Gravity-Based Media Filtration for a Waterfront Marine Terminal

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Kennedy/Jenks Consultants – Federal Way, WA
Discussion Topics

- Port of Seattle, NWSA, & T46 marine cargo facility
- Stormwater Regs & Permits
- Why WA is different...for now
- Stormwater Conveyance and Treatment Alternatives
- Design & Construction
- Treatment Performance
- What’s Next
Port of Seattle & The Northwest Seaport Alliance

- Port of Seattle
- NWSA
- T46 Background

Terminal 46
Port of Seattle Terminal 46 Lease Improvements
4 basins about 20 acres each (B2, B5, B6, B8 N-S)

Basin 2 – deferred for Tunnel project
**Roles & Responsibilities**

- **Port owns the land and infrastructure**
- **Terminal operator holds the permit & triggers treatment requirement**
- **Port designs treatment improvements**
- **Port receives Ecology approval & inherits very tough schedule**
- **Terminal operator responsible for BMPs and O&M**

*Clean Water Act – Citizen Suit*
Regulatory Background

Clean Water Act

EPA - National Pollutant Discharge Elimination System

Delegated State Programs
(e.g. Washington Department of Ecology, Oregon Department of Environmental Quality, California State Water Quality Control Boards)

Federal Program
ID, NM, NH, MA, 6 territories, Tribal Lands, Federal Lands, Military Installations, and Washington DC
Industrial Stormwater Permit
Requirements Vary

- Water Transportation Standard Industrial Classification (4491)
- Vehicle Maintenance shops & “activity”
## General Industrial Stormwater Permits, Benchmarks & Corrective Actions for Water Transportation Facilities Standard Industrial Classification Codes 44XX(Sector Q)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>EPA 2015 MSGP (06/2020)</th>
<th>CA 2015 1200-Z (06/2016)</th>
<th>OR TXR050000 (08/2016)</th>
<th>WA ISGP (12/2020)</th>
<th>LA LA050000</th>
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</thead>
<tbody>
<tr>
<td>Aluminum (ug/L)</td>
<td>750</td>
<td>750</td>
<td>750</td>
<td>1,200</td>
<td>750</td>
</tr>
<tr>
<td>Iron (ug/L)</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1,300</td>
<td>1000</td>
</tr>
<tr>
<td>Copper (ug/L)</td>
<td></td>
<td>20</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead (ug/L)</td>
<td>14-262 (FHD) 210 (Marine)</td>
<td>40</td>
<td>10</td>
<td>14-262 (Freshwater Hardness Dependent) 210 (Marine)</td>
<td></td>
</tr>
<tr>
<td>Total Zinc (ug/L)</td>
<td>40-260 (FHD) 90 (Marine)</td>
<td>120</td>
<td>160</td>
<td>117</td>
<td>40-260</td>
</tr>
<tr>
<td>Oil &amp; Grease (mg/L)</td>
<td>15 (25 MAX)</td>
<td>10</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (SU)</td>
<td>6 - 9</td>
<td>5.5 - 9</td>
<td>6 - 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS (mg/L)</td>
<td>100 (400 MAX)</td>
<td>100</td>
<td>50</td>
<td>30 (Disch. Specific)</td>
<td></td>
</tr>
</tbody>
</table>

### 3.3. Corrective Actions – Data Exceeding Benchmark Values

After collection of 4 quarterly samples, if the average of the 4 monitoring values for any parameter exceeds the benchmark, the permittee must review the selection, design, installation, and implementation of the control measures to determine if modifications are necessary to meet the effluent limits in this permit, and either:

- make the necessary modifications and continue quarterly monitoring until 4 consecutive quarters of monitoring for which the average concentration of the pollutant does not exceed the benchmark have been completed; or
- make a determination that no further pollutant reductions are technologically available and economically practicable and achievable in light of best industry practices and notify the LDEQ of this determination in the next benchmark monitoring report. The permittee must also document the rationale for concluding that no further pollutant reductions are achievable, and retain all records related to this document with the SWPPP.
There’s Never Enough Data

- Little historical data
- One rain event to go on
- Some operational differences reflected
- Zinc/copper 60%-80% particulate
- High turbidity, moderate TSS, fine particulate predominates

Table 3: Stormwater Sampling Analytical Data Summary

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Benchmark</th>
<th>TTI 4320 (g)</th>
<th>Basin 2 (b) (%)</th>
<th>Basin 5 (b) (%)</th>
<th>TTI 4489 (g)</th>
<th>Basin 6 (b) (%)</th>
<th>Basin 8 (b) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity (N TU)</td>
<td>25</td>
<td>61.3 (g)</td>
<td>120</td>
<td>170</td>
<td>136 (g)</td>
<td>165</td>
<td>140</td>
</tr>
<tr>
<td>pH (SU)</td>
<td>7.28</td>
<td>7.27</td>
<td></td>
<td></td>
<td>7.26</td>
<td>7.05</td>
<td></td>
</tr>
<tr>
<td>TSS (mg/L)</td>
<td>NA</td>
<td>46.5</td>
<td>77.5</td>
<td>77.0</td>
<td>68.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Zinc (µg/L)</td>
<td>117</td>
<td>456 (g)</td>
<td>370</td>
<td>540</td>
<td>546 (g)</td>
<td>530</td>
<td>470</td>
</tr>
<tr>
<td>Dissolved Zinc (µg/L)</td>
<td>NA</td>
<td>120</td>
<td>108</td>
<td></td>
<td>110</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>Total Copper (µg/L)</td>
<td>14</td>
<td>26 (g)</td>
<td>34.7</td>
<td>41</td>
<td>41.7 (g)</td>
<td>38</td>
<td>37</td>
</tr>
<tr>
<td>Dissolved Copper (µg/L)</td>
<td>NA</td>
<td>17.8</td>
<td>15.8</td>
<td></td>
<td>14.5</td>
<td>15.1</td>
<td></td>
</tr>
<tr>
<td>Salinity (ppt)</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Chloride (mg/L)</td>
<td>NA</td>
<td>19.6</td>
<td>57.7</td>
<td></td>
<td>100</td>
<td>88.9</td>
<td></td>
</tr>
</tbody>
</table>
Conveyance & Treatment Alternatives

- Looked at 4 conveyance options
- One, two, or 4 above grade treatment systems
- 4 subgrade systems near each outfall
- Evaluated EC, 4 types of media filtration, BIOF, CESF
Treatment Alternative Criteria Evaluation

Table 4: Criteria Evaluation 1 of 2

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EC</td>
<td>MF 1</td>
<td>BIOF</td>
<td>CESF</td>
</tr>
<tr>
<td>Encumbered Operational Area</td>
<td>55' x 130'</td>
<td>80' x 100'</td>
<td>120'x220'</td>
<td>95' x 95'</td>
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<tr>
<td>Initial Capital Budgetary Costs (CSO)</td>
<td>$12.5 M</td>
<td>$10.8 M</td>
<td>$8.5 M</td>
<td>$9.2 M</td>
</tr>
<tr>
<td>Initial Capital Budgetary Costs (CBC)</td>
<td>$24.1 M</td>
<td>$17.8 M</td>
<td>$14.2 M</td>
<td>$15.5 M</td>
</tr>
<tr>
<td>Annual O&amp;M Costs</td>
<td>$264,300</td>
<td>$239,000</td>
<td>$122,100</td>
<td>$107,900</td>
</tr>
</tbody>
</table>

- Detailed cost estimates developed for initial capital improvements and O&M
- Just getting electricity to pumped alternatives adds >$1,000,000
- Conveyance for combined system doesn’t pencil out
- All surface approaches bad operationally
- > Treatment Confidence > $$$$
Pilot Testing Two Most Viable Alternatives

- MF2 above-grade pumped
- MF3 – subsurface gravity-based
- Difficult getting low tide, ship operations, and adequate rain to coincide
- Ultimately sampled 4 storm events and all 4 basins
Pilot Results

- Discharge data <10% of historical results
- Most solids in dissolved range
- Pilot units removed between 30% - 90% total and dissolved metals

In 121 years of Seattle rain records, it's never done this before... until now

By Scott Sistek Published: Dec 17, 2013 at 8:00 AM PDT  Last Updated: Dec 26, 2013 at 3:02 PM PDT
Water Quality

Water Quality > Industrial Stormwater General Permit > Stormwater Guidance Documents

Stormwater Guidance Documents

Ecology commends the WPPA, and its member ports for their good faith efforts to comply with ISGP requirements, and for actively engaging Ecology to develop the Manual. We also applaud the valuable input from key advocacy groups for both industry and the environment during the development of the Manual including: marine terminal operators, the Pacific Merchant Shipping Association, Puget Soundkeeper Alliance, Washington Environmental Council, and Citizens for a Healthy Bay. We look forward to working with WPPA and the Washington port community stakeholders to implement and update the Manual to ensure that it continues as a relevant and useful tool marine terminals use to effectively manage stormwater in compliance with the ISGP.

Sincerely,
Maia D. Bellon
Director

Furthermore, a facility that follows the pathway to compliance and receives Ecology approval of the facility’s chosen stormwater treatment approaches (through approval of Engineering Reports prepared in accordance with Ecology guidelines, as required), will be understood to have implemented AKART to the satisfaction of Washington State standards.
Almost 2X the cost
For additional 6% pollutant reduction

Plot the costs vs. pollutant reduction efficiency
Select the approach to the left of the knee of the curve

EXAMPLE WASHINGTON STATE MARINE TERMINAL
STORMWATER TREATMENT COST/PERFORMANCE CURVE

Alternative Cost vs. % Zinc Reduction

Screened Proprietary Electrocoagulation - Pumped
Screened Proprietary Above Grade Media Filtration - Pumped
Selected Proprietary Below Grade Gravity-Based Media Filtration

Curve Fit Trendline
Gravity-Based Conceptual Alternative

Plot the costs vs. pollutant reduction efficiency
Select the approach to the left of the knee of the curve
Typical Process
Final Plan

- Similar designs for Basins 5, 6, & 8
- Basin 2 later
That’s a Big Box
CPZ Media Installation & Startup

- Carbon (GAC)
- Peat
- Zeolite (Greensand)
Startup & First Maintenance

- First Maintenance performed after 4-6 months of operation
- Confined space entry required
- All systems cleaned and repaired
- No small effort
- Significant pollutant reduction though sampling doesn’t show it
- Working to improve BMPs and ID O&M schedules with the tenant
Take Home Messages

► Stormwater regulations are getting tougher & more expensive
► You will NEVER have enough data
► Retrofitting infrastructure can cost more than treatment
► There is NO SILVER BULLET for stormwater treatment
► Implementing BMPs and frequent O&M is key for system performance
► Facility drainage design needs to change to meet future compliance at most port terminals