Nutrient Removal

History, Long-Term Planning, Operational Lessons Learned

Nutrient Forum
June 4, 2019
What is LOTT?

• Regional wastewater utility
  • Lacey
  • Olympia
  • Tumwater
  • Thurston County

• Governmental, non-profit corporation

• Population served = 118,000
Original Plant: Primary Treatment

1951
Secondary Upgrades

1983
Nutrient Removal and Ultraviolet Disinfection

Capital cost =
$47.7 million

$3.2 million in grants

$35.5 million low interest loans
Wastewater Resource Management Plan

Public values:
- Meet future wastewater needs
- Treat wastewater as a valuable resource
- Maximize benefits to the environment
- Provide multiple community benefits

Long-term strategy:
- Continue discharge of treated effluent to Budd Inlet
- Expand production and use of reclaimed water
  - Multiple satellite plants in service area
  - Build capacity in increments, “just in time”
- Use reclaimed water to replenish groundwater
Beneath this field is a state-of-the-art groundwater recharge facility that is using locally-produced Class A Reclaimed Water to replenish groundwater and streamflows in nearby Woodland Creek.

A Unique Facility
This recharge facility is the result of a joint effort by the Cities of Lacey and Olympia to ensure that stream flows in Woodland Creek are not diminished because of pumping drinking water from new wells constructed by the cities. This recharge facility consists of 4.7 miles of underground infiltration chambers underneath a four-acre field. The chambers are located about three feet below ground and slowly discharge reclaimed water into the soil. Groundwater in and around the recharge facility is monitored remotely from a control center. The data collected is used to determine how much reclaimed water to release through the infiltration chambers. More water can be discharged during dry summer months, while less water is released during the wet months when groundwater levels are typically high. Depending on the month, 0.3 - 0.9 million gallons of reclaimed water are infiltrated per day.

For more information, please visit www.ci.lacey.wa.us/reclaimed-water.
Planning Considerations

• Centralized facilities are more cost effective than multiple satellites
  • Can we expand production at existing facilities?

• Growth is slower than anticipated
  • Do not have adequate flow to expand reclaimed water production
  • Can we add equalization to capture diurnal peaks?

• Partners’ demands are increasing – may become driver
  • Does the funding formula change?

• Sites purchased for future infiltration have limited capacity
  • Are other sites more viable?
  • Do other sites provide opportunity for multiple benefits?

• Residual chemical study underway – local regulatory decisions pending

• How will the local TMDL and PSNR process affect capacity?
Budd Inlet and Capitol Lake TMDL

• Four main sources of nutrients
  • Local nonpoint: stormwater, septic systems, etc.
  • Local WWTPs: LOTT and other plants on Budd Inlet
  • External: WWTPs and nonpoint north of Budd Inlet
  • Capitol Lake

• Reductions are needed in all sources to meet the allowable depletion

Sources of Oxygen Depletion

- Capitol Lake: 62%
- Local Nonpoint: 15%
- Local WWTPs: 3%
- External Sources: 20%
Existing Permit

Permit Limit TIN: 288 lbs/day

Performance Limit TIN: 3.0 mg/L

Discharge Capacity of Martin Way/Hawks Prairie Reclaimed Water System = 2 MGD

Discharge Capacity of Budd Inlet Treatment Plant = 11.5 MGD
Current Performance

Permit Limit TIN: 288 lbs/day
Current Performance: 216 lbs/day

Performance Limit TIN: 3.0 mg/L
Current Performance: 2.25 mg/L

Discharge Capacity of Martin Way/Hawks Prairie Reclaimed Water System = 2 MGD
Discharge Capacity of Budd Inlet Treatment Plant = 15.3 MGD
Reduced Discharge due to pending TMDL

Permit Limit TIN: ~250 lbs/day

Discharge Capacity of Martin Way/Hawks Prairie Reclaimed Water System = 2 MGD

Discharge Capacity of Budd Inlet Treatment Plant = 12.5 MGD

Lost Discharge Capacity = 3.2 MGD
## Permit Limits: Budd Inlet Treatment Plant

<table>
<thead>
<tr>
<th></th>
<th>1987</th>
<th>1996</th>
<th>2005</th>
<th>2011</th>
<th>2018</th>
<th>changes to come with TMDL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BOD</strong>&lt;br&gt;average monthly mg/L</td>
<td>30</td>
<td>20</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>BOD</strong>&lt;br&gt;average monthly lbs/day</td>
<td>4,000</td>
<td>3,670</td>
<td>1,050</td>
<td>671</td>
<td>671</td>
<td></td>
</tr>
<tr>
<td><strong>TIN</strong>&lt;br&gt;average monthly mg/L</td>
<td>no limit</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>TIN</strong>&lt;br&gt;average monthly lbs/day</td>
<td>no limit</td>
<td>no limit</td>
<td>350</td>
<td>288</td>
<td>288</td>
<td></td>
</tr>
</tbody>
</table>
Phase 1 Master Planning

Budd Inlet Treatment Plant

- Determine process/facility needs
- Locate facilities within footprint
- Consider need for additional property
- Update site plan
Phase 2 Master Planning

Overall System Capacity

• Reclaimed water treatment, conveyance, disposition
  • When?
  • Where?
  • Quantity?
  • Quality?
  • Cost?
  • Mutual benefits?
• Initial update to strategy in 2020
Planning Lessons Learned

- Things change
  - Permit limits
  - Operational conditions
  - Community needs

- Need to stay nimble

- Have to be willing to revisit overarching strategy

- Centralize as much as practicable

- Look for opportunities for multiple community benefits
Nitrogen Removal: Modified 4-Stage Bardenpho
Current Biological Process

1st Anoxic (no air)

1st Aerobic (air)

Flow

Pumps

Blowers

3 x Flow

3 x Flow

3 x Flow
## Permit Limits: Budd Inlet Treatment Plant

<table>
<thead>
<tr>
<th></th>
<th>BOD average monthly mg/L</th>
<th>TIN average monthly mg/L</th>
<th>TIN average monthly lbs/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>June - Sep</td>
<td>7</td>
<td>3</td>
<td>288</td>
</tr>
<tr>
<td>Apr, May, Oct</td>
<td>8</td>
<td>3</td>
<td>338</td>
</tr>
<tr>
<td>Nov - Mar</td>
<td>30</td>
<td>NH$_3$ 26 mg/L</td>
<td>N &lt; 10 mg/L (CLA)</td>
</tr>
</tbody>
</table>
Lessons Learned: Carbon Source

- 1994 upgrades designed assuming carbon inputs from Olympia brewery
  - Brewery closed in 2003

- Need to supplement carbon sources
  - Pepsi & Fishtale Brewery discharges can provide additional carbon to benefit LOTT
    - High strength waste charges waived for these carbon sources
  - Methanol used as a supplemental carbon source to support denitrification in 2nd Anoxic
# Methanol Spending

<table>
<thead>
<tr>
<th>Year</th>
<th>$USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>95,927</td>
</tr>
<tr>
<td>2009</td>
<td>75,611</td>
</tr>
<tr>
<td>2010</td>
<td>78,866</td>
</tr>
<tr>
<td>2011</td>
<td>46,031</td>
</tr>
<tr>
<td>2012</td>
<td>66,392</td>
</tr>
<tr>
<td>2013</td>
<td>33,393</td>
</tr>
<tr>
<td>2014</td>
<td>45,155</td>
</tr>
<tr>
<td>2015</td>
<td>53,461</td>
</tr>
<tr>
<td>2016</td>
<td>42,783</td>
</tr>
<tr>
<td>2017</td>
<td>32,938</td>
</tr>
</tbody>
</table>
Lessons Learned: Oxygen Control

- Ecology Orange Book specifies 2.0 mg/L DO setpoint to treat ammonia
- Blowers
- Probes
- Ammonia Based Aeration Control (ABAC)
Simple DO Control

First Aeration Train 2 DO Trend

Airflow

Ammonia
Centrate Management + ABAC (3 mg/L SP in Cell 2)
Moving NH₃ Set-Point Based On NO₃ Probe
(NH₃ SP = NO₃/4 + 1)
BITP Loadings

HISTORICAL NH3 LOADINGS (APR - OCT)

AVE NH3

- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017

LB

2145

3299
Aeration Cost During BNR Season

HISTORICAL POWER CONSUMPTION kWh/LB NH₃-N (APR - OCT)

$64,520 annual savings from 2008 to 2017
Foam Control

- Remove Foam Trapping Structures
- Microbiology monitoring
- PAX – 14
- SRT
Lessons Learned: Improving Treatment Efficiency

- Probes are helpful – TSS/DO/AN-ISE/NH$_3$/NO$_x$/ORP/pH
  - Constant SRT
  - Ammonia based aeration control (ABAC)
  - Methanol control
- Computer simulation software – BIOWIN
- Training and teamwork
Simulation Software (BioWin)
Biological Process Improvements Project

- **Treatment Process**
  - Improves control
  - Upgrades instrumentation
  - Reduces permit risk

- **Plant Space**
  - Consolidates biological treatment components
  - Frees up premium plant space
  - Unused basins can be used for equalization

- **Energy**
  - Over 20% estimated total plant energy savings
  - Improves safety by eliminating medium voltage (4,160V)
Current Biological Process

1st Anoxic (no air)
1st Aerobic (air)
Flow
3 x Flow
Blowers
Pumps
3 x Flow
Flow
3 x Flow
Biological Process Improvements

Capital cost estimate = $22 million
Keys to Managing Nutrient Removal Process

- Process control team
  - Probes to monitor process
  - Microbes monitored daily
  - Constant adjustments to process

- Hauled waste moratorium

- Continual capital projects/upgrades
  - Improvements to address hydraulic choke points & process controls
    - Master planning
    - Biological Process Improvements project

- Centrate management as a separate process
  - Carefully metered to avoid overloading the process with nutrients
  - Future project anticipated to pre-treat centrate to reduce NH3 loadings – we’re working on it!
Questions?

Lisa Dennis-Perez:

LisaDennis-Perez@lottcleanwater.org