“PUTTING THE EXTRA IN THE ORDINARY”
OWASA Mason Farm WWTP Optimization Program
A public, non-profit agency providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill Community.
Orange Water and Sewer Authority
Community owned utility providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill community in North Carolina.
OWASA manages wastewater

THE WASTEWATER MANAGEMENT SYSTEM

Customer → Manhole → Pumping → Headworks → Primary Clarification → Aeration Basins → Secondary Clarification → Filtration → Disinfection → Morgan Creek

- Anaerobic Digesters
- Biosolids to Land Application
- Reclaimed Water to UNC

Mason Farm Wastewater Treatment Plant
Mason Farm Wastewater Treatment Plant
Implementing Organizational Change Can Be Challenging...
Implementing Organizational Change Can Be Challenging. . .

Yes, Sometimes Very Challenging. . .
OWASA – Culture of Continuous Improvement

- After Action Reviews (out of adversity comes opportunity)
- Comprehensive Emergency Management Planning
- Comprehensive Risk Assessment Planning
- Energy Management Planning
- Asset Management / CMMS / GIS Mapping
- CIP Prioritization / Replacement & Renewal Programs
OWASA – Mason Farm WWTP

- NACWQ Peak Performance Award – Platinum-7
- NC-DEQ Exceptionally Performing WWTP
- Energy Management Plan – Energy Management Team
- DOE – Energy Optimization On-Site Training
- High Performance SCADA (transitioning currently)
- On-Line Instrumentation (nutrients, MLSS, pH, ORP, DO)
- Real Time DO Control Strategy (nitrogen loading)
AWWA – PARTNERSHIP FOR CLEAN WATER

• Global optimization and recognition program for wastewater utilities
  – *Wastewater treatment plants*
  – Reuse facilities
  – Collection systems
  – Stormwater
Supporting All Optimization Efforts

1. Product Quality
2. Customer Satisfaction
3. Employee and Leadership Development
4. Operational Optimization
5. Financial Viability
6. Infrastructure Strategy & Performance Stability
7. Enterprise Resiliency Operational
8. Community Sustainability
10. Stakeholder Understanding and Support
Wastewater Optimization

Multiple-Barrier Approach
Program Phases

• Phase I – Commit and Subscribe
• Phase II – Baseline Data Submission
• Phase III – Self-Assessment
• Phase IV (future) - Demonstrated optimization
PHASE I – COMMITMENT

Partnership for Clean Water
Charter Subscriber

Orange Water & Sewer Authority
Recognizing utility commitment to wastewater treatment plant optimization through participation as a Partnership for Clean Water Charter Subscriber

May 25, 2016

Barbara Martin
Sr. Manager – Partnership Programs

David LaFrance
CEO, AWWA
PARNTERSHIP FOR CLEAN WATER

PHASE II- Baseline Data Collection

Key Optimization Data Points For Quantifying Treatment Plant Performance and Program Performance Including Effluent Quality

BOD5/CBOD5, Total Suspended Solids, Ammonia Nitrogen and Total Phosphorus

Plant Flow and Energy Consumption
PHASE II- Baseline Data Collection (continued)

Total Sludge Mass Control – provides comprehensive data tracking/trending for biological process control

Partnership Optimization Performance Goals

BOD/CBOD5, TSS, NH3, TP < 95% permit limits

Sludge Mass Control  +/- 15% theoretical vs. actual
<table>
<thead>
<tr>
<th>CY 2016 Month</th>
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<th><strong>Removal Efficiencies</strong></th>
<th><strong>TN</strong></th>
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<tr>
<td></td>
<td></td>
<td><strong>123,058</strong></td>
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<tr>
<td></td>
<td><strong>&gt; 99%</strong></td>
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<th><strong>NPDES Permit Limits</strong></th>
<th><strong>Monthly Average</strong></th>
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<tr>
<td>Flow</td>
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**Optimization Performance Goals**

CBOD\textsubscript{5} < 3.8 mg/l
TSS < 28.5 mg/l
NH\textsubscript{3}-N < 0.95 mg/l
TP < 9,679 lbs.
PHASE III-Self Assessment

Treatment Plant Staff Will Perform Comprehensive Self-Assessments of Wastewater Treatment Plant Performance, Operations and Energy Consumption (use EPA Comprehensive Correction Program Framework)

Self Assessment Reports Will Be Peer Reviewed By Wastewater Utility Optimization Experts (Program Effectiveness Assessment Committee – PEAC)
Phase III - Self-Assessment

- In-House Initiative; Team Development
- Input valued from ALL level of the organization
PARNTERSHIP FOR CLEAN WATER

PHASE III – SELF ASSESSMENT PROCESS

STEP 1 – Complete Performance Assessment

STEP 2 – Complete Capacity Assessment (determine if sizes of major unit processes are limiting performance)

STEP 3 – Complete Unit Process Performance and Energy Assessment (identify other aspects of unit process design limiting performance)

STEP 4 – Complete Operations Assessment (identify operational practices limiting performance)
PHASE III – SELF ASSESSMENT PROCESS

STEP 5 – Complete Administration Assessment
(identify administration practices limiting performance)

STEP 6 – Assemble & Prioritize Comprehensive List of Factors Limiting Performance
(identify activities to address factors that will improve performance)

STEP 7 – Implement Performance Improvements

STEP 8 – Assess Performance Improvements
PHASE III – SELF ASSESSMENT

• Team-based self-assessment of:
  – Performance
  – Capacity
  – Unit Processes – including process energy efficiency
  – Facility energy efficiency
  – Operations
  – Administration

EPA’s CCP structure continues to guide self-assessment procedures.
PHASE III – SELF ASSESSMENT

- Unit processes:
  - Influent water
  - Preliminary/Primary treatment
  - Suspended growth
  - Attached growth
  - Secondary clarification
  - Nitrification/denitrification
  - Biological/chemical phosphorus removal
  - Chlorine/UV disinfection
  - Tertiary treatment

EPA’s CCP structure continues to guide self-assessment procedures.
PHASE III – SELF ASSESSMENT

• Successful completion of the self-assessment process results in receipt of the program’s Directors Award
  – Positive messaging and utility outreach

• Annual data submission process maintains performance accountability
FOSTERING A CULTURE OF CONTINUOUS IMPROVEMENT

• Setting goals
  – Initial effluent performance goals set at 95% of permit requirements – OR
  – Utility determined performance goals for effluent quality and additional desired parameters
  – Annual reduction in energy use

• Assessment questions are a starting point
CY18 Partnership for Clean Water Focus Areas

- Optimize Digester Gas Utilization in Boiler System for Digester Heating
- Optimize Bio-P process (reduce effluent TP to $\leq 0.25\text{ mg/l}$)
- Optimize acetic acid & alum utilization for chemical effluent TP trim
- Optimize GBT thickener operations; optimize polymer utilization
- Optimize High Performance SCADA (including mobile applications)
- Continued focus efforts toward established biosolids recycling goals
- Update/Merge Standard Operating Procedures and Process Control Protocols
- In-house maintenance & calibration of on-line process control instrumentation
## OWASA MASON FARM WWTP - PLANT PERFORMANCE

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**AVERAGE**

<table>
<thead>
<tr>
<th>CBOD₅</th>
<th>TSS</th>
<th>NH₃-N</th>
<th>TP</th>
<th>ADF</th>
<th>CBOD₅</th>
<th>TSS</th>
<th>NH₃-N</th>
<th>TP</th>
<th>TN</th>
<th>TP</th>
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<tbody>
<tr>
<td>245</td>
<td>289</td>
<td>28.1</td>
<td>6.26</td>
<td>6.411</td>
<td>&lt;2.0</td>
<td>&lt;2.5</td>
<td>0.03</td>
<td>0.39</td>
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<td>596</td>
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### Optimization Performance Goals

- **CBOD5** < 3.8 mg/l
- **TSS** < 28.5 mg/l
- **NH₃-N** < 0.95 mg/l
- **TP** < 9,679 lbs.

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6-Year WWTP Flow Summary

- **FY12**: 7.6 MGD
- **FY13**: 8.1 MGD
- **FY14**: 8.3 MGD
- **FY15**: 8.1 MGD
- **FY16**: 8.6 MGD
- **FY17**: 8.5 MGD
6-Year WWTP Max Day Flow Summary

<table>
<thead>
<tr>
<th>Year</th>
<th>Max Day</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY12</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td>FY13</td>
<td>22.3</td>
<td></td>
</tr>
<tr>
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<td>FY17</td>
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Legend:
- Blue: Max Day
- Red: Average
WWTP Electricity Usage - Post Aeration Project

FY15: 8,350,000 KWH
FY16: 8,250,000 KWH
FY17: 8,200,000 KWH

126,000 KWH reduction in FY17
WWTP - Caustic Use & Cost Summary

- **Caustic Cost**
- **Caustic Use**
- **Linear (Caustic Use)**

**Bar Chart**

- FY11: $180,000.00
- FY12: $180,000.00
- FY13: $160,000.00
- FY14: $140,000.00
- FY15: $120,000.00
- FY16: $100,000.00
- FY17: $350,000.00

**Line Chart**

- Use (Tons)
- Total Cost

- **FY11**
- **FY12**
- **FY13**
- **FY14**
- **FY15**
- **FY16**
- **FY17**
WWTP - Acetic Acid Use & Cost Summary

- **Total Cost**
  - FY11: $120,000
  - FY12: $130,000
  - FY13: $140,000
  - FY14: $150,000
  - FY15: $200,000
  - FY16: $180,000
  - FY17: $160,000

- **Use (Pounds)**
  - FY11: 800,000
  - FY12: 900,000
  - FY13: 1,000,000
  - FY14: 1,100,000
  - FY15: 1,200,000
  - FY16: 1,300,000
  - FY17: 1,400,000

Legend:
- **Acetic Acid Cost**
- **Acetic Acid Use**
- **Linear (Acetic Acid Use)**
HIGH PERFORMANCE SCADA
Situational awareness – Blood test example

<table>
<thead>
<tr>
<th>Blood Tests for Fluffy -1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
</tr>
<tr>
<td>HCT</td>
</tr>
<tr>
<td>HGB</td>
</tr>
<tr>
<td>MCHC</td>
</tr>
<tr>
<td>WBC</td>
</tr>
<tr>
<td>GRANS</td>
</tr>
<tr>
<td>L/M</td>
</tr>
<tr>
<td>PLT</td>
</tr>
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Source: High-Performance HMI Handbook
### Blood Tests for Fluffy - 3

<table>
<thead>
<tr>
<th>Test</th>
<th>Results</th>
<th>Range</th>
<th>Indicator</th>
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</thead>
<tbody>
<tr>
<td>HCT</td>
<td>31.7%</td>
<td>24.0 – 45.0</td>
<td>![Indicator](Low - Normal - High)</td>
</tr>
<tr>
<td>HGB</td>
<td>10.2 g/dl</td>
<td>8.0 – 15.0</td>
<td>![Indicator](Low - Normal - High)</td>
</tr>
<tr>
<td>MCHC</td>
<td>32.2 6/dl</td>
<td>30.0 – 36.9</td>
<td>![Indicator](Low - Normal - High)</td>
</tr>
<tr>
<td>WBC</td>
<td>9.2 x10⁹ /L</td>
<td>5.0 – 18.9</td>
<td>![Indicator](Low - Normal - High)</td>
</tr>
<tr>
<td>GRANS</td>
<td>6.5 x10⁹ /L</td>
<td>2.5 – 12.5</td>
<td>![Indicator](Low - Normal - High)</td>
</tr>
<tr>
<td>L/M</td>
<td>2.7 x10⁹ /L</td>
<td>1.5 – 7.8</td>
<td>![Indicator](Low - Normal - High)</td>
</tr>
<tr>
<td>PLT</td>
<td>310 x10⁹ /L</td>
<td>175 – 500</td>
<td>![Indicator](Low - Normal - High)</td>
</tr>
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</table>

Source: High-Performance HMI Handbook
Color and Attention

Color is a powerful way to guide attention
- Your eye is automatically drawn to colored objects - “pop out” effect

How many “L”s and “I”s are in this picture?

- The Effectiveness of the Pop Out Effect drops dramatically as additional colors are added.

How many “L”s and “I”s are in this picture now?

Source: NASA Ames Research Center Color Usage Lab
http://colorusage.arc.nasa.gov/puzzles.php
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“PUTTING THE EXTRA IN THE ORDINARY”
OWASA Mason Farm WWTP Optimization Program

QUESTIONS - ?
Opportunities to Optimize Performance – Headworks

- Headworks (influent pumping, bar screening and grit removal unit processes provide adequate capacity to manage design annual average and peak hourly flows

- Influent pump VFD obsolete, planned replacements needed

- Back-up level monitoring is needed; locate remotely in VFD control room

- Influent flow metering parshall flume area showing signs of significant corrosion due to covers

- Influent flow metering includes recycle streams; account for those flow accordingly to provide true raw influent flow metering

- Evidence of corrosion in Morgan Creek PS; include in comprehensive coatings program

- Re-balance odor control airflow from headworks area; verify design airflow and exchanges are provided to affected areas

- Create valve exercising program; provide for routine exercising

- Install power monitors on influent pumps; leverage data to also assist maintenance in providing key diagnostics to assess pump performance

- Provide proper vac truck off-loading station to capture debris prior to discharge into Morgan Creek PS
Opportunities to Optimize Performance – Headworks

- Enhanced public education and outreach regarding not using the toilet as a trash can; specifically proper disposal of grease & disposable wipes

- Evaluate whether accumulated grease in Morgan Creek PS can be captured, screened, liquefied and pumped to digesters

- Rehab bar screen #1 and #4 similar to recent rehab of bar screen #2

- Evaluate adjusting conveyor belt run time; avoid running when no screening debris is on belt

- Investigate whether consolidated screenings press can be designed; or even compacting dumpster – addresses on-going challenges with existing screening compactors (especially in winter months)

- Evaluate other dumpster options (screenings & grit) and log tonnage of each to landfill monthly

- Evaluate merits of installing baffle in vortex grit chamber to enhance performance; especially for smaller micron grit (Smith & Loveless)

- Evaluate how to effectively bypass primary clarifiers; requires getting flow to alternate weir height – this will be necessary to address corrosion/coatings repairs to primary splitter box #1
Opportunities to Optimize Performance – Primary Clarifiers

- Primary clarifiers provide adequate capacity to manage design annual average and peak hourly flows
- Hydraulic bottleneck exists in splitter box #2 during extreme wet weather flows
- Evaluate/repair north slide gate in splitter box #2 – needed for wet weather flow management
- Evaluate how to effectively bypass primary clarifiers; this will be necessary to address needed corrosion/coatings repairs to primary splitter box #1 and #2
- Address primary sludge pumping limitations to provide ability to pump thicker solids; impact fermenter operations (mixing and detention time)
- Primary clarifier scum pump stations needed rehab
- Primary clarifier #3 significantly impacted with grit accumulation after extreme wet weather events
- Rebalance odor control airflow; insure adequate airflow and exchanges are provided for clarifiers and splitter boxes
- Evaluate primary clarifier performance relative to influent CBOD value to biological process to insure for target F/M and also evaluate COD value relative to whether primary effluent/sludge could be viable food source to Bio-P process