UDF is Easier in the Office: Pilot Testing a System with Wells Equipped with Variable Frequency Drives

Jeremy Cox
City of Woodland

Irene Suroso, P.E.
West Yost Associates
Flush Program

Conventional Flushing

Unidirectional Flushing

Continuous Blow-off
What is the Difference between Unidirectional and Conventional Flushing Programs?
# Differences in Flushing Programs

<table>
<thead>
<tr>
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<th>Conventional Flushing</th>
<th>Unidirectional Flushing</th>
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</thead>
<tbody>
<tr>
<td><strong>Target Velocity</strong></td>
<td>Difficult to dial in</td>
<td>Maintains target minimum velocity of 5 fps</td>
</tr>
<tr>
<td><strong>Scouring</strong></td>
<td>Less scouring</td>
<td>More = Better Cleaning</td>
</tr>
<tr>
<td><strong>Water Use</strong></td>
<td>More</td>
<td>Less (up to 40% less)</td>
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</table>
Maintains Distribution System Water Quality

• Restores disinfectant residual
• Reduces bacterial growth
• Removes mineral and biological deposits (calcium, lime, rust, biofilms)
• Restores flows and pressures
• Eliminates taste and odor problems

And…
Why Do You Need Unidirectional Flushing?

Other reasons for UDF

• Identifies missing or broken valves
• Integrates with preventive maintenance program (hydrant or valve exercise)
• Helps corrosion control
Agenda

1. Flushing Program
2. City of Woodland Water System
3. UDF Pilot Studies
4. Questions
15,000 Customers

No Interties with Other Agencies
City of Woodland Water Distribution System

Wells
- 19 Active Wells
- 4 VFD Pumps
- 15 Constant Speed Pumps

Storage
- 1 400,000 gallon Tank

Under Construction
- 1 3 MG Tank
- 1 8.9 MGD BPS
How can a flushing program and valve exercising program support these goals?
City Objectives for UDF Program

- Improve water quality
- Locate broken hydrants
- Maintain fire hydrants
- Start valve exercise program in conjunction with UDF
  - Locate broken/closed valves
  - Locate missing valves (paved over)
  - Verify accuracy of GIS information
- Provide immediate response to customer complains
Agenda

- Flushing Program
- City of Woodland Water System
- UDF Pilot Studies
- Questions
Pilot Program Helps Determine....

...Level of Effort
...Cost
...System Condition
Initial Steps to Develop Pilot Program

- **Review overall water system**
  - Source of Supplies (i.e. groundwater wells, clearwell, storage, booster pumps)

- **Select two to three areas for pilot program**
  - Pipeline Material
  - Pipeline Age
  - Traffic Condition
  - Drainage Condition
Using Hydraulic Model to Develop UDF Program

Determine how accurate is the hydraulic model, does it reflect existing condition

Use unique ID for hydrants and valves (from GIS)
Existing hydraulic model does not contain parallel pipelines that are less than 3” diameter.
City of Woodland UDF Pilot Program Planning

Review Hydraulic Model and GIS Mapping

Develop UDF Pilot Program for 2 areas

Existing hydraulic model does not contain parallel pipelines that are less than 3” diameter

Springlake Area – newer, residential neighborhood, less traffic
Downtown Area – older, commercial/office, high traffic

Parallel Pipe
City of Woodland UDF Pilot Program Planning

- **Review Hydraulic Model and GIS Mapping**
- **Develop UDF Pilot Program for 2 areas**
- **Conduct Field Crew Reviews prior to flushing**

Existing hydraulic model does not contain parallel pipelines that are less than 3” diameter.

- **Springlake Area** – newer, residential neighborhood, less traffic
- **Downtown Area** – older, commercial/office, high traffic

Checks valves and hydrants locations listed on each flushing sequence.

Water valve with sewer cap

Parallel Pipe
Present each sequence at the meeting with Ops staff to identify issues.
Use the Right Equipment for the Job

Long rubber hose, high headloss, low flow – can not maintain minimum velocity

Hose monster diffuser recommended (to obtain minimum velocity)

Short rigid hose, low headloss, high flow – can maintain minimum velocity
More Equipment for the Job

- Public notification before starting the flushing
- Pressure gages (backup recommended)
- Water quality equipment (chlorine and turbidity)
- SCADA computer to monitor system response during flushing
- Dechlorination tablets
- Stopwatch
- All safety PPE
- Head lamp for night work
- Reflective signs for traffic
Springlake UDF Pilot Area

- Newer Residential Area
- Less Traffic
- Supply Source: Groundwater well with a VFD Pump

UDF Program Statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Sequences</td>
<td>24</td>
</tr>
<tr>
<td>Total Flush Length</td>
<td>17,615 feet</td>
</tr>
<tr>
<td>Total Flush Time</td>
<td>171 min</td>
</tr>
<tr>
<td>Total Flush Volume</td>
<td>3,792 gallon</td>
</tr>
<tr>
<td># of operated hydrants</td>
<td>27</td>
</tr>
<tr>
<td># of operated valves</td>
<td>17</td>
</tr>
</tbody>
</table>
Springlake Pilot Program – Day 1 Sequence 1

- Closed loop system served by VFD pump - After valves closed
- Very low demand (night time flushing and light rain)
- Well started pumping to waste - pump was set on automated pump to waste mode
- Pressure spike was observed on SCADA screen…..
• VFD pump was adjusted from hand mode to control mode
• Sequence was modified by opening a hydrant nearby park site to create static demand
• Pressure spike disappeared
• Flushing was ended after 5 sequences
• Springlake Pilot Program was revised to accommodate VFD operation
• VFD pump was adjusted from hand mode to control mode
• Sequence was modified by opening a hydrant nearby park site to create static demand
• Pressure spike disappeared
• Flushing was ended after 5 sequences
• Springlake Pilot Program was revised to accommodate VFD operation

RESULT:
Revised Program by re-sequenced was completed more efficiently in the field
Downtown UDF Pilot Program

- Older, Commercials/Offices
- High Traffic
- Supply Source: Groundwater well with a VFD Pump

UDF Program Statistics

- Sequences: 27
- Total Flush Length: 19,161 feet
- Total Flush Time: 126 min
- Total Flush Volume: 4,051 gallon
- # of operated hydrants: 27
- # of operated valves: 59
Creating Additional Demand Prevents Pressure Spike & Allows VFD to Operate Consistently

Open Hydrant to Create Static Demand
When Valve Has not Been Maintain, You Will Hear This
Sample of Debris Coming Out of Flushed Hydrant
Check Pressure Gauge when You Hear Air Bubble Sound
Prepare to Stop Traffic Even at Night Time
Chlorine Residual after Flushing is Improved

Average chlorine residual
**Before:** 0.15

Average chlorine residual
**After:** 0.21
Average turbidity in Downtown pilot program

**Before flushing is 29.7**  **After flushing is 5.5**

Initial turbidity for Sequences 14, 17 and 25 were high. The initial flush prior to WQ sampling might not be long enough. High turbidity might reflect stagnant water in hydrant assembly.
Crew knew UDF routine after Springlake Pilot Program – they were able to complete Downtown Pilot Program within 3 working nights with 59 valves to operate.
Lessons Learned

- **Inconsistency between Water System Map and Field**
  - Make sure all pipelines (recently constructed) are in your map/hydraulic model
  - Make sure all valves (recently installed) are in your map or hydraulic model

- **Groundwater Well with VFD pump**
  - Static pressure can be high when the area is isolated and the demand is very low.
  - Make sure the demand in the study area is high enough to allow a VFD pump to operate steadily.
  - Open hydrant to create minimal demand in the closed-loop when not flushing
Develop UDF Program for the entire water system

UDF Program will consist of 14 sections

Each sections will be developed with prioritization from the most critical to the least critical and will be reviewed based on

- Number of customer complains
- Leak record
- System condition
Thank you to these guys for their hard work in the field!
Agenda

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