Creating a New Legacy out of the Past Membrane Retrofit of the Brandywine Filtration Plant

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Outline of Presentation

- Background Existing Facility
- Proposed Improvements
- Historic Structure Considerations
- Summary

Overview of Existing Facilities

- Brandywine Filtration Plant 11 MGD
 - Constructed in 1917, Upgraded in 1934
 - Avg. Daily Production 5 MGD
 - Peak Daily Production 10 MGD
 - Serves Two Pressure Zones
- Water Source Brandywine Creek



Brandywine Complex



Raw Water Quality

| | Units | Avg | Range | | | |
|---------------------------------|---------------------------|-------|-------|-------|-------|--|
| Physical Parameters | | | | | | |
| рН | units | 7.3 | 6.6 | - | 8.5 | |
| Alkalinity | mg/L as CaCO ₃ | 52 | 33 | - | 71 | |
| Hardness | mg/L as CaCO ₃ | 94 | 58 | - | 122 | |
| Temperature | °C | 16 | 4 | - | 30 | |
| Conductivity | uohms/cm | 280 | 120 | - | 500 | |
| Inorganics | | | | | | |
| Chloride | mg/L | 36 | 14 | - | 135 | |
| Nitrate | mg/L | 2.1 | 0.9 | - | 3.6 | |
| Nitrite | mg/L | 0.03 | 0.001 | - | 0.36 | |
| Ammonia | mg/L | 0.12 | 0.01 | - | 0.75 | |
| Orthophosphate | mg/L | 0.26 | 0.01 | - | 0.62 | |
| Zinc | mg/L | 0.06 | 0.02 | - 15 | 0.24 | |
| Metals | | | | | | |
| Total Iron | mg/L | 0.19 | 0.004 | - | 1.4 | |
| Total Manganese | mg/L | 0.05 | 0.005 | | 0.22 | |
| Microbiological | | | | | | |
| Total Coliform | #/100mL | 579 | 46 | - | 2419 | |
| E. Coli | #/100mL | 79 | 1 | | 1120 | |
| Heterotrophic Plate Count | #/100mL | 1337 | 76 | - | 17000 | |
| Organics | | | | | | |
| Ultra-Violet Absorbance @ 254nm | cm ⁻¹ | 0.076 | 0.038 | - | 0.36 | |
| Total Organic Carbon | mg/L | 2.5 | 1.4 | LINEX | 7.7 | |

Brandywine Filter Plant



Finished Water Quality

| Parameter | Average | Minimum | Minimum Maximum | |
|----------------------------|---------|---------|-----------------|--|
| Alkalinity (mg/l as CaCO3) | 46 | 29 | 68 | |
| Chloride (mg/l) | 55 | 47 | 106 | |
| Conductance (umhos/c) | 344 | 256 | 398 | |
| Fluoride (mg/l) | 0.92 | 0.22 | 1.40 | |
| Iron (mg/l) | 0.017 | 0.003 | 0.180 | |
| Free chlorine (mg/l) | 1.87 | 0.97 | 0.180 | |
| Hardness (mg/l) | 111 | 94 | 130 | |
| Nitrite (mg/I) | 0.0051 | 0.0023 | 0.0250 | |
| Nitrate (mg/l) | 1.9 | 1.3 | 2.5 | |
| pH (SU) | 7.2 | 6.5 | 7.8 | |
| Phosphate (mg/l) | 0.248 | 0.024 | 0.909 | |
| TOC (mg/l) | 1.30 | 0.79 | 2.87 | |
| Turbidity (NTU) | 0.057 | 0.039 | 0.102 | |
| UV254 (cm-1) | 0.024 | 0.012 | 0.084 | |
| Zinc (mg/l) | 0.188 | 0.031 | 0.640 | |

Project Needs

- Modernize Plant
 - Advanced Age & Deterioration
 - Operational Limitations
 - Regulatory Compliance



Chemical Feed Systems



Advanced Age & Deterioration



High Zone Pumps





Low Zone Pumps

Filter Piping in Clearwell

Project Needs

- Meet Capacity Requirements

 Minimum Capacity 6 MGD
 Peak Capacity 14 MGD
 Future Peak Capacity Up to 20

 - MGD
- Comply with SDWA
- Facilitate New Brandywine Pumping Station







Finished Water Goals

| Parameter | Value |
|---------------------------------|----------|
| TOC Removal | > 35% |
| HAA5 Formation Potential (SDS) | 60 µg/l |
| TTHM Formation Potential (SDS) | 80 µg/l |
| Average Turbidity | 0.05 NTU |
| Maximum Turbidity | 0.10 NTU |
| Particle Removal Efficiency | |
| (2-5 μm range) | 4-log |
| SDWA Maximum Contaminant Levels | Meet All |

Proposed Process Flow Diagram



Proposed Plan



Historic Structure



Existing Structure



Demolition in Filter Building



Planned Improvements

Finished Water Pumping



Membrane System in Filter Building



Membrane System in Filter Building



Protection of Existing Structure

- No good drawings of existing structure
- Removed interior support of exterior wall by demolition
- Need to remove exterior loading on the wall to prevent failure
- Geofoam installation





Monitoring of Existing Struture



Monitoring of Existing Structure

- Monitor continuously for movement of existing structure
 - Real time
 - Seasonal
 - Daily
- Seismographs for vibration monitoring
- Dynamic strain gauge monitoring for determining of permanent damage
- Tilt beams to monitor movement of roof structure

Summary

- Historic structures have unique challenges that are not normally encountered
 - Minimize damage to existing structure
 - No changes to the existing structure
 - Requires special monitoring techniques to determine when things are occurring
 - Requires immediate response to things occurring to reduce permanent damage
 - Requires design features that will minimize damage from existing conditions

Summary

- Can use historic structures for a new water treatment plant
- Need to consider how to reduce affects of structural changes to accommodate the features of a new water treatment plant
- Need to monitor the existing structure to minimize permanent damage during construction

COMMENTS

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QUESTIONS

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