BACWA Annual Meeting

27 January 2017
Agenda

1. Watershed Permit Requirements

2. Project Status
   a) Optimization
   b) Upgrades
   c) Sidestream

3. Role of Averaging Periods

4. Nutrient Load Reduction by Other Means

5. Summary of 2016 Group Annual Report

6. Summary of Preliminary Findings
The following dischargers are subject to waste discharge requirements (WDRs) set forth in this Order, for the purpose of regulating nutrient discharges to San Francisco Bay and its contiguous bay segments:

### Table 1. Discharger Information

<table>
<thead>
<tr>
<th>Discharger</th>
<th>Facility Name</th>
<th>Facility Address</th>
<th>Minor/Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>151 Main St.</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Watershed Permit Requirements

- Issued April 9, 2014 – Regional Water Board Order No. R2-2014-0014

- Requirements:
  - Scoping and Evaluation Plan (Accepted first quarter of 2015)
  - July 2018: Task 1 - Conduct treatment plant optimization and sidestream treatment evaluation for nutrient load reductions (Submittal deadline is July 2018)
  - July 2018: Task 2 - Conduct treatment plant upgrades and analysis of removal by other means for nutrient load reductions (Submittal deadline is July 2018)
  - Annual Reporting (Annual submittal in October from 2015 through 2018)
37 Participating Agencies
Project Status
Overview / Status of Study

Scoping Plan
Evaluation Plan
Data Collection & Analysis

Plant Optimization
Sidestream Treatment
By Other Means
Facility Upgrades

Synthesis
Nutrient Reduction Plan

Completed
In progress
Upcoming
## Reports Status

<table>
<thead>
<tr>
<th>Number</th>
<th>Submitted Draft Reports (26 Plants)</th>
<th>Outstanding (11 Plants)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>American Canyon</td>
<td>FSSD</td>
</tr>
<tr>
<td>2</td>
<td>Benicia</td>
<td>Hayward</td>
</tr>
<tr>
<td>3</td>
<td>Burlingame</td>
<td>Livermore</td>
</tr>
<tr>
<td>4</td>
<td>CCCSD</td>
<td>Mt. View</td>
</tr>
<tr>
<td>5</td>
<td>City of San Leandro</td>
<td>Napa San</td>
</tr>
<tr>
<td>6</td>
<td>City of Palo Alto</td>
<td>Novato</td>
</tr>
<tr>
<td>7</td>
<td>City of Petaluma</td>
<td>Oro Loma</td>
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<tr>
<td>8</td>
<td>City of San Jose</td>
<td>SFPUC SEP</td>
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<td>9</td>
<td>City of Sunnyvale</td>
<td>Silicon Valley Clean Water</td>
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<tr>
<td>10</td>
<td>CMSA</td>
<td>South San Francisco</td>
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<tr>
<td>11</td>
<td>Delta Diablo</td>
<td>Treasure Island</td>
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<tr>
<td>12</td>
<td>DSRSD</td>
<td>USD</td>
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<tr>
<td>13</td>
<td>EBMUD</td>
<td>Vallejo</td>
</tr>
</tbody>
</table>

* *Analysis completed and included with the presentation preliminary results*
Preliminary Optimization Results

Marketing is putting together different pics for dividers.
Optimization Approach

- **Basis of Evaluation**
  - Identify no / low cost strategies to reduce effluent nutrients
  - Planning Period: 2025 Horizon
  - Loading: 0% Increase in Flows and 15% Increase in Loads
  - Design Criteria: Aggressive – no permit limits

- **Optimization Concepts**
  - Use offline tankage
  - Operate in split treatment mode
  - Modify operational mode (e.g., raise SRT)
  - Add chemicals
  - Process control instrumentation
  - Add internal recycle for denitrification
DRAFT Optimization Findings Based on 29 Plants

All results are preliminary

Which nutrients are easiest to remove?
- Ammonia load reduction is most difficult
  - Increasing SRT for plants with act sludge
  - Operating Trickling Filter as a Nitrifying Trickling filter
- TN load reduction is possible if ammonia removal implemented
- TP load is easier to remove
  - Most plants have metal salt chemical feed facilities
  - Some have anaerobic zones
  - Lose TP removal capability by forfeiting anaerobic zone

Costs
- Total PV = $171M Dry and $212M Wet
- Total PV ranged from $0.5M to $28M per plant
- Flow-weighted Total PV unit cost = $0.4/gpd
- Not all plants can reduce ammonia/TN loads for both dry and wet seasons:
  - 18 of 29 plants for dry season reduction
  - 15 of 29 plants for wet season reduction
- Overall Load Reduction from Current Discharge
  - Overall Ammonia/TN load reduction is 10-14%
  - Overall TP load reduction is 45-50%
DRAFT Optimization Total PV Costs

All results are preliminary

Flow-Weighted Average = $12.3 Mil per Plant

Dry Flow-Weighted Average = $12.4 Mil per Plant

*Draft Results are Sorted by Permitted Capacity
DRAFT Optimization Total PV Costs

All results are preliminary

Wet Flow-Weighted Average = $13.0 Mil per Plant
Dry Flow-Weighted Average = $12.4 Mil per Plant

*Draft Results are Sorted by Permitted Capacity
ALL RESULTS ARE PRELIMINARY

Dry Flow-Weighted Average = $0.4/gpd

*Draft Results are Sorted by Permitted Capacity
All results are preliminary

Dry and Wet Flow-Weighted Average = $0.4/gpd

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DRAFT Optimization Findings Based on 29 Plants

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Load Reduction with Respect to Current Discharge:

- Overall Ammonia/TN load reduction is 10-14%
- Overall TP load reduction is 45-50%
Preliminary Upgrades Results
Upgrades Approach

- **Basis of Evaluation**
  - Identify upgrade strategies to meet effluent targets
  - Planning Period: 30 Years
  - Loading: Permitted Capacity
  - Design Criteria: Reliability – meet permit limits

- **Concepts**
  - Sidestream Treatment
  - Design Facilities for Level 2 that could be further upgraded to meet Level 3 – no stranded assets
  - Technology Status: Established Technologies

<table>
<thead>
<tr>
<th>Treatment Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level</strong></td>
</tr>
<tr>
<td>Level 1</td>
</tr>
<tr>
<td>Level 2</td>
</tr>
<tr>
<td>Level 3</td>
</tr>
</tbody>
</table>
**DRAFT Upgrade Findings Based on 29 Plants**

*All results are preliminary*

Which nutrients are easiest to remove?
- Ammonia is the most difficult and expensive
  - Bigger basins due to increasing SRT for plants with act sludge
  - Expanded aeration system
  - Additional pumping
- TN load reduction requires ammonia removal
  - Level 3 typically require an external carbon source
- TP load is the simplest and most straightforward to remove
  - Level 3 requires tertiary filtration
  - Many upgrades use MBR which include filtration in Level 2 already

Costs
- Total PV Costs
  - Level 2 = $5,575M Dry and $7,080M Wet
  - Level 3 = $7,310M Dry and $9,040M Wet
- Total PV Cost Range per Plant
  - Level 2 = $3.5M to $2,240M per plant
  - Level 3 = $22M to $2,470M per plant
- Total PV Unit Costs
  - Level 2: $0.4 to $43 per gpd treated
  - Level 3: $2.9 to $46 per gpd treated

Load Reduction with Respect to Current Discharge:
- Level 2 and 3: >90% for Ammonia
- Level 2: about 55-60% for TN and TP
- Level 3: about 80-85% for TN and TP
DRAFT Total PV Costs for Upgrades

All results are preliminary

Flow-Weighted Averages:
$490 Mil per plant for Level 2 dry
DRAFT Total PV Costs for Upgrades

All results are preliminary

Flow-Weighted Averages (color coded by series):
$490 Mil and $630 Mil per plant for Level 2 dry and wet, respectively
DRAFT Total PV Costs for Upgrades

All results are preliminary

Flow-Weighted Averages (color coded by series):
Level 2 = $490 Mil and $630 Mil per plant for Level 2 dry and wet, respectively
Level 3 = $640 Mil per plant for Level 3 dry
Flow-Weighted Averages (color coded by series):
Level 2 = $490 Mil and $630 Mil per plant for Level 2 dry and wet, respectively
Level 3 = $640 Mil and $800 Mil per plant for Level 3 dry and wet, respectively
Flow-Weighted Averages = $7.5/gpd per plant
DRAFT Total PV Unit Costs for Upgrades

All results are preliminary

Flow-Weighted Averages:
Level 2 = $7.5/gpd and $8.4/gpd per plant for Level 2 dry and wet, respectively
Flow-Weighted Averages (color coded by series):
Level 2 = $7.5/gpd and $8.4/gpd per plant for Level 2 dry and wet, respectively
Level 3 = $9.8/gpd plant for Level 3 dry
Flow-Weighted Averages (color coded by series):
Level 2 = $7.5/gpd and $8.4/gpd per plant for Level 2 dry and wet, respectively
Level 3 = $9.8/gpd and $10.8/gpd plant for Level 3 dry and wet, respectively
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Load Reduction with Respect to Current Discharge:

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Sidestream Approach

- Basis of Evaluation
  - Identify upgrade strategies to reduce nutrients
  - Planning Period: 30 Years
  - Loading: Design Capacity
  - Design Criteria:
    - Year-round sidestream
    - Sufficient Dewatering Frequency (≥4 days/week)
    - Water temperature governs technology selection

- Concepts
  - Ammonia/TN Removal:
    - Conventional nitrification technology
    - Deammonification technology
  - TP Removal: metal salt precipitation

- Acknowledgements
  - EPA Regional Grant led by EBMUD
  - Agencies that hosted pilots
### DRAFT Plants Eligible for Sidestream Treatment by Subembayment

<table>
<thead>
<tr>
<th>Subembayment</th>
<th>No. Plants Eligible for Ammonia Discharge Reduction to the Bay</th>
<th>No. Plants Eligible for Total Nitrogen Discharge Reduction to the Bay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suisun Bay</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>San Pablo Bay</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Central Bay</td>
<td>6</td>
<td>6</td>
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<tr>
<td>South Bay</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Lower South Bay</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>
DRAFT Total PV Costs for Sidestream

All results are preliminary
DRAFT Sidestream Findings for the 29 Plants

- Criteria used for screening:
  - Year-round sidestream
  - Year-round discharge
  - Sufficient dewatering frequency (>4 days/week)

- Number of candidate plants
  - 19 out of 37 plants if ammonia reduction is the discharge objective
  - 25 out of 37 plants if TN reduction is the discharge objective

- Costs
  - The Total PV costs is $550M
  - Flow-weighted average = $1.9/lb N removed

- The overall Ammonia/TN load reduction from Current Discharge is 22 and 17 percent, respectively
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Optimization</th>
<th>Sidestream</th>
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<th>Level 3</th>
</tr>
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<tbody>
<tr>
<td>Planning Horizon</td>
<td>Years</td>
<td>10</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Total PV Cost</td>
<td>$ Mil</td>
<td>171</td>
<td>550</td>
<td>5,575</td>
<td>7,310</td>
</tr>
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<td>Total PV Range per Plant</td>
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<tr>
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<td>14</td>
<td>17 - 22</td>
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<td>83</td>
</tr>
<tr>
<td>Unit Total PV Cost Range</td>
<td>$/gpd</td>
<td>0.1 – 2.8</td>
<td>--</td>
<td>0.8 – 29</td>
<td>3.0 – 32</td>
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<tr>
<td>Unit Total PV Cost Flow-Weighted Average</td>
<td>$/gpd</td>
<td>0.4</td>
<td>--</td>
<td>7.5</td>
<td>9.8</td>
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<tr>
<td>Unit TN Cost Range</td>
<td>$/lb N</td>
<td>0.4 – 8.2*</td>
<td>1.2 – 6.5</td>
<td>1.1 – 164</td>
<td>1.7 – 178</td>
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All results are preliminary.
## Summary of DRAFT Wet Results (Represents 29 Plants)

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<tr>
<td>Total PV Cost</td>
<td>$ Mil</td>
<td>212</td>
<td>415</td>
<td>7,060</td>
<td>8,980</td>
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<tr>
<td>Total PV Range per Plant</td>
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<td>2.9 – 46</td>
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- Optimization = 10-yr planning horizon
- Sidestream and Upgrades (Level 2 and 3) = 30-yr planning horizon
DRAFT: Projecting Baywide Preliminary Total N Results (Dry plus Wet Season)

- Optimization = 10-yr planning horizon
- Sidestream and Upgrades (Level 2 and 3) = 30-yr planning horizon
Role of Averaging Periods
Importance of Averaging Periods

![Graph showing the importance of averaging periods for influent ammonia load. The graphPlot Influent Ammonia Load (lb N/d) vs. Time (Jan-08 to Jul-11). The x-axis represents the months from January 2008 to July 2011. The y-axis represents the influent ammonia load in pounds of nitrogen per day (lb N/d). The graph includes lines for Maximum Day Limit, Maximum Month Limit, Average Annual Limit, and Dry Season Seasonal Limit. The data points indicate the variability in influent ammonia load over time and the significance of using different averaging periods to understand the load better.](image-url)
Role of Averaging Periods on SRT and Basin Volume

SRT for Various Ave Periods
Ave Annual SRT = 8.0 d
Max Month SRT = 10 d
Max Day SRT = 15 d

Averaging Periods Govern the SRT and Overall Basin Volume
## Role of Averaging Periods on Cost: Oro Loma for Level 3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Dry Season</th>
<th>Wet Season</th>
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<td>Ave Annual</td>
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<tr>
<td>Capital PV</td>
<td>$ Mil</td>
<td>60</td>
<td>68</td>
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<tr>
<td>O&amp;M</td>
<td>$ Mil /yr</td>
<td>5.7</td>
<td>6.0</td>
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<tr>
<td>O&amp;M PV</td>
<td>$ Mil</td>
<td>130</td>
<td>134</td>
</tr>
<tr>
<td>Total PV</td>
<td>$ Mil</td>
<td>190</td>
<td>202</td>
</tr>
<tr>
<td>NH4 Load Reduction *</td>
<td>%</td>
<td>97</td>
<td>99</td>
</tr>
</tbody>
</table>

* Based on 6-years historical data from Hampton Roads Sanitation District VIP Plant
Nutrient Load Reduction by Other Means
### Recycled Water Survey 2015

**Agency Name (Recycled Water Producer):**

**Recycled Water Distributors/Retailers:**

#### CURRENT AND PROJECTED FUTURE AMOUNT OF RECYCLED WATER BY USE CATEGORY (in acre-feet)

<table>
<thead>
<tr>
<th>Type of RW (See Note A)</th>
<th>Confidence (see Note B)</th>
<th>Golf Course</th>
<th>Irrigation</th>
<th>Landscape</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Agricultural</th>
<th>Environmental Enhancement</th>
<th>Internal Use</th>
<th>GW Recharge for Indirect Potable Reuse</th>
<th>Surface Water Augmentation</th>
<th>Direct Potable Reuse</th>
<th>Other Non-potable Reuse (see Note J)</th>
<th>RO concentrate or other return</th>
<th>Comments</th>
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</thead>
<tbody>
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<td>Current</td>
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</table>

#### 2015 MONTHLY RECYCLED WATER DISTRIBUTION DATA BY USE CATEGORY (in acre-feet)

<table>
<thead>
<tr>
<th>Month</th>
<th>TOTAL</th>
<th>Golf Course</th>
<th>Landscape</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Agricultural</th>
<th>Environmental Enhancement</th>
<th>Internal Use</th>
<th>GW Recharge for Indirect Potable Reuse</th>
<th>Surface Water Augmentation</th>
<th>Direct Potable Reuse</th>
<th>Other Non-potable Reuse (see Note J)</th>
<th>RO concentrate or other return</th>
<th>Comments</th>
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</table>
Overall: About half of the plants have completed the surveys (22).
We are still quantifying the water uses (purple pipe vs potable reuse) and where the loads end up.

Fate of Nutrients that Exit a POTW (Excludes Biosolids)
Produce up to 2,200 AFY (~2mgd) of Title 22 Recycled Water at the City’s WWTP for use as cooling tower makeup water at the Valero Benicia Refinery and irrigation water for City customers.
Group Annual Report (GAR)
Submitted on 9/30/2016
2016 Group Annual Report: Changes from 2015 Submittal

- Provided Input:
  - SRP Terminology / Data Reporting
    - Dissolved orthophosphate
  - Recycled Water Data Collection
- Used the template to streamline 2016 data collection
- Raw influent data collected to avoid misinterpretation of flow and load data
- Added the percent change in slope with respect to initial three years of data
- Next year: refine the statistical approach
Dry Season Daily Average Flows

Flow by Subembayment, mgd

Suisun Bay
San Pablo Bay
Central Bay
South Bay
Lower South Bay
Total

Baywide Total Flow, mgd

Schedule

- Complete all draft reports by March 31, 2017
- Address comments and submit updated plant reports by July 31, 2017
- Prepare draft summary report by September 30, 2017
DRAFT: Summary of Draft Report Findings

- 29 out of 37 plants have been analyzed.
  - We anticipate changes to each plant’s draft report based on plant provided comments (after draft reports are all released).
  - The evaluation is not intended to serve as a pre-design. The concepts are all plant specific that will require more detailed analysis to verify/confirm any report findings.

- Findings from the 29 plants evaluated thus far:
  - Ammonia removal is the most difficult and expensive of the nutrients evaluated
  - Costs increase with each treatment level and the wet season is typically more expensive than dry.
  - Nutrient load reduction increases with treatment level

- Draft Costs for the 29 plants evaluated thus far:
  - Optimization: the Total PV costs are $171M to $212M for dry and wet, respectively
  - Sidestream: the Total PV costs are $550M
  - Upgrades: Total PV costs range from $5.6B for Level 2 dry to $9.0B for Level 3 wet

- The final results will provide information in parallel with the science plan to assist with making informed management/policy decisions
Hip Pocket
2016 GAR Results (Ammonia Load)

Dry Season Daily Average Ammonia Load

Ammonia Load by Subembayment, kg N/d

Baywide Total Ammonia Load, kg N/d

Suisun Bay  San Pablo Bay  Central Bay  South Bay  Lower South Bay  Total