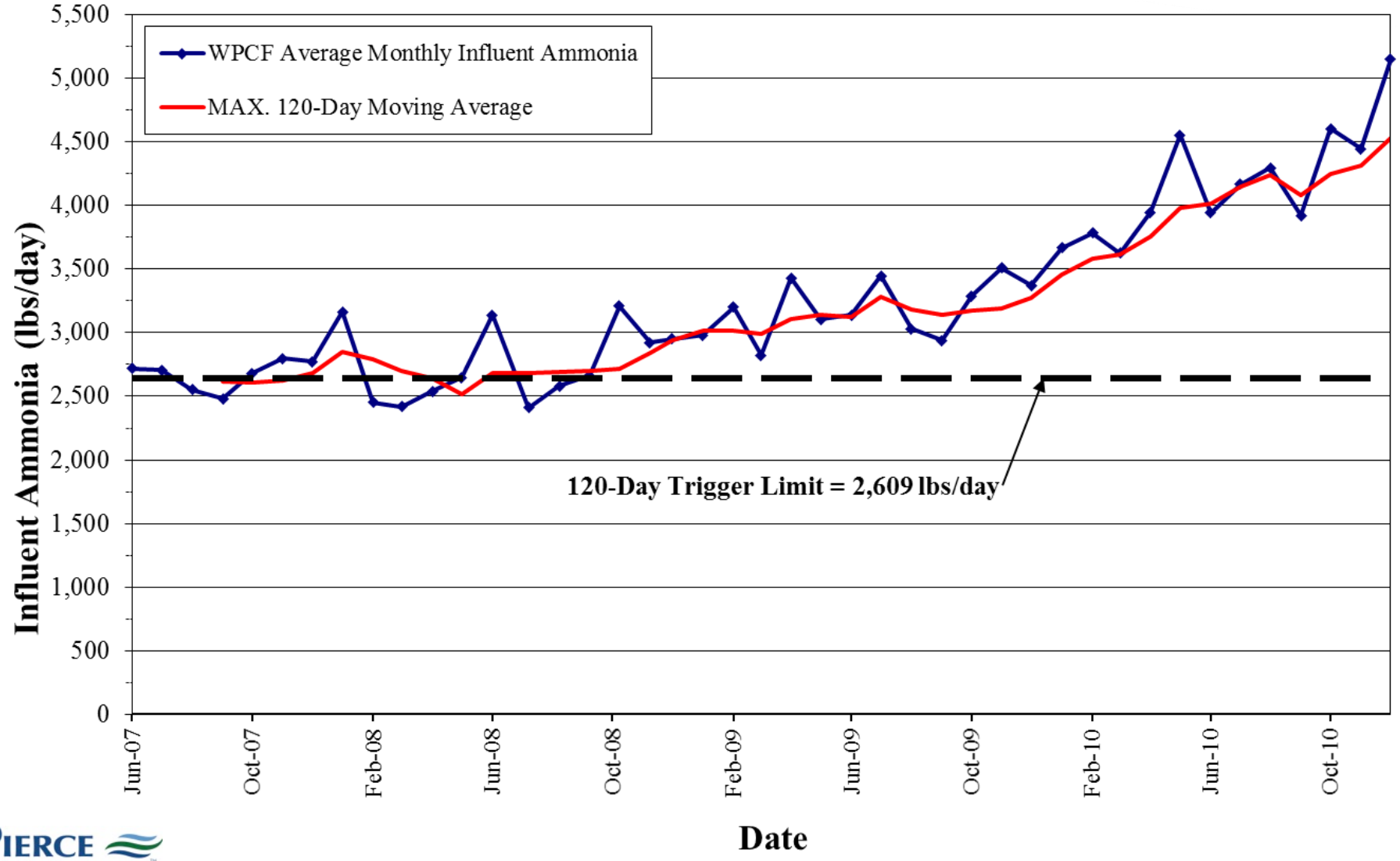
Project Overview
Influent NH_3 Loading



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Influent Loading Change

- RIRRC landfill leachate "OUT"
  - December 2010
  - Most significant influent pollutant loading to plant
    - BOD_5 (~ 15 - 25%)
    - Nitrogen (~ 30 - 50%)
    - Arsenic (~ >50%)

✓**Notable Cost Savings to the City $$**

Project Overview
Goals and Objectives?

- Identify solutions to meet new permit limits:
  - Total Nitrogen
  - Total Phosphorus
  - Total Arsenic
- *"Our objective was to select the lowest cost technical solutions which satisfy the City's current wastewater needs and can be expandable to address possible future needs"*
- Obtain Regulatory Compliance

Facility Planning
Alternatives Evaluation

SECONDARY TREATMENT – NITROGEN REMOVAL

Multiple technologies evaluated

- MLE Process– reuse existing – "No Build"
  - Insufficient capacity

✓ Bardenpho (4-Stage) – flexibility for future limits!
  ✓ Add IFAS Plastic Media (future) – $

- Existing MLE combined with Tertiary Denitrification
  - MLE with Moving Bed Bioreactor – $$
  - MLE with Biological Aerated Filter – $$$

- Membranes – $$$$

Nitrogen Removal
"Phased Approach"

- ✓ Considered projected loads
- ✓ Uncertainty: when will landfill leachate be out?
- ✓ Regulatory coordination/ approvals (RIDEM)
- ✓ Reduces capital costs

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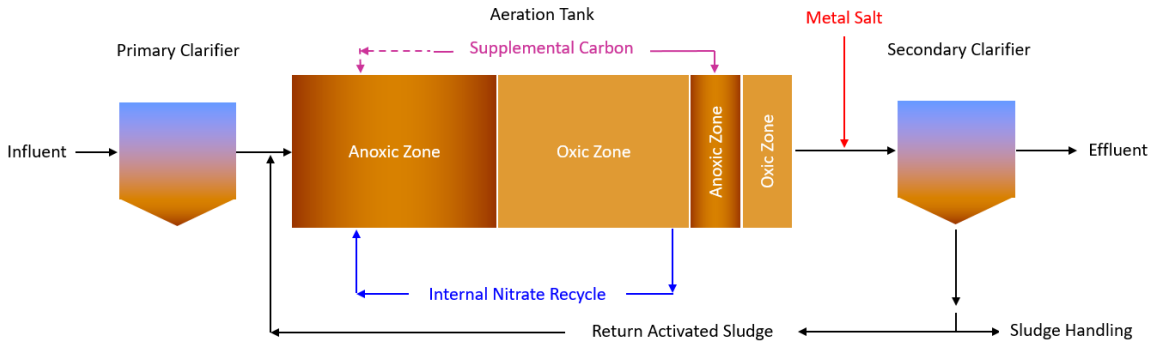
Nitrogen Removal
"Phased Approach"

PHASE 1 IMPROVEMENTS

Bardenpho (4-Stage Process)

- ✓ Allows for "Phased Approach"
- ✓ Lowest cost (reuse existing tanks)
- ✓ Proven track-record
- ✓ Similar to current MLE process operation
- ✓ Flexibility for future loads/limits (add plastic media)



PHASE 2 IMPROVEMENTS

- ✓ WPCF influent loads exceed 90% Phase 1 capacity
- ✓ "Trigger Limits"
  - cBOD5 load of 32,300 lbs/day 120-day moving average
  - TKN load of 5,900 lbs/day120-day moving average

Enhanced 4-Stage Bardenpho

- IFAS media
- Fine Screen (.6 mm band screening system – Headworks)
- Media Retention Screens (in aeration tanks)
- Medium bubble diffusers
- Additional 525 HP Blower

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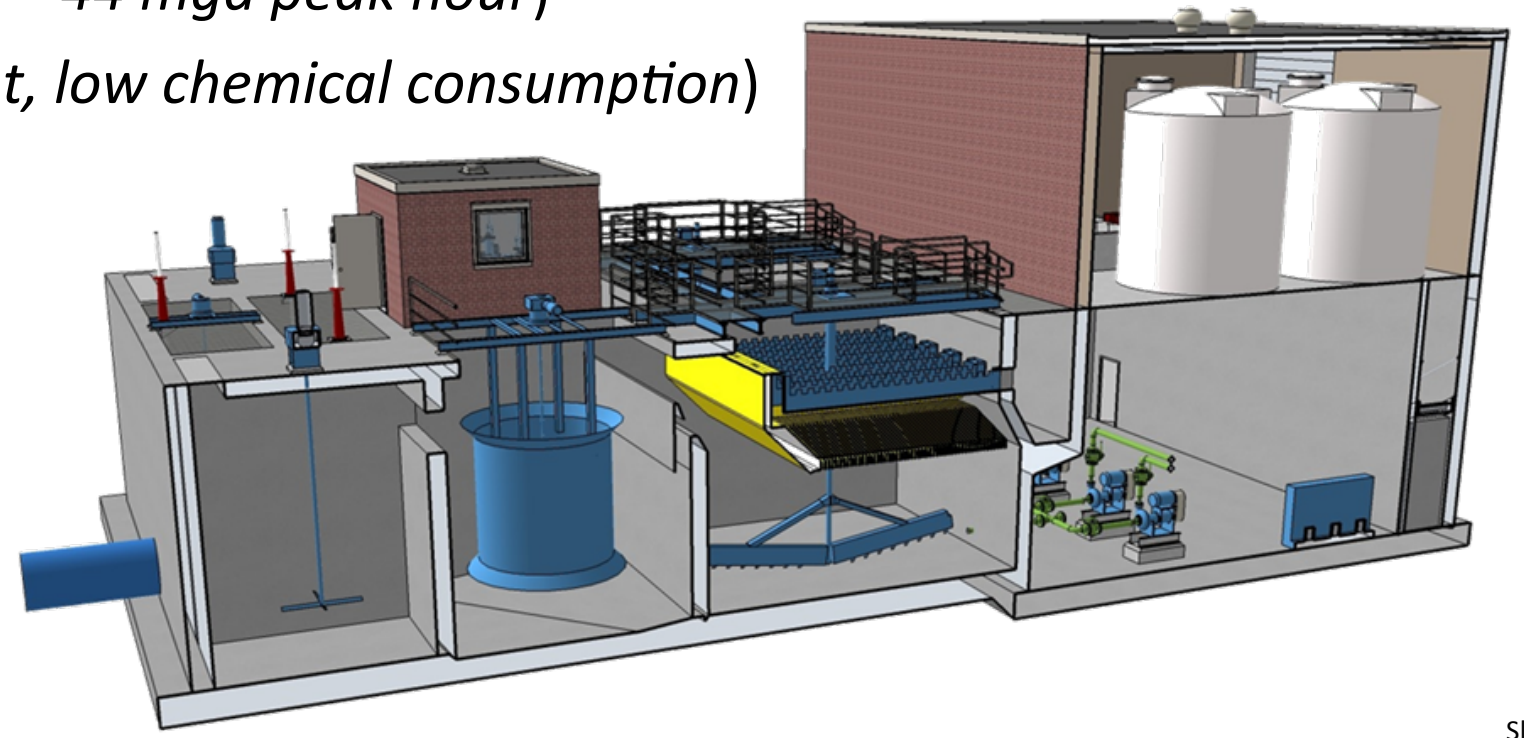
TERTIARY TREATMENT – PHOSPHORUS & ARSENIC REMOVAL

Ballasted Flocculation Process

- ✓ Proven track-record
- ✓ Low Headloss (*no pumping – 44 mgd peak hour*)
- ✓ Lowest cost (*small footprint, low chemical consumption*)
- ✓ Flexibility



Design Challenges

General

- Maintain plant operations (chemical deliveries, sludge, septage)
- Construction Sequencing (Landfill still “IN” – access to Aeration Tanks)

Aeration Tanks

- Deep aeration tanks (25-feet)
- Mixing – *reuse existing mixers (2006)*
- Floatables Control (FOG)
- Medium Voltage Standby Power (existing 480V Standby Power System)

Tertiary Treatment Facility

- Abandoned WPCF - *unknowns*
- Deep excavation
- Groundwater level

Technology Selection
Summary

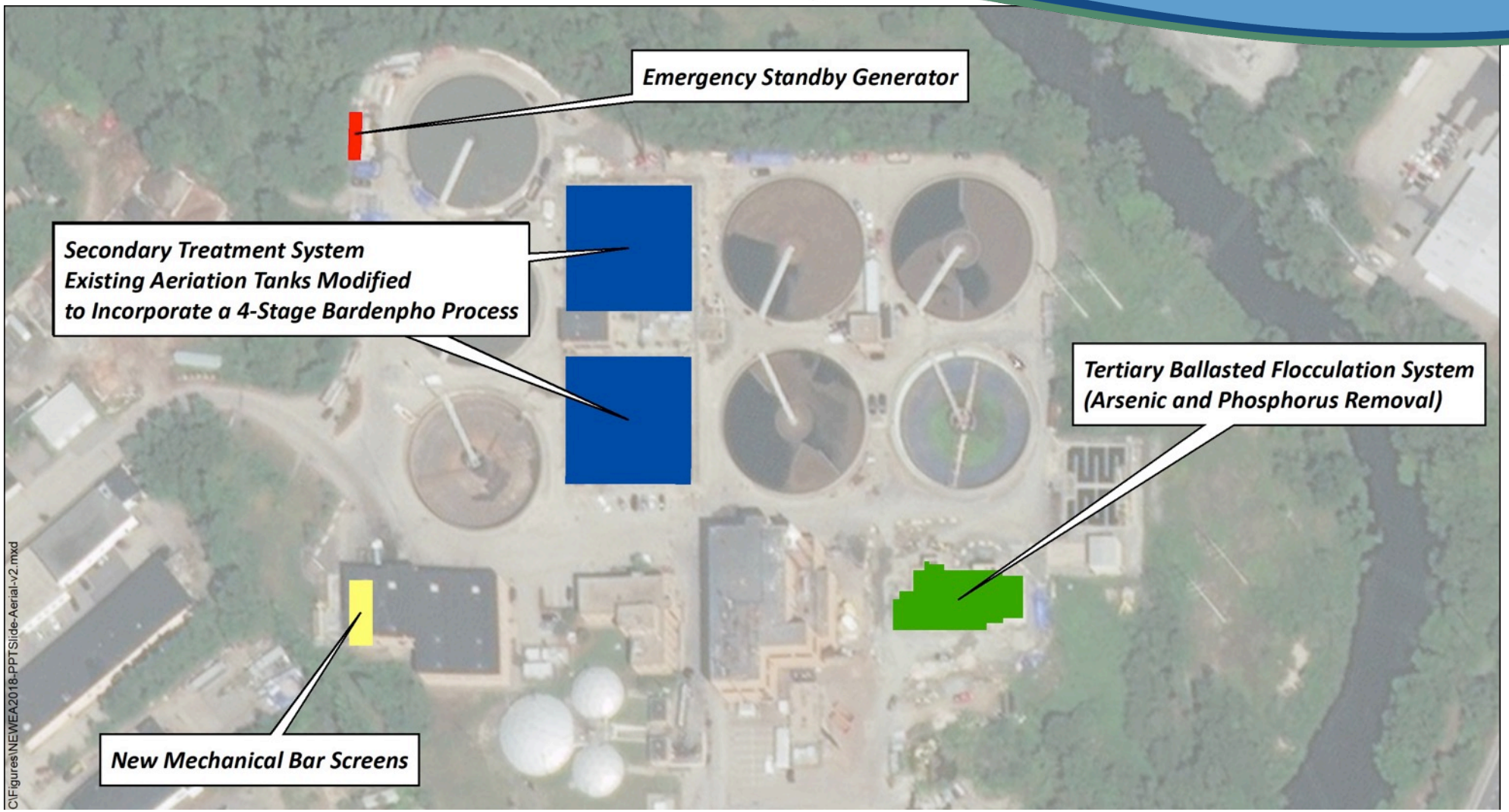
- Nitrogen Removal
  - ✓ Bardenpho (4-Stage)
    - *Most flexible cost-effective solution!*
    - *Pre-anoxic Zones 1 &2 (existing) retained – ability for 5-Stage Bardenpho if lower TN loading*
      - ➢ *Bio-P removal, 30% Ferric reduction – save $*
- Phosphorus and Arsenic Removal
  - ✓ Ballasted Flocculation – *Robust Technology!*
- Influent Screening System ($^{3}/_{8}$-inch screens)
- Medium Voltage Standby Power Generator (Aeration Tank Blowers)
  - ✓ *Consent Agreement*

Capital Costs

Project	Cost
Original Project Estimate	$50 million
Phase 1 Upgrades – as Constructed	$16.8 million
Phase 2 Upgrades (future??)	$13.4 million

- ✓ "Phased Approach" **Reduced Capital Costs by $33.2 Million**
- ✓ City qualified for principal forgiveness reduction (additional savings)

Construction Overview



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Headworks Building Improvements

- Demo'd existing mechanical bar screen racks and belt conveyor system
- Installed 2 mechanical climber screens and 2 washer compactors

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Standby Generator Facility

New Medium Voltage Standby Power System

- 1,500 kW diesel generator
- Med. Voltage (4160V) ATS
- Outdoor Walk-In Enclosure

Aeration Tank Improvements

Phase 1 Improvements

- 4-Stage Bardenpho (4 Aeration Tanks)
- Supplemental Carbon System
- New selector walls
- Relocation of internal recycle pumps and mixers

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Aeration Tank Improvements
Supplemental Carbon Facility

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Aeration Tank Improvements Construction

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Aeration Tank Improvements
Pre-Construction Hydraulics

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Aeration Tank Improvements
Post-Construction Hydraulics

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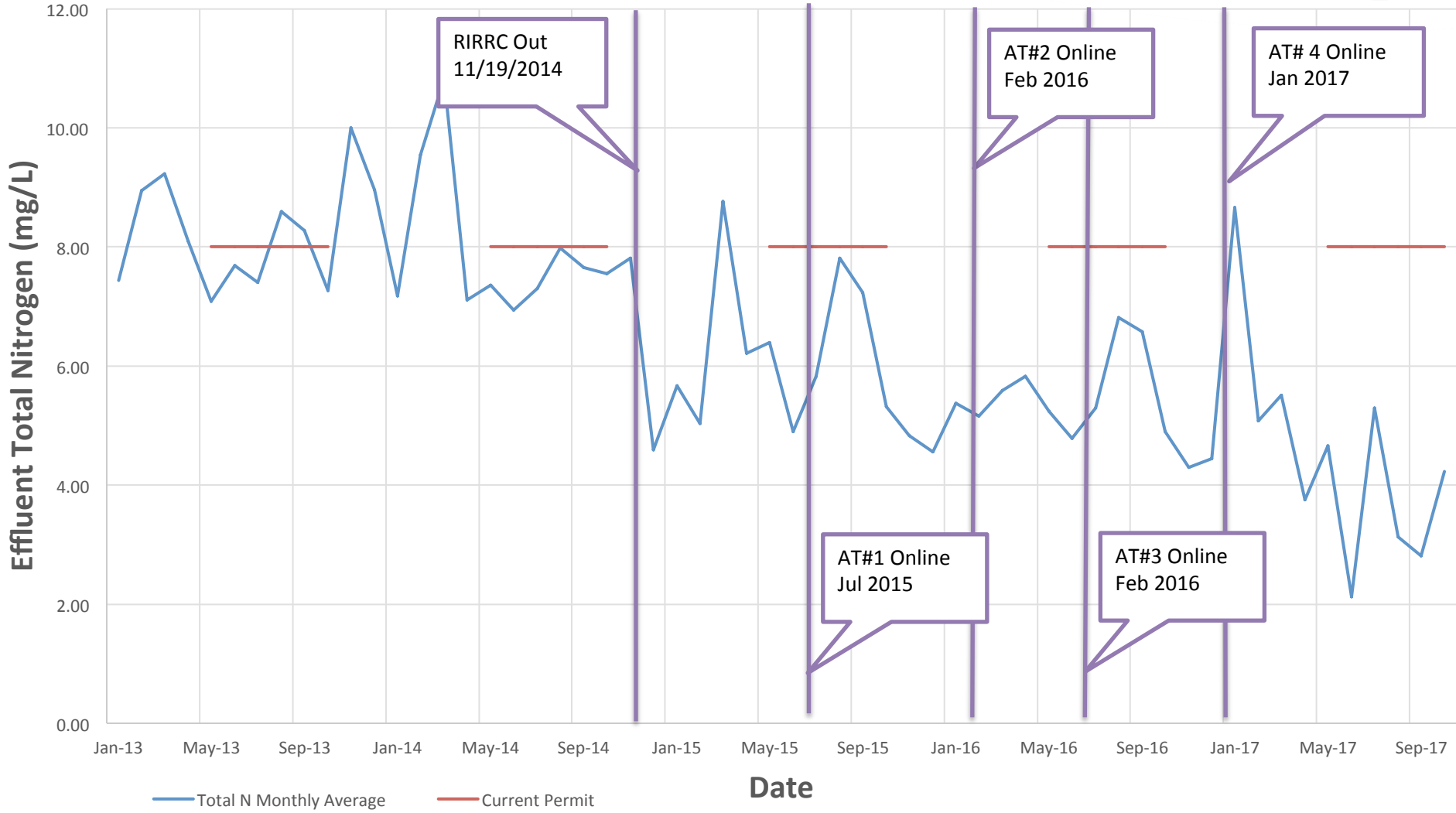
Aeration Tank Improvements
Effluent Total Nitrogen



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Tertiary Treatment Facility

- Ballasted Flocculation System - redundant treatment trains
- Chemical Feed Systems - TP and TA removal
  - Ferric Chloride (coagulation)
  - Lime (pH adjustment)
  - Polymer (flocculation)
- Kruger ACTIFLO Turbo® system
  - compact footprint
  - reduced energy and operational costs

Tertiary Treatment Facility
Construction

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Tertiary Treatment Facility
Building Construction

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Tertiary Treatment Facility
"Finished Product"

Project Highlights

- ✓ “Phased Approach” to Nitrogen Control saved city money
- ✓ Achieved water quality objectives
- ✓ Largest ballasted flocculation system in RI
- ✓ No net increase in construction cost
- ✓ City qualified for principal forgiveness

Project Team

OWNER

Kenneth Mason, PE
Director of Public Works

Edward Tally
Environmental Program Manager

OPERATOR

Earl Salisbury
Superintendent, Project Manager

GENERAL CONTRACTOR

David Jacques
Senior Project Manager

Erik Costello
Superintendent

ENGINEER

David Bowen, PE
Associate, Senior Project Manager

Andrew Grota, PE
Project Engineer

Thank You

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Bullpen Slides

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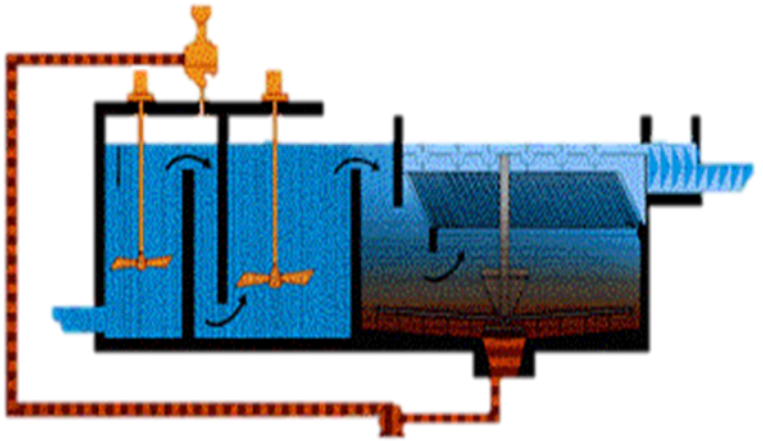
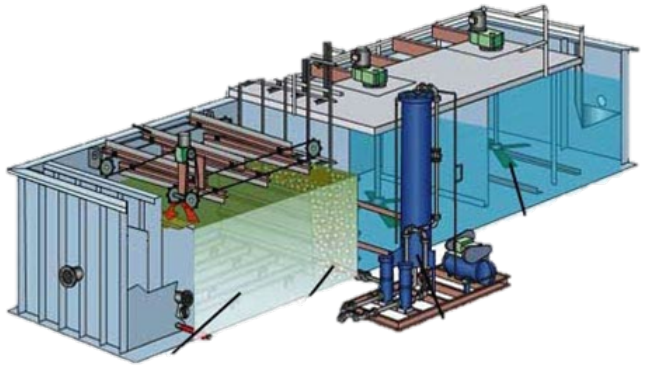
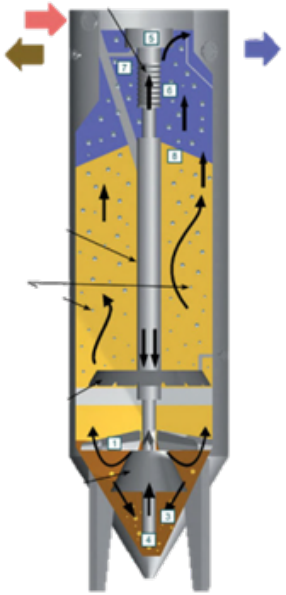
TERTIARY TREATMENT – PHOSPHORUS & ARSENIC REMOVAL

Technologies evaluated

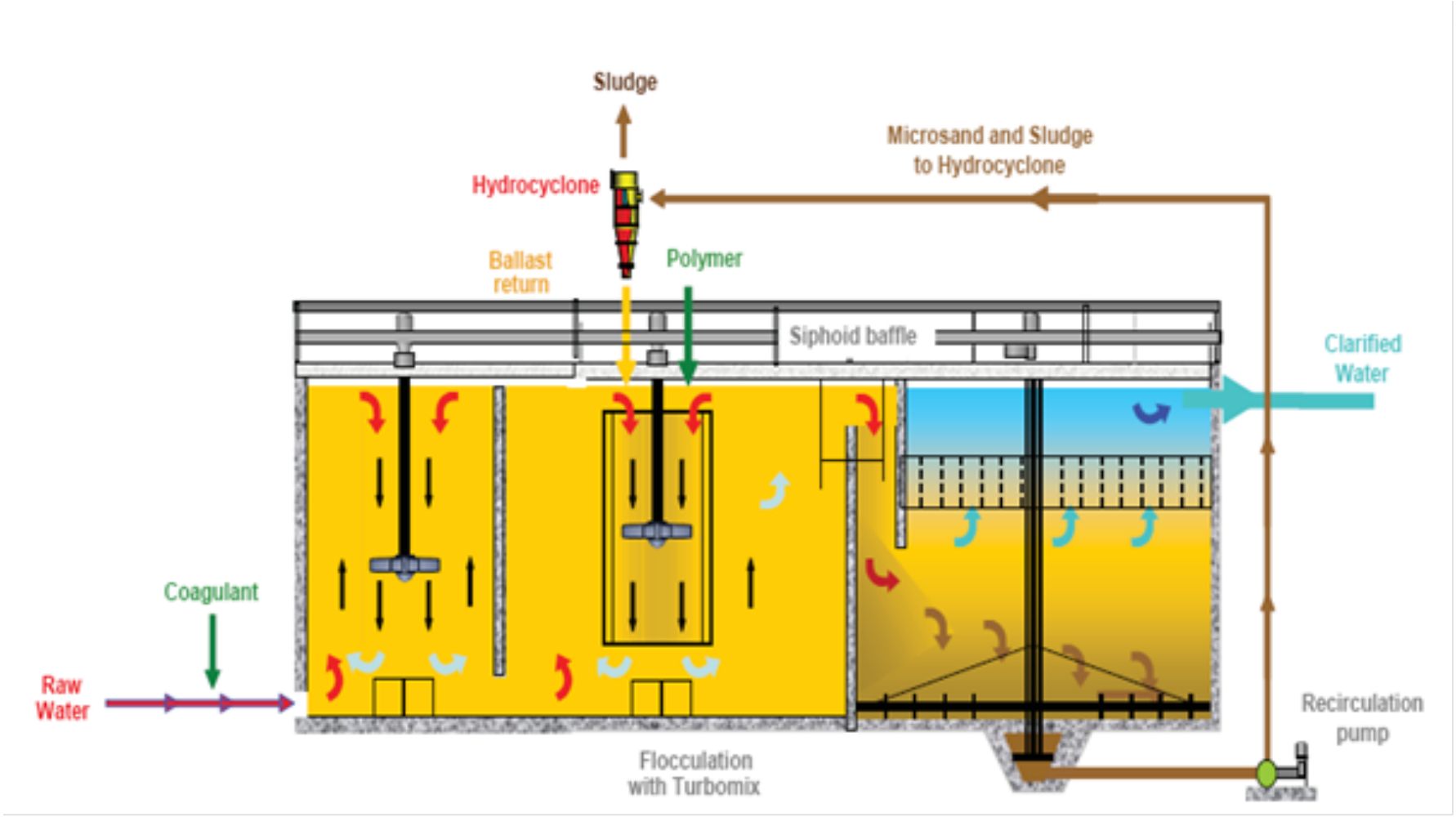
- ✓ Ballasted Flocculation
- Activated Filtration - $
- Dissolved Air Floatation - $







Ballasted Flocculation System



Effluent Flow Meter

- Magnetic flow meter
- Improved hydraulics
- Eliminated downstream pumping

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Tertiary Treatment Facility
Process Tanks

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Tertiary Treatment Facility
Chemical Feed Systems

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Tertiary Treatment Facility
Pumping Equipment

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Unique Features

Privatized Operations

- 1997: 25-year lease Agreement - Triton Ocean State, LLC (operated by Veolia)

- Merchant Sludge - *$ Revenue*
- Septage - ~40,000 gpd (average)
- Effluent reuse – FPL cooling tower (2 - 5 mgd)