Something Old, Something New: Redirecting an Existing, Operating Influent System to Serve a New Treatment Plant

The Brightwater Influent System

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Department of Natural Resources and Parks
Wastewater Treatment Division

MWH
The Problem

How to modify the existing Brightwater influent conveyance system to serve the new treatment plant when the existing system is designed to transport flows in the opposite direction…

• cost effectively;
• maximizing used of existing facilities;
• maintaining all current flexibility;
• while keeping all facilities operating?
Outline

- Background
- Existing Influent System
- Constraints/Criteria
- The Influent System Modifications
- Control Strategy Development
- Emergency Operations
- Control System Overview
- Project Status
- Results
Existing King Co. Wastewater Service Area

- 34 customer agencies
- 1.5 million people served
- 420 square mile service area
- 206 MGD average annual system flow
- 4 existing WW treatment plants and 4 CSO plants
- 353 miles of conveyance pipe with 42 pump stations and 19 regulator stations
Brightwater Treatment System

- Flows from Redmond, Bellevue, Woodinville, Bothell, and Kenmore directed to Brightwater
- Est. 320,000 people served
- 4 pump stations affected
- 7 major interceptors rerouted
Brightwater Effluent System

PLAN

PROFILE
Existing Influent System
Existing Flow Routing

Dry Weather: [Diagram showing flow routes]

Wet Weather: [Diagram showing flow routes]
Stakeholder Requirements

• Staffing limitations require maximum automation
• All flows must remain within Brightwater system for treatment (permit requirement)
• Phased operation: existing flow routing until 2011, then switch to final routing
• Integrated with existing control system
• Compatible with new Ovation control system
• Strong public sensitivity to overflow risks based upon past occurrences
Guiding Principles

• Flows treated/stored in Brightwater System until capacity reached
• All secondary treatment options must be exhausted before primary discharge is allowed
• Storage is preprogrammed and automatic unless operator intervenes
• Diversion to other treatment system automated upon specific emergency events
Critical Design Issues

• No emergency bypass overflow; storage sequence and use critical to preventing spills
• Continuous operation during construction, with switchover up to 3 years after completion
• Influent Pump Station design by others, requiring close coordination
• Storage dispersed in the system, requires programming based on flow rates to maximize storage
Design Criteria

- Low Flow: \( \frac{1}{2} \) ADWF = 7.7 MGD
- Average Wet Weather Flow: 36 MGD
- 20-year peak hour design flow:
  - 55 MDG – Swamp Creek Diversion
  - 115 MGD – North Creek Diversion
- Keep all flows within Brightwater System up to peak 1-hour flow from 20-year storm (pumping and storage)
Brightwater Influent System Design

- Tunnel backbone
- Pump station modifications
- New Conveyance elements
Pump Station Modifications

- Hot/cold standby
- Pump modifications
- Control system changes
- Reclaimed water system
New Conveyance Elements

- New Diversion
- Connector
- Portal Structure
- Influent /Storage Tunnel

- York and Hollywood Diversion changes
- Odor and Corrosion Control

- Connector
- Odor Control
- New Diversion Structure
- Exist. Diversion Mods
Key Features

- Hot/cold standby and ventilation modifications reduce energy consumption
- Early activation based on storage level and/or rates of fill provides margin of safety
- Operator transition to cold standby to allow washdown
- Operator override allowed at all times
- Maintains flow routing flexibility
Control Strategies

• Phase 1 for operation prior to Brightwater system online
• Phase 2 for operation with Brightwater system online
• Automatic normal operation up to 170 MGD with IPS and Treatment Plant operating
• Emergency operation for excess flows or in case of IPS/Treatment Plant problems
Phase 1 Operations

- Control strategies for new diversion structures and modifications to existing
  - Revised flow routing
  - New gates
  - Replacement gates
  - New level sensors
- New Bioxide injection system and generator at Hollywood Pump Station
- New odor control system at North Creek Pump Station
Final Influent System Operations

• Normal Operation:
  ◦ Flows to Brightwater WWTP
  ◦ Storage for excess flows

• Emergency Operation:
  ◦ All possible flows to Brightwater WWTP
  ◦ Storage for excess flows
  ◦ Routing to other treatment systems when capacities exceeded
Emergency Operations

- Operator initiated
- Automatic control if Operator doesn’t act
- Sequential activation of storage based on storage levels or time-to-fill tunnel storage
Emergency Operations – Tunnel Storage

INFLUENT/STORAGE TUNNEL

Storage Chamber

Influent Line

WET WELL

Emergency Elevation

Normal Elevation
## Emergency Operations

Matrix 2 - Storage and Diversion Control Strategy Sequence Based on Predicted Time to Fill Tunnel

<table>
<thead>
<tr>
<th>Brightwater System Storage</th>
<th>Pump Station Transition</th>
<th>Shortcut Diversion</th>
<th>Long Way Diversion</th>
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<tr>
<th>Time Remaining to Fill Tunnel (hours)</th>
<th>Start Storing in North Creek Storage Facility</th>
<th>Start Emergency Storage in Sammamish Interceptor</th>
<th>North Creek Pump Station to Hot Standby</th>
<th>York Pump Station to Hot Standby</th>
<th>Divert Swamp Creek Trunk to Logboom Storage</th>
<th>Divert North Lake Sammamish Interceptor to Eastside Interceptor via Pump Station</th>
<th>Divert to Eastside Interceptor via North Creek and York Pump Stations</th>
<th>Divert to Eastside Interceptor via North Creek and York Pump Stations</th>
<th>Divert to Kenmore Interceptor Section 5</th>
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<td>Annunciate operator message – “Dispatch North Creek Pump Station spool piece installation crew”</td>
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- ✔: Event has occurred
- /checkbld/checkbld: Event is set to occur
- /checkbld/checkbld: Event is on hold
- /checkbld/checkbld: Event is cleared
System Architecture

• PLC based for compatibility with existing elements
• Fiber optic communications, with some radio/telephone where FO not available
• Local HMI provided at all sites
• All controls duplicated at Brightwater Supervisory Control Center
• Virtually all control strategies automated but operator intervention allowed
## Construction Status

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<th>Project</th>
<th>2007</th>
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Looking Forward

- Startup planning:
  - Initiated in 2007
  - Component and operational testing by each contract
  - All Conveyance control system programming by IPS contract
- Startup and Commissioning – IPS/Plant
  - System testing with fresh water in 2010
  - Wastewater introduced in mid 2011
  - 60 day commissioning period
- Full System in operation: After tunnel and Odor Control Facility completion in early 2012
Looking Forward

• Operations training requirements
  ◦ System configuration and normal operation
  ◦ Emerson controls
  ◦ Periodic (annual?) training for emergency operations
    – Predicted more than 20-year recurrence
    – Impact of failure is great
    – Refresher needed to avoid control paralysis
    – Desktop scenarios to maintain capabilities
What Has Been Our Experience?

• No handbook for such planning
• Extensive planning by many players
• Operations input and cooperation was essential
• Need to review and account for as many flow scenarios as possible
• Guiding principles helped greatly in communicating design/operating intent to users and agency
• Written plan was key to success
• Has needed close attention through construction
Results to Date

- Hollywood Pump Station mods functioning as designed
- Completed facilities at North Creek Pump Station operating as planned for Phase 1
- Close cooperation between Conveyance team and System Integrator (IPS contract) through startup planning and execution
- Initial startup has gone according to plan
- Experience gained will facilitate next phases of startup
Acknowledgements

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