Automated Unidirectional Flushing Software Programs

Do You Flush?

Pacific Northwest Section
American Water Works Association
Water Quality
Eugene, Oregon
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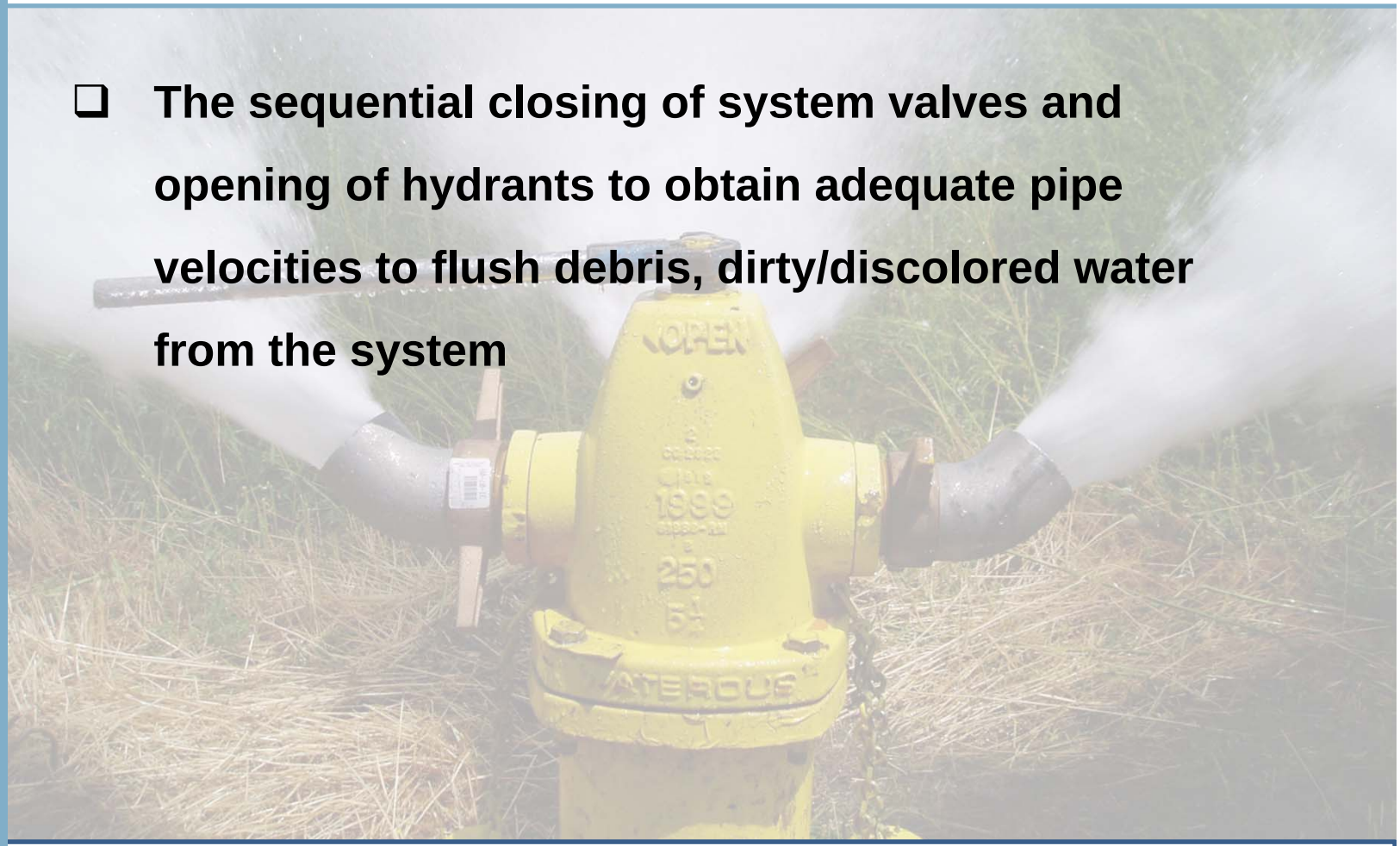
MSA

What is Unidirectional Flushing or UDF?

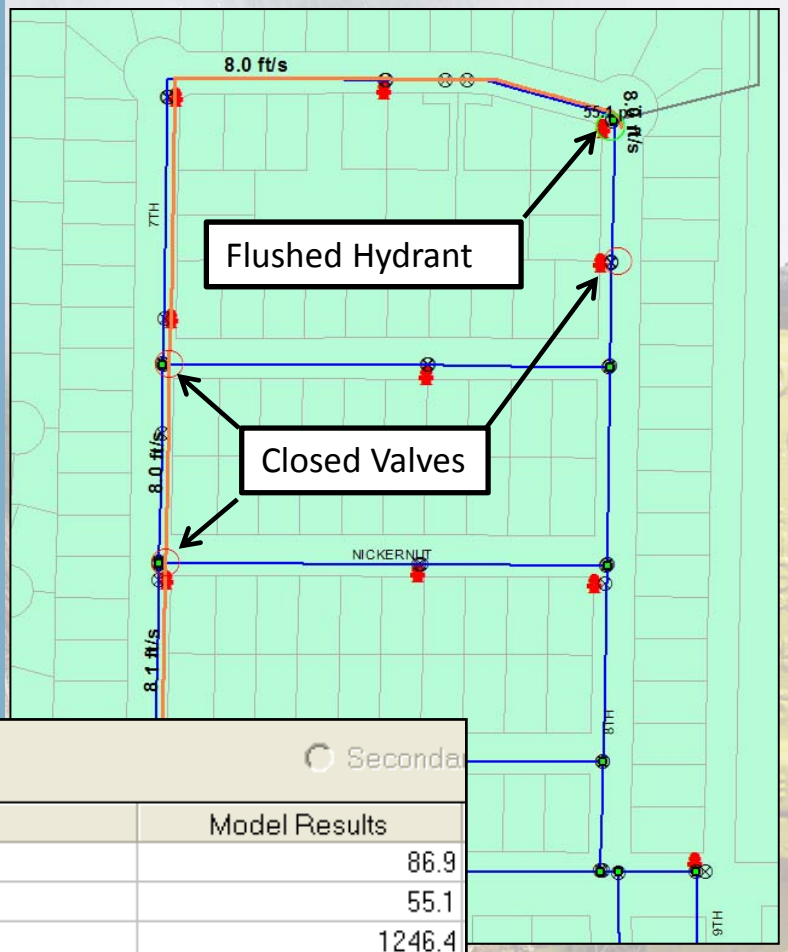


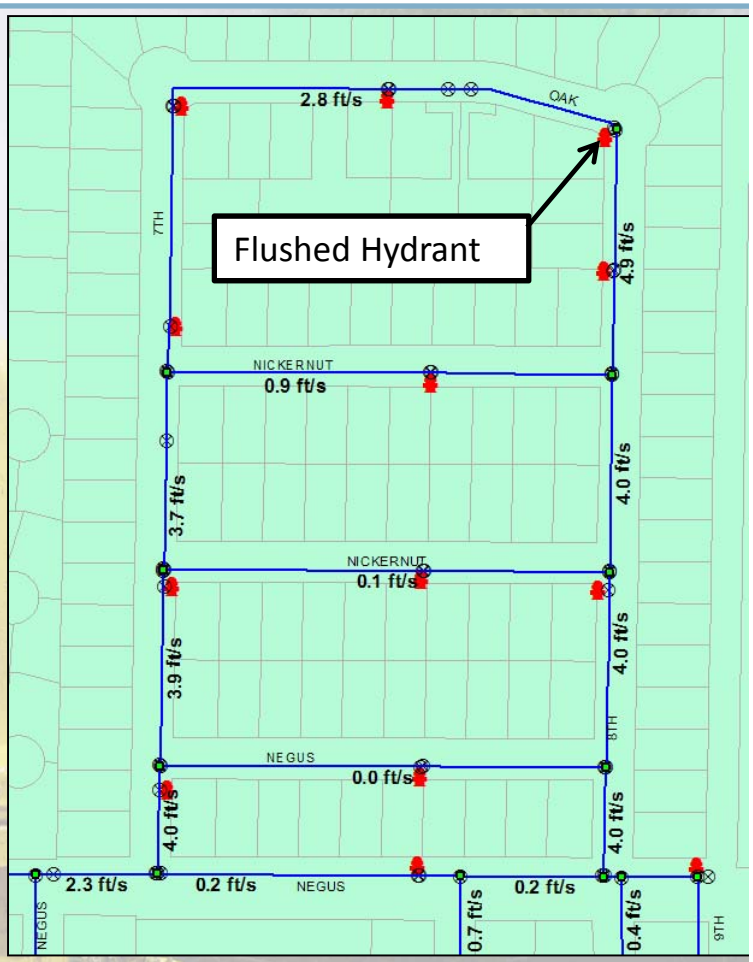
- The sequential closing of system valves and opening of hydrants to obtain adequate pipe velocities to flush debris, dirty/discolored water from the system

How is it Different than Traditional Flushing Methods?

- **Additional planning is required**
  - Identification of flushing areas using hard copy maps
  - Typically aided by a hydraulic model to identify valve/hydrant sequence and simulate velocities and discharge rates
- **Targets velocities of 5 ft/s (min 3 ft/s)**
- **Traditional flushing doesn't guarantee adequate velocities**
  - Normally positive redundancy and looping works against flushing
- **Traditional flushing may drop system pressure below 20 psi**
- **Traditional flushing may involve all hydrants**
  - UDF only flushes strategically placed hydrants

UDF Compared with Traditional Flushing

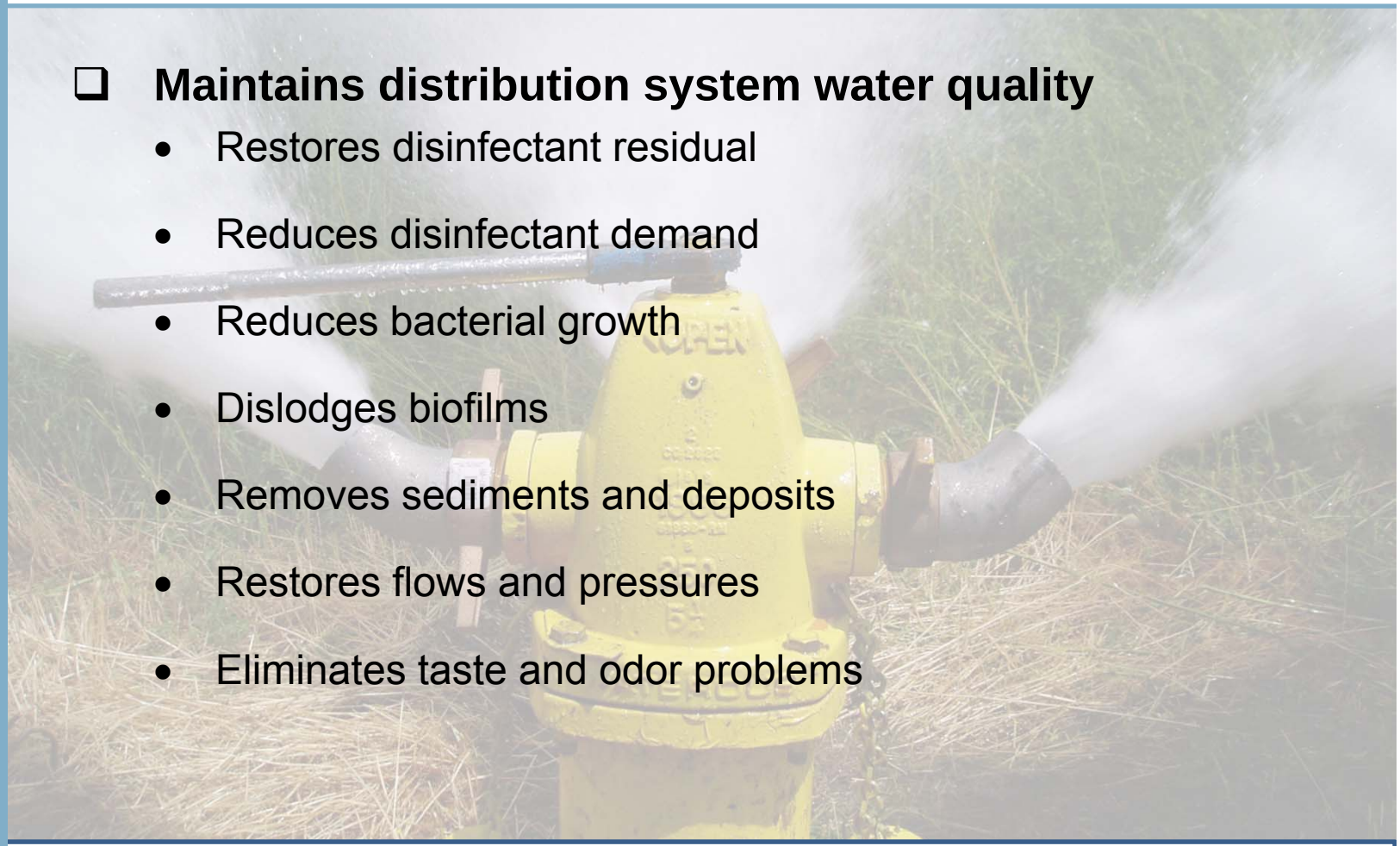




Primary Hydrant Seconda

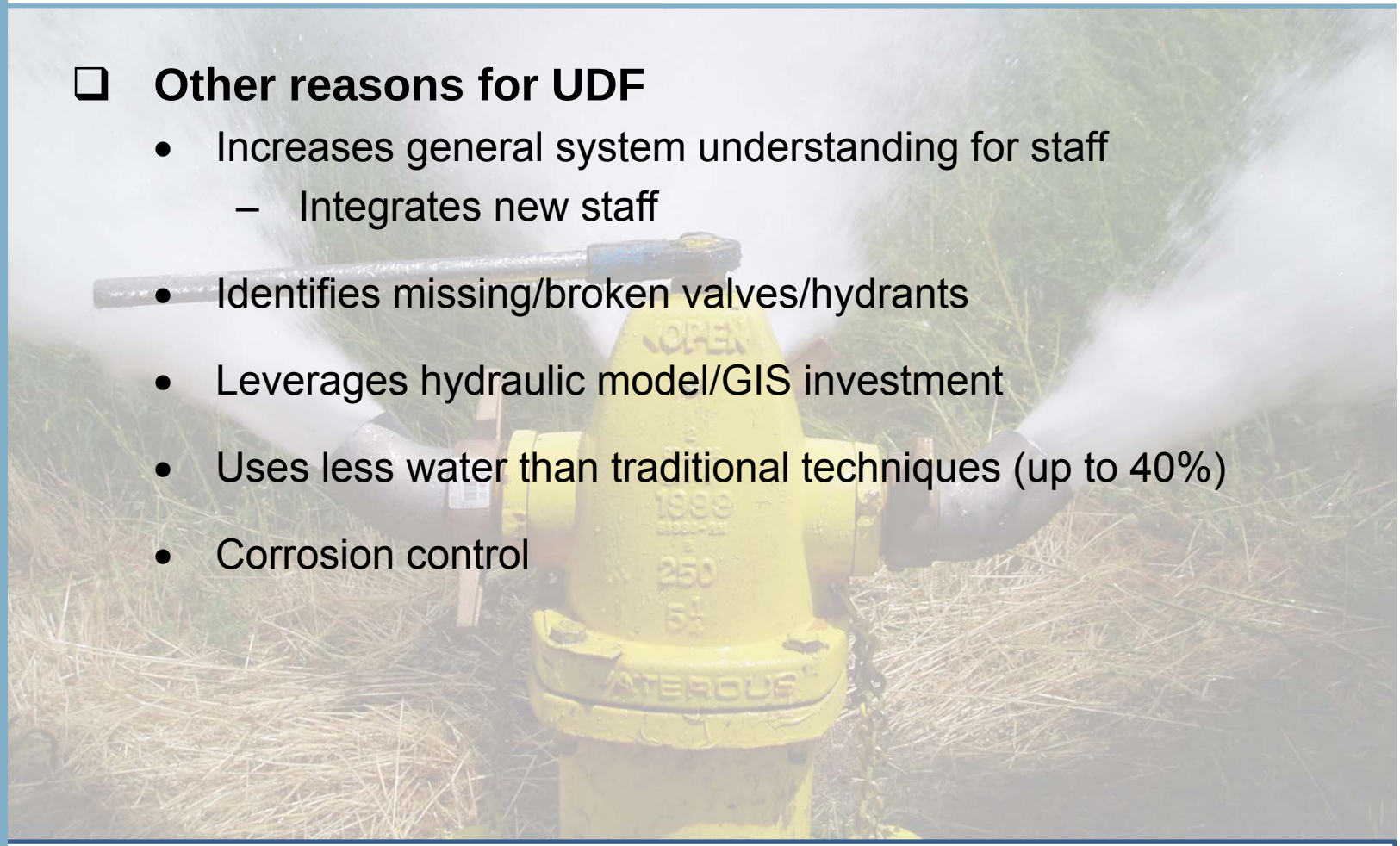
Item	Model Results
Static Pressure	86.9
Residual Pressure	55.1
Discharge Flow	1246.4

Why Flush?
(other than for obvious personal reasons)



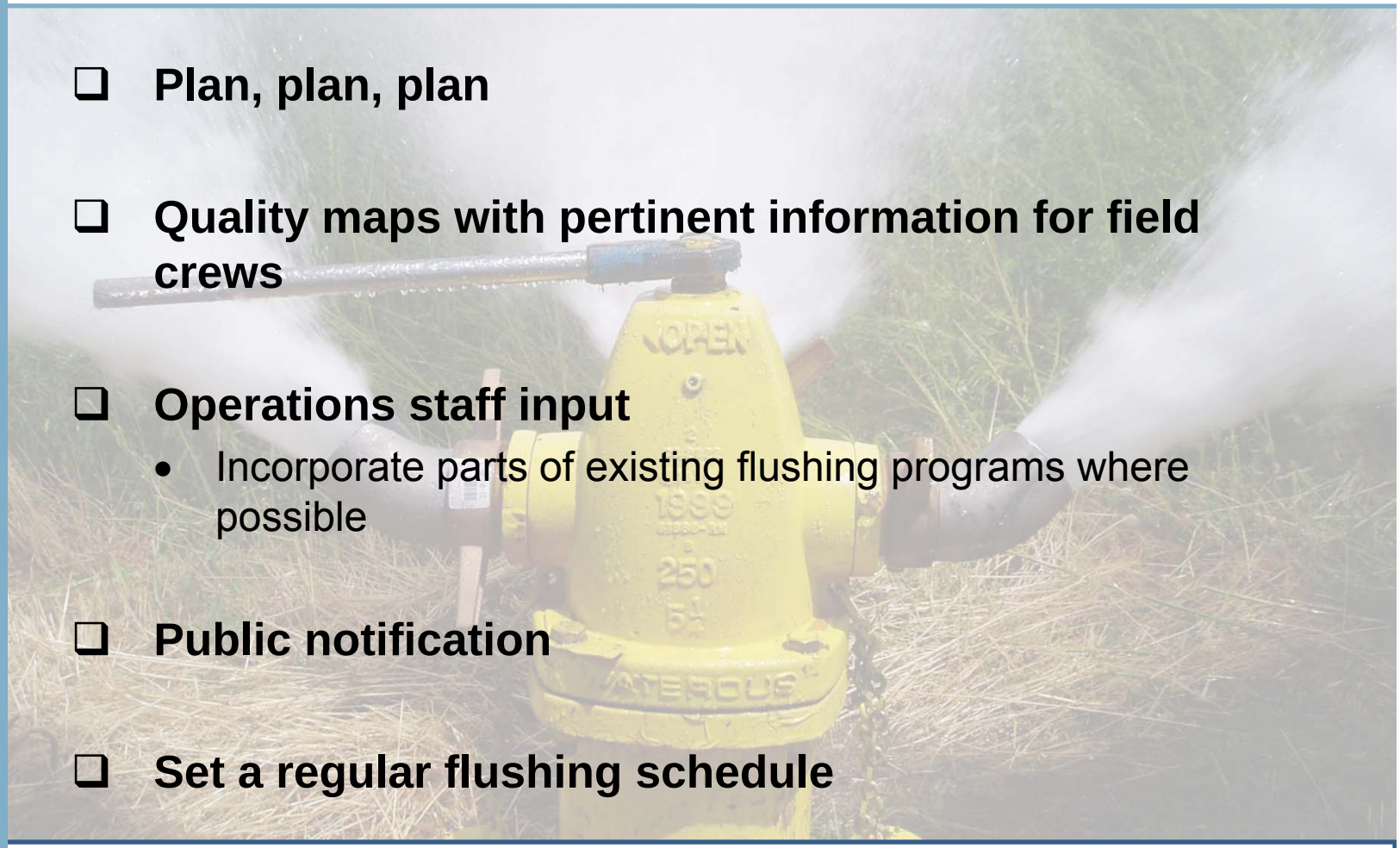
- **Maintains distribution system water quality**
  - Restores disinfectant residual
  - Reduces disinfectant demand
  - Reduces bacterial growth
  - Dislodges biofilms
  - Removes sediments and deposits
  - Restores flows and pressures
  - Eliminates taste and odor problems

Why Flush?



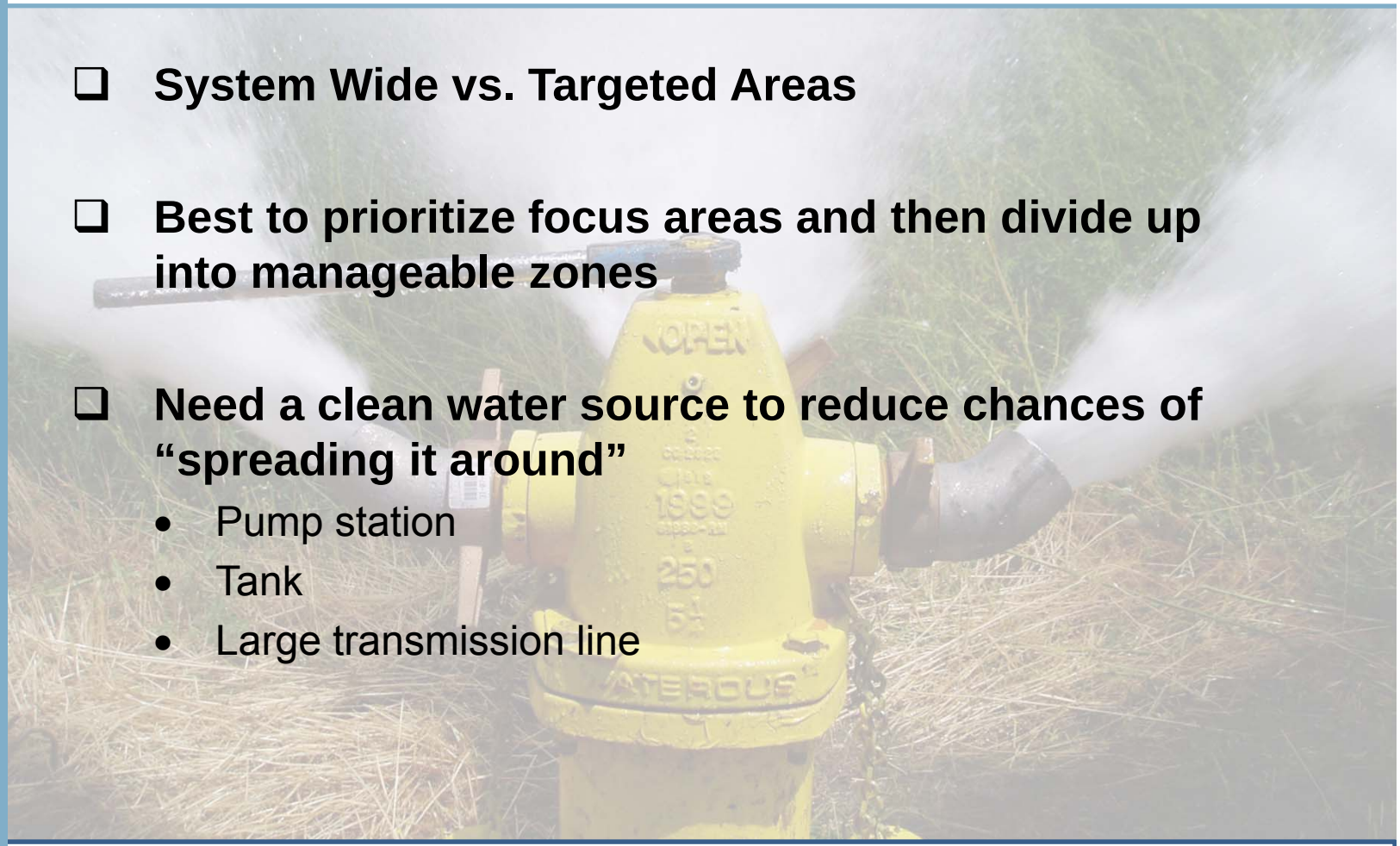
- **Other reasons for UDF**
  - Increases general system understanding for staff
    - Integrates new staff
  - Identifies missing/broken valves/hydrants
  - Leverages hydraulic model/GIS investment
  - Uses less water than traditional techniques (up to 40%)
  - Corrosion control

Keys to an Effective UDF Program



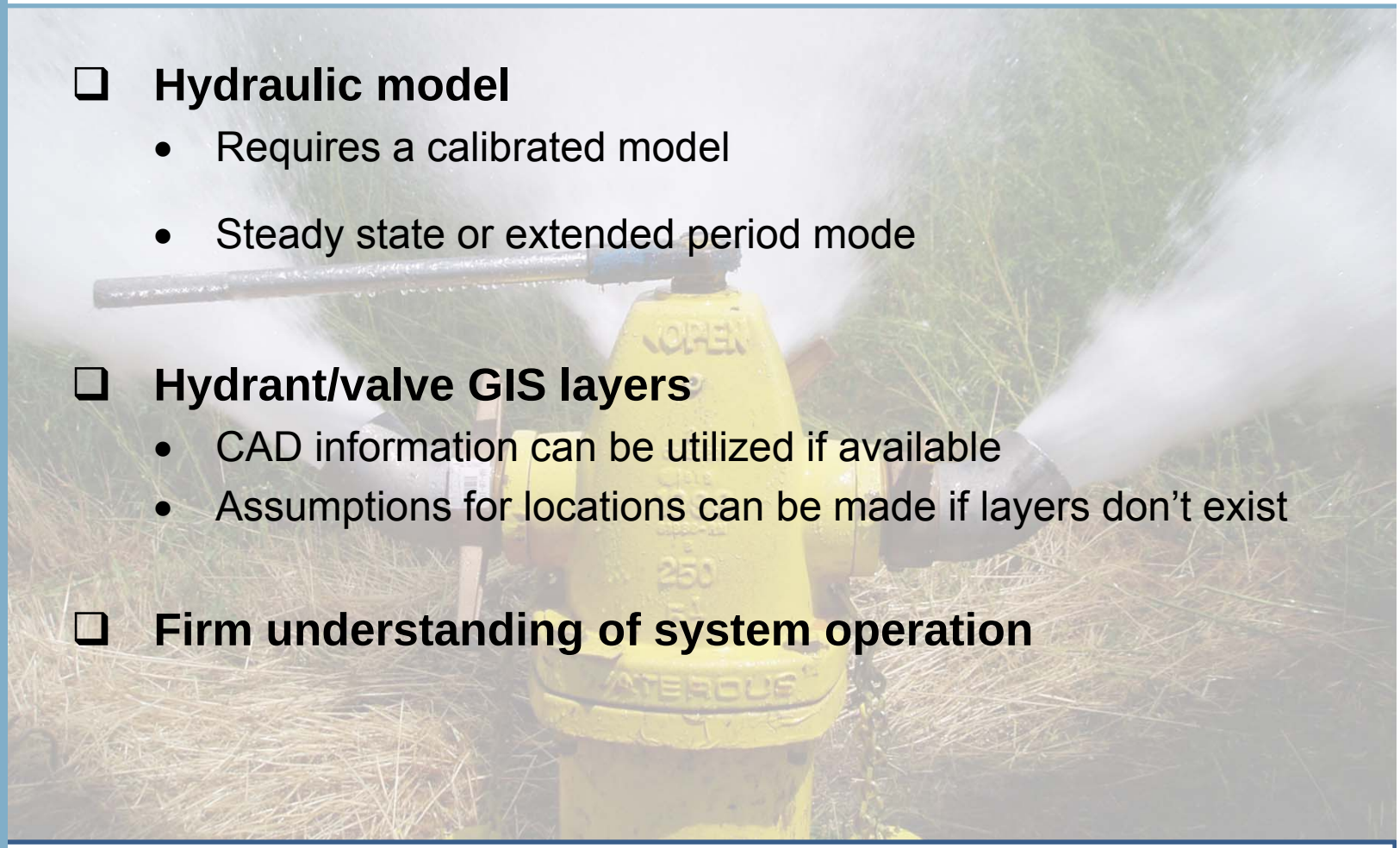
- **Plan, plan, plan**
- **Quality maps with pertinent information for field crews**
- **Operations staff input**
  - Incorporate parts of existing flushing programs where possible
- **Public notification**
- **Set a regular flushing schedule**

Keys to an Effective UDF Program



- **System Wide vs. Targeted Areas**
- **Best to prioritize focus areas and then divide up into manageable zones**
- **Need a clean water source to reduce chances of "spreading it around"**
  - Pump station
  - Tank
  - Large transmission line

What Information is Required to Develop a UDF Plan?



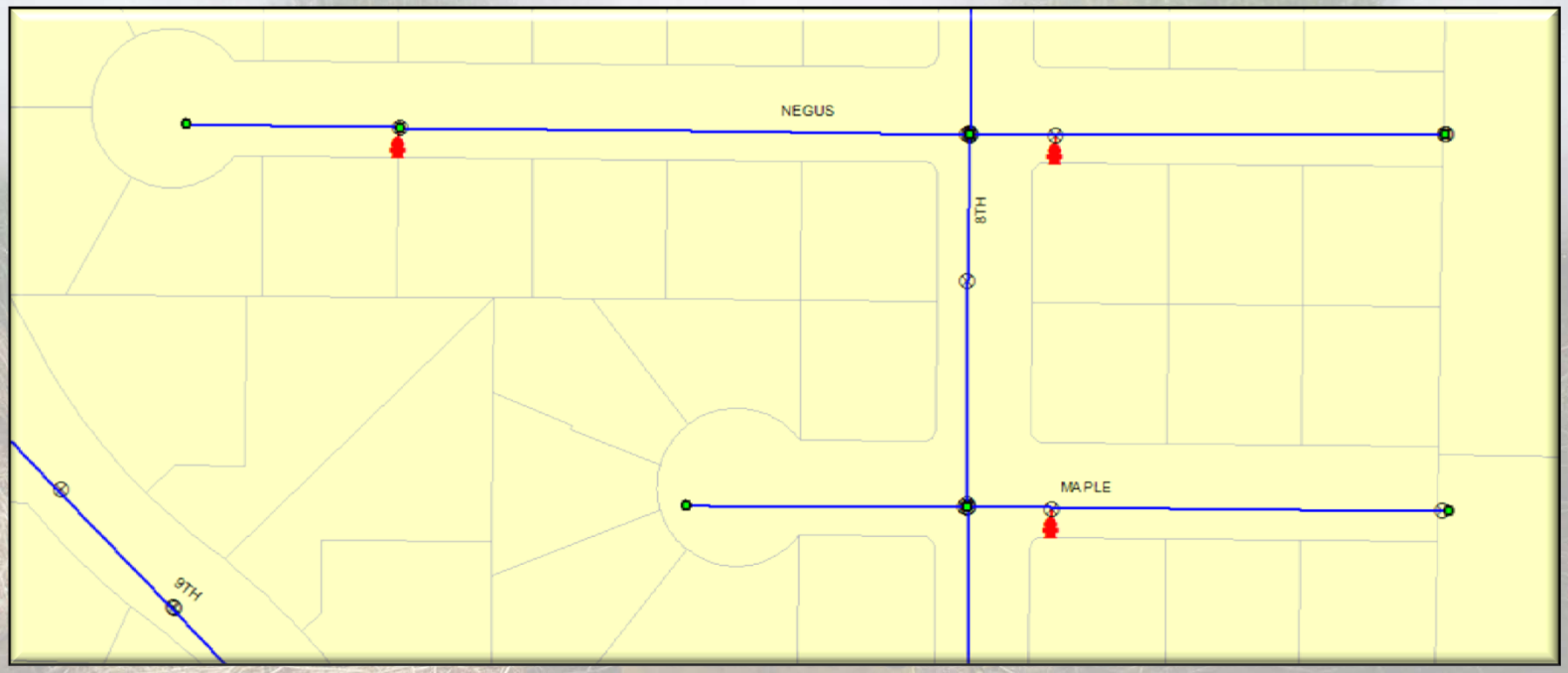
- **Hydraulic model**
  - Requires a calibrated model
  - Steady state or extended period mode
- **Hydrant/valve GIS layers**
  - CAD information can be utilized if available
  - Assumptions for locations can be made if layers don't exist
- **Firm understanding of system operation**

UDF Model Building Process

- **Add valves/hydrants**
  - Was the model created from GIS?
  - Valves/hydrants to be operated should be provided
  - QA/QC
    - Are hydrant and valve numbers populated and unique?
    - Valves
      - Does layer “register” with model?
    - Hydrants
      - Number of ports and size
      - Elevations
    - Hydrant laterals
      - Length and diameter

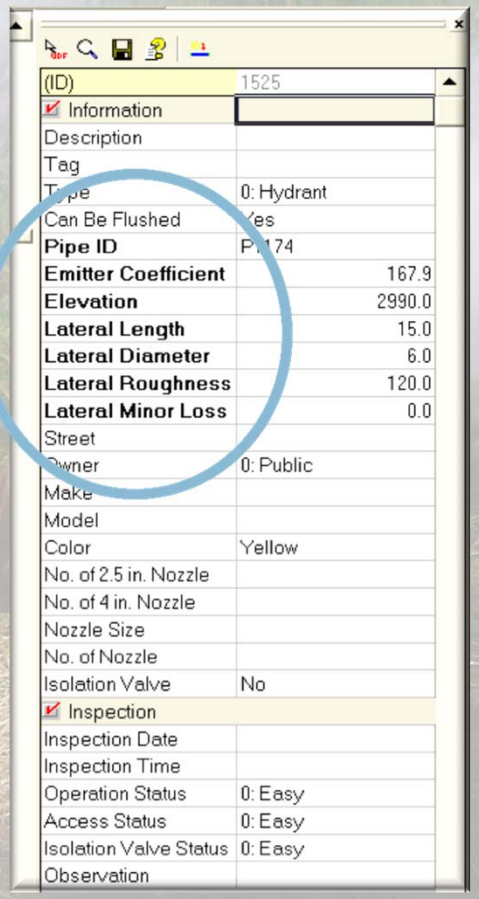
UDF Model Building Process

- **Valves & Hydrants are key for building the UDF database**



Hydrants

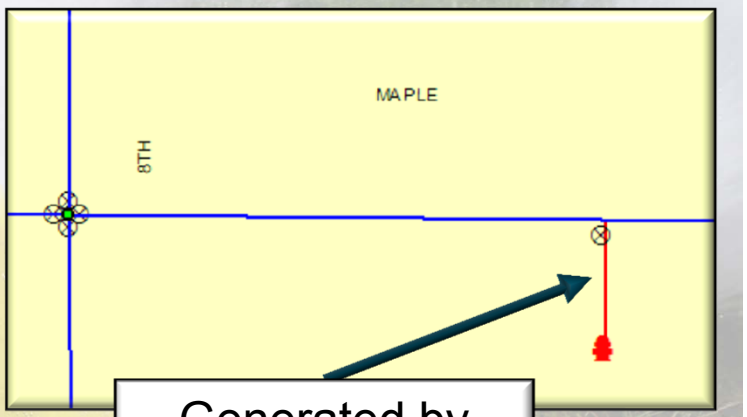
- **Pertinent attributes associated with hydrant**
- **Requires preprocessing**
  - "Pipe" attributes not normally associated with hydrants
    - Length, roughness, diameter
- **Non-hydraulic information can be tracked**



(ID)	1525
Information	
Description	
Tag	
Type	0: Hydrant
Can Be Flushed	Yes
Pipe ID	P-174
Emitter Coefficient	167.9
Elevation	2990.0
Lateral Length	15.0
Lateral Diameter	6.0
Lateral Roughness	120.0
Lateral Minor Loss	0.0
Street	
Owner	0: Public
Make	
Model	
Color	Yellow
No. of 2.5 in. Nozzle	
No. of 4 in. Nozzle	
Nozzle Size	
No. of Nozzle	
Isolation Valve	No
Inspection	
Inspection Date	
Inspection Time	
Operation Status	0: Easy
Access Status	0: Easy
Isolation Valve Status	0: Easy
Observation	

Hydrants

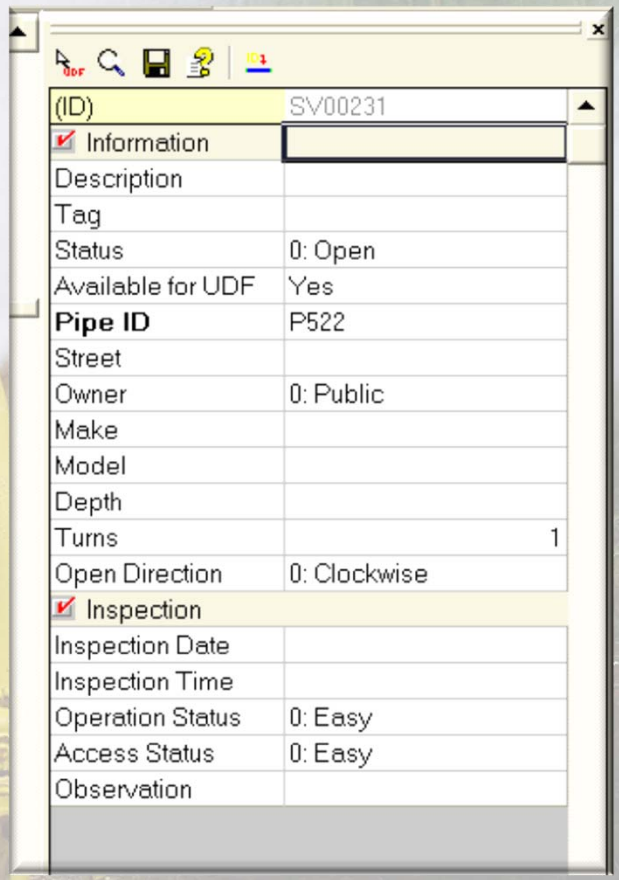
- **Auto-associated to model pipes**
  - Auto-calcs mainline distance
  - Hydrants can be associated “mid-pipe”



Generated by InfoWater UDF

Valves

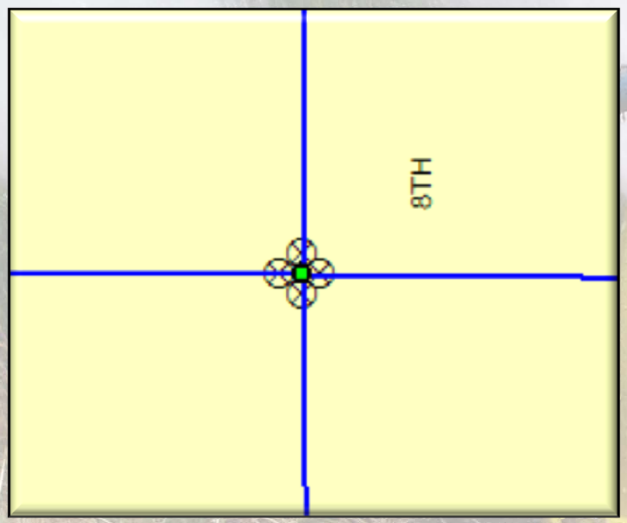
- Ensure correct valve/pipe association
- Auto-associated
- Non-hydraulic information can be tracked



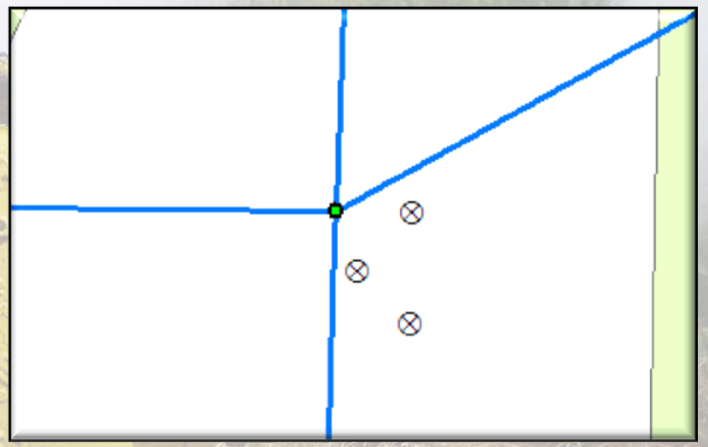
(ID)	SV00231
Information	
Description	
Tag	
Status	0: Open
Available for UDF	Yes
Pipe ID	P522
Street	
Owner	0: Public
Make	
Model	
Depth	
Turns	1
Open Direction	0: Clockwise
Inspection	
Inspection Date	
Inspection Time	
Operation Status	0: Easy
Access Status	0: Easy
Observation	

Valve Registration

- What we want to see

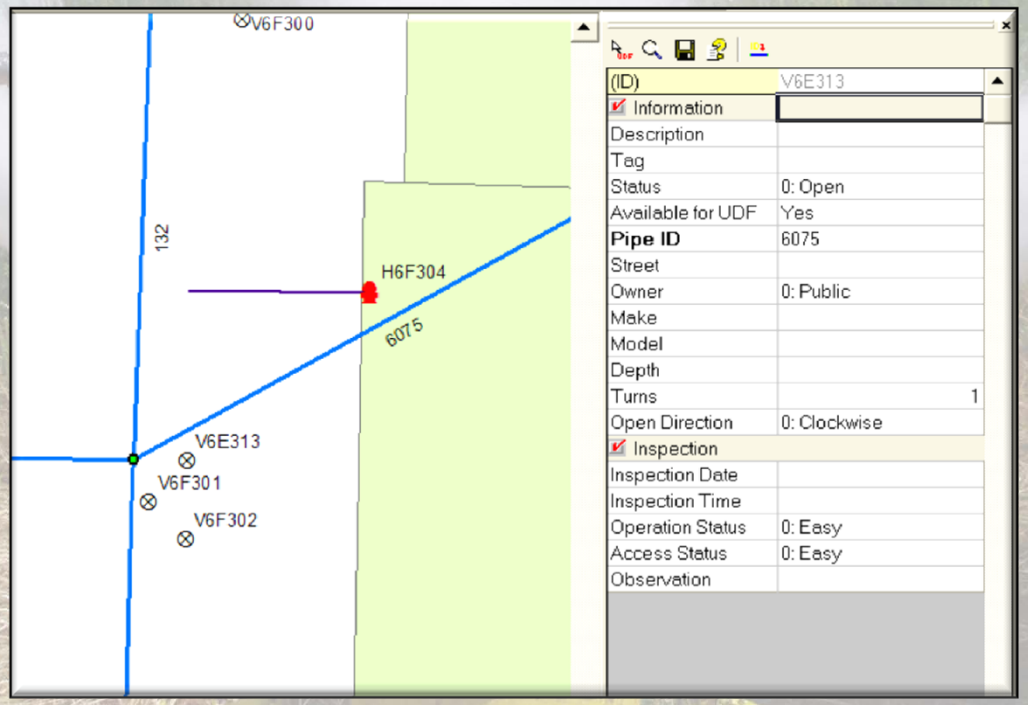


- Making our life interesting



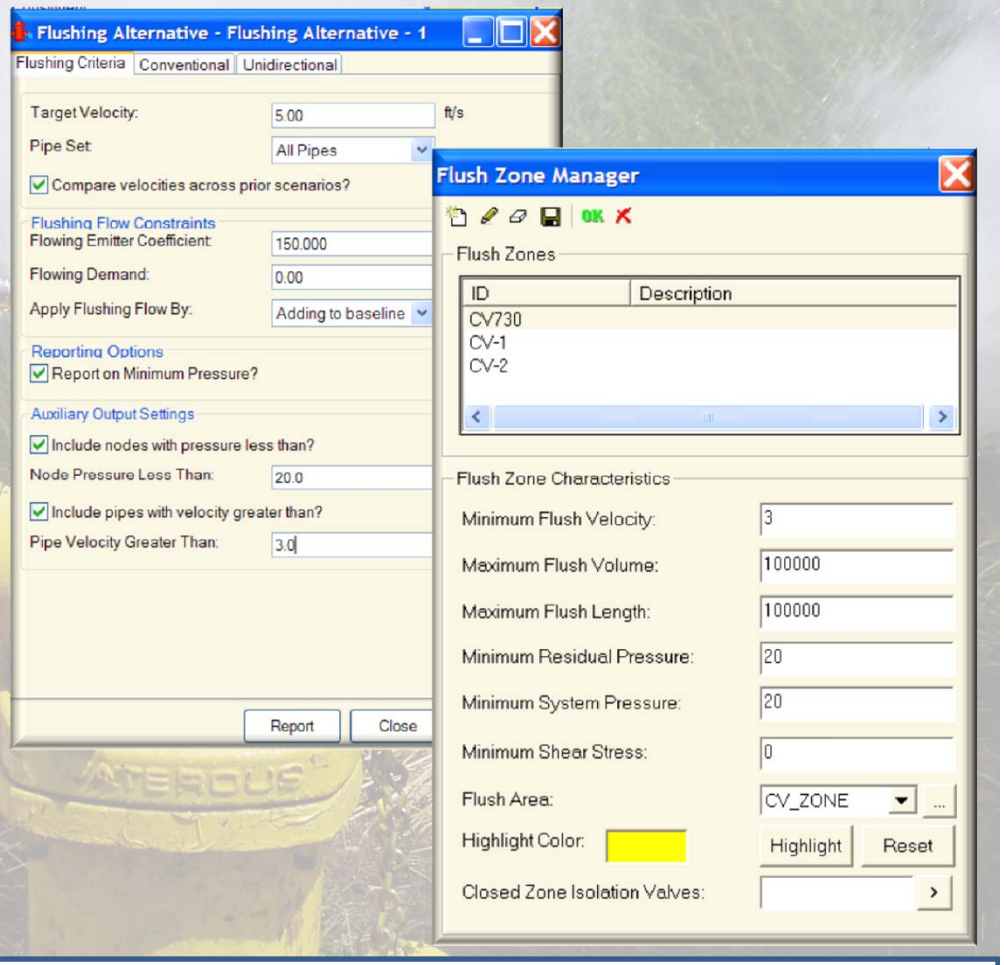
Registration Issues

- **Valve registration can be critical**
  - If the user wants to use valve ids in the field



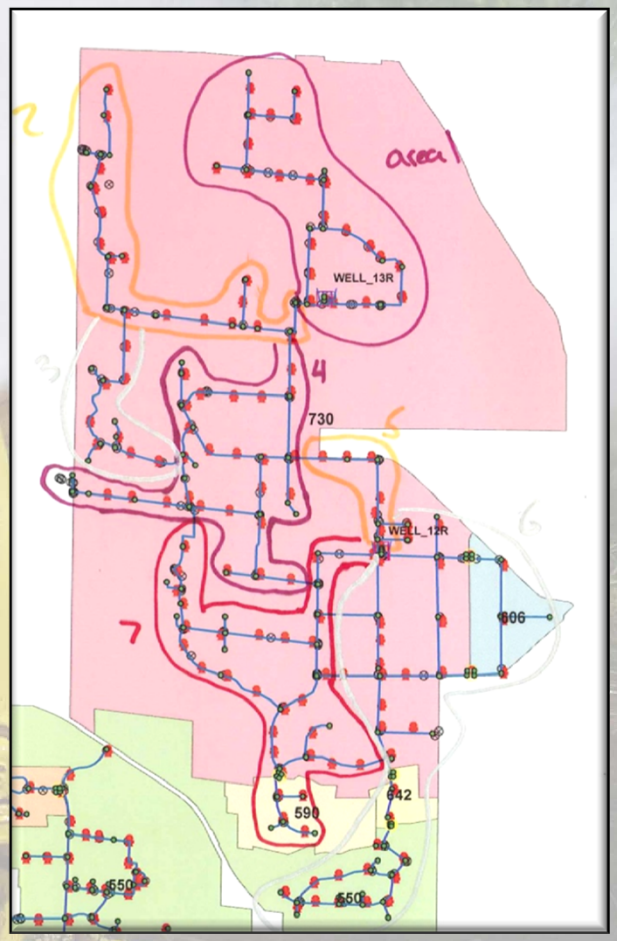
UDF Analysis Criteria

- **Typical flushing velocity**
  - Min 3 ft/s
  - Target 5 ft/s
  - Shear stress criteria can be used in InfoWater
- **Min system pressure typically 20 psi**



Analysis Process

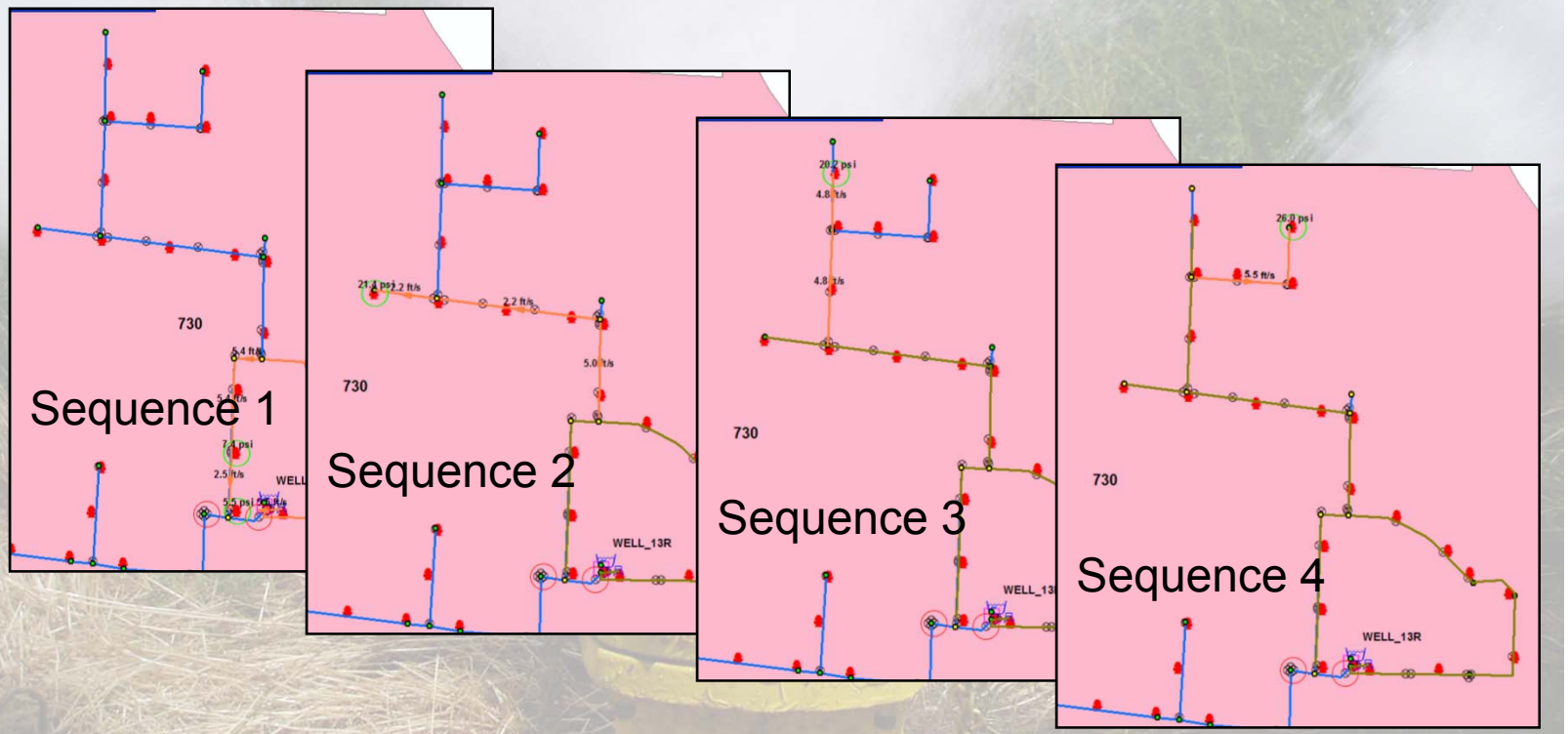
- **Using large format system map:**
  - Mark up flush zones
    - Typically pressure zones or smaller
    - Each zone associated with a “primary” source
    - Each zone includes a number of flush sequences
    - Work from source to system periphery



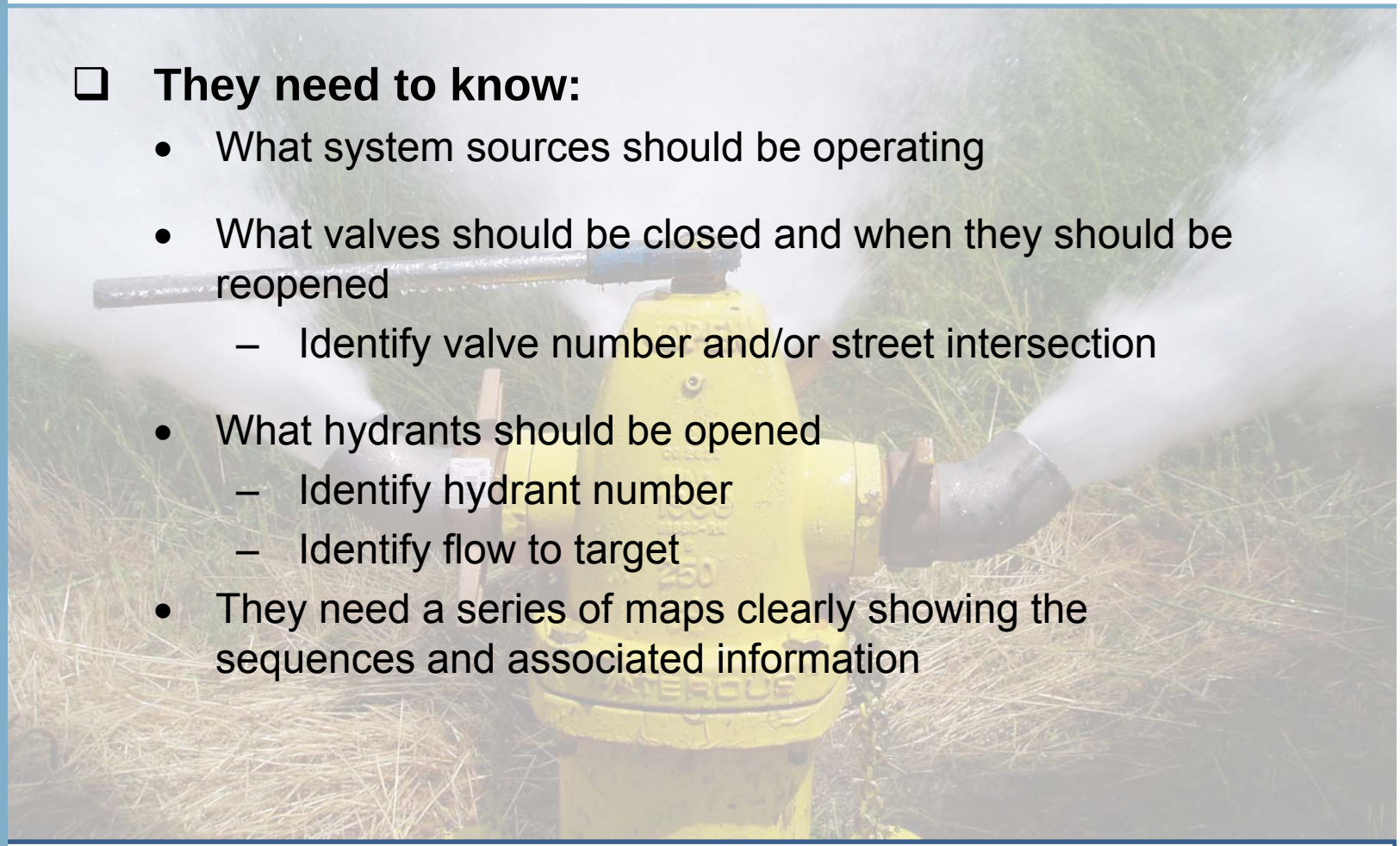
Analysis Process

- **In the model:**
  - Identify initial flush pipeline(s)
  - Identify what hydrant(s) will be opened
  - Identify valves to be closed
    - Take care not to isolate portions of the system from water
    - Minimize valve closures
      - Labor intensive for field crews

Example
UDF Flushing Sequence

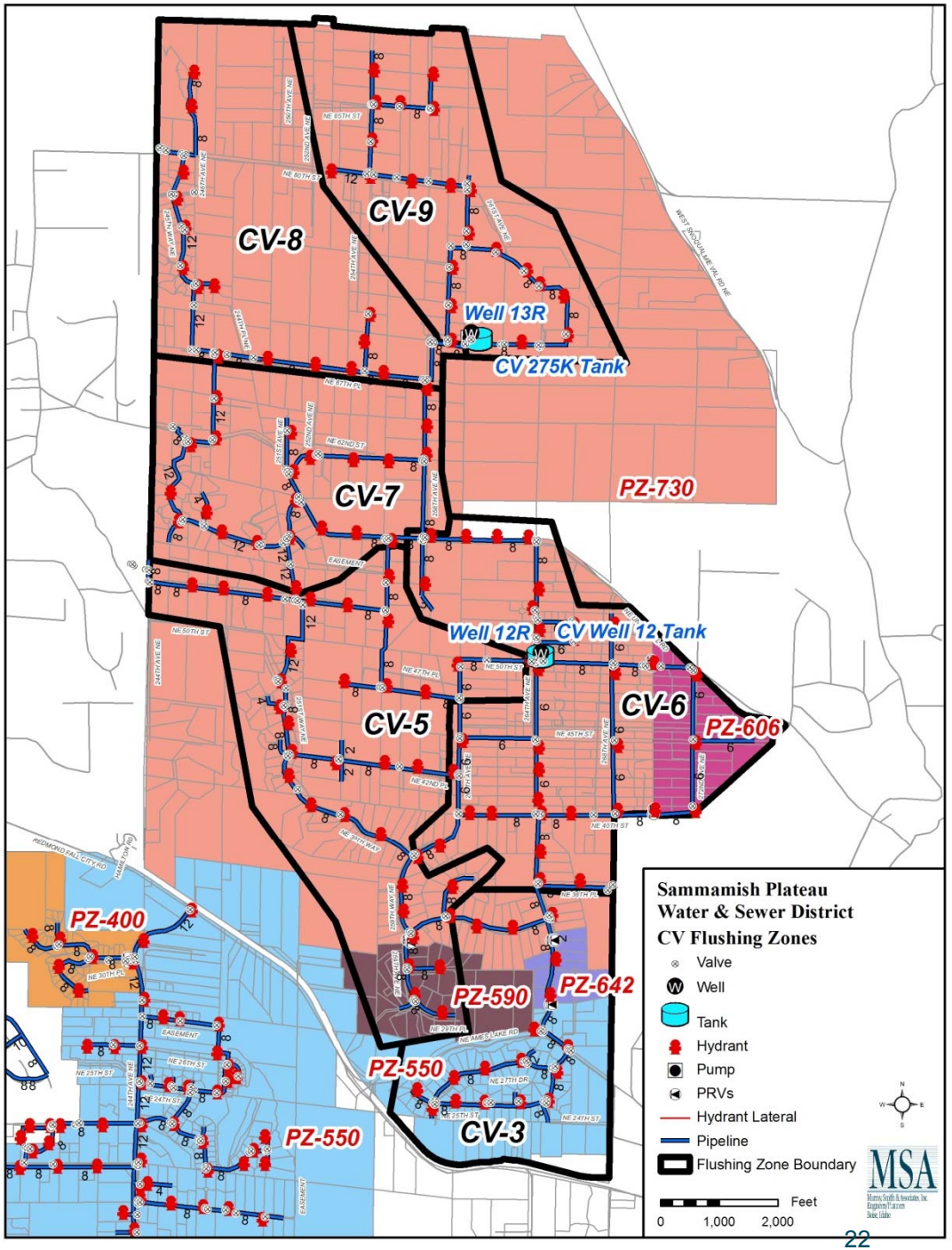


What Does the Field Crew Use?



- **They need to know:**
  - What system sources should be operating
  - What valves should be closed and when they should be reopened
    - Identify valve number and/or street intersection
  - What hydrants should be opened
    - Identify hydrant number
    - Identify flow to target
  - They need a series of maps clearly showing the sequences and associated information

Sample Custom Flush Zone Map



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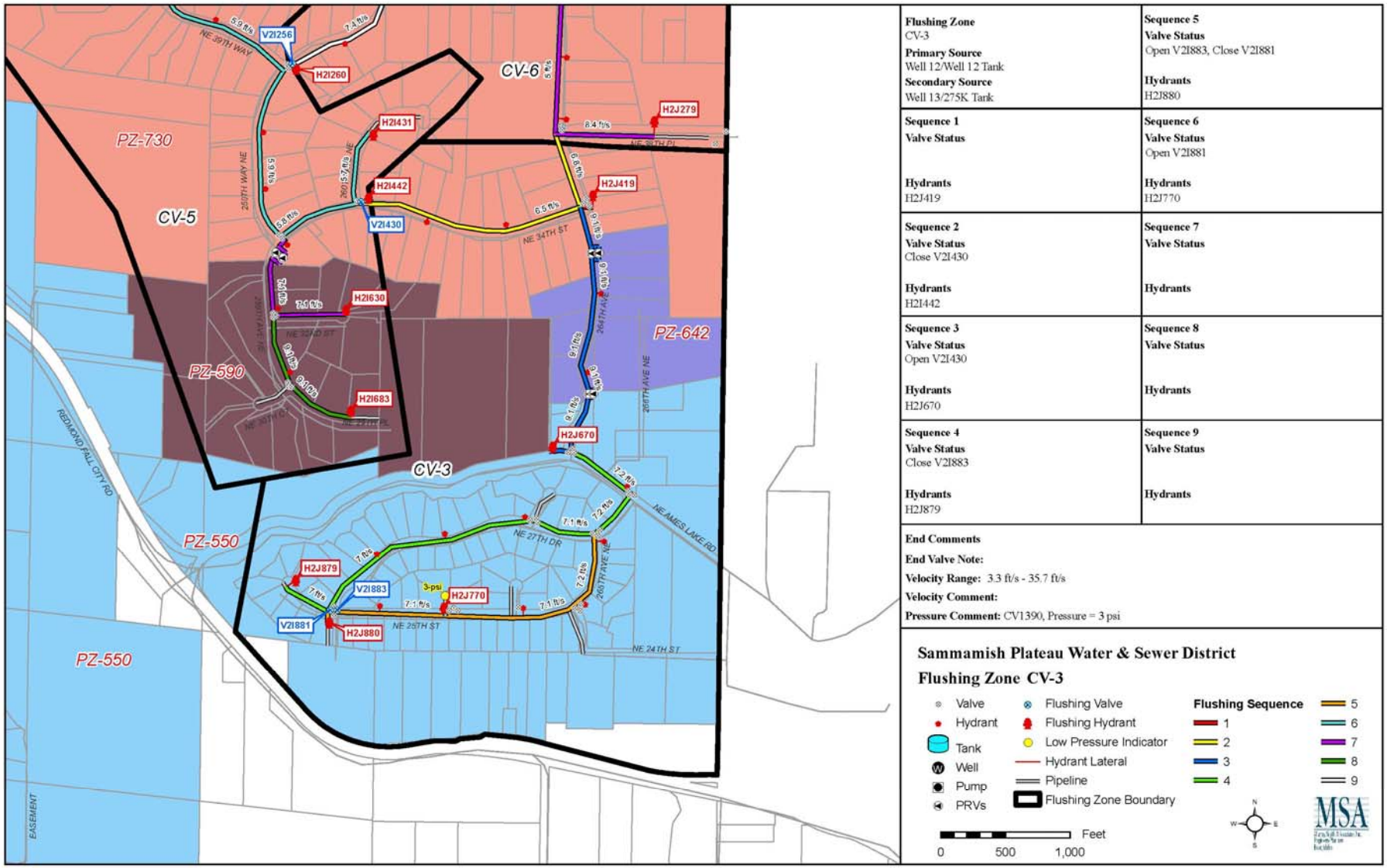
Sample Custom Flush Sequence Map



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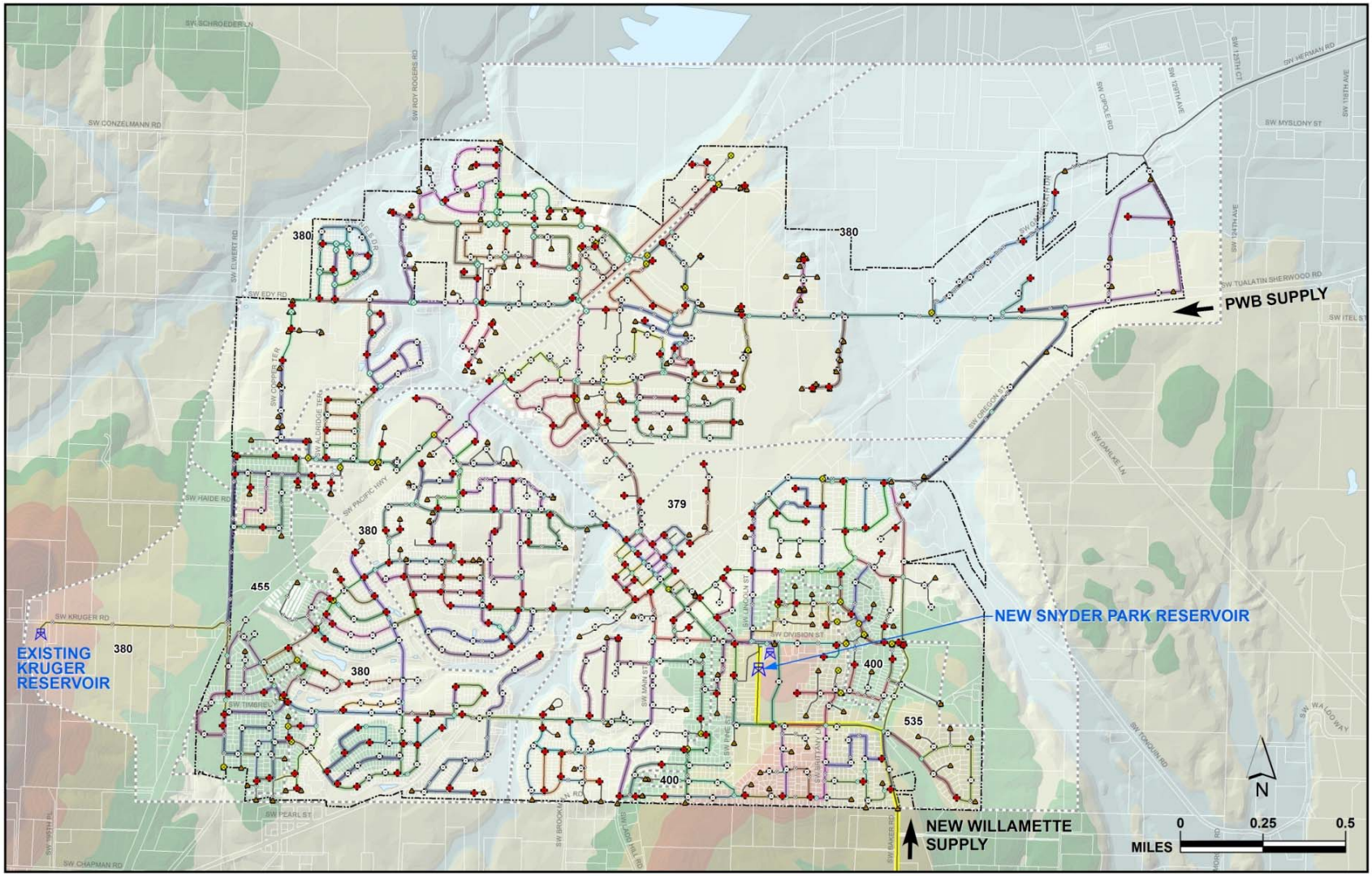
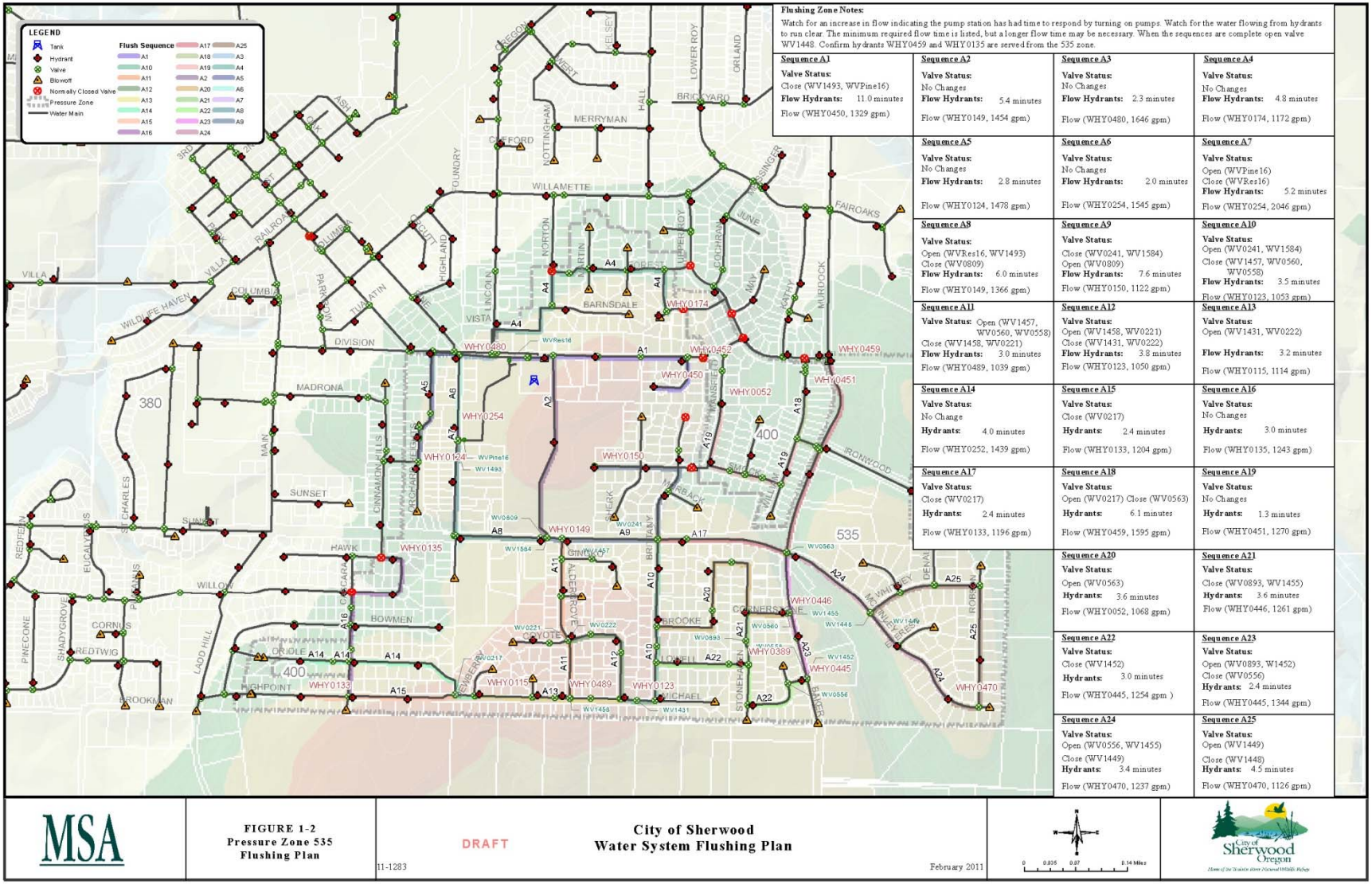
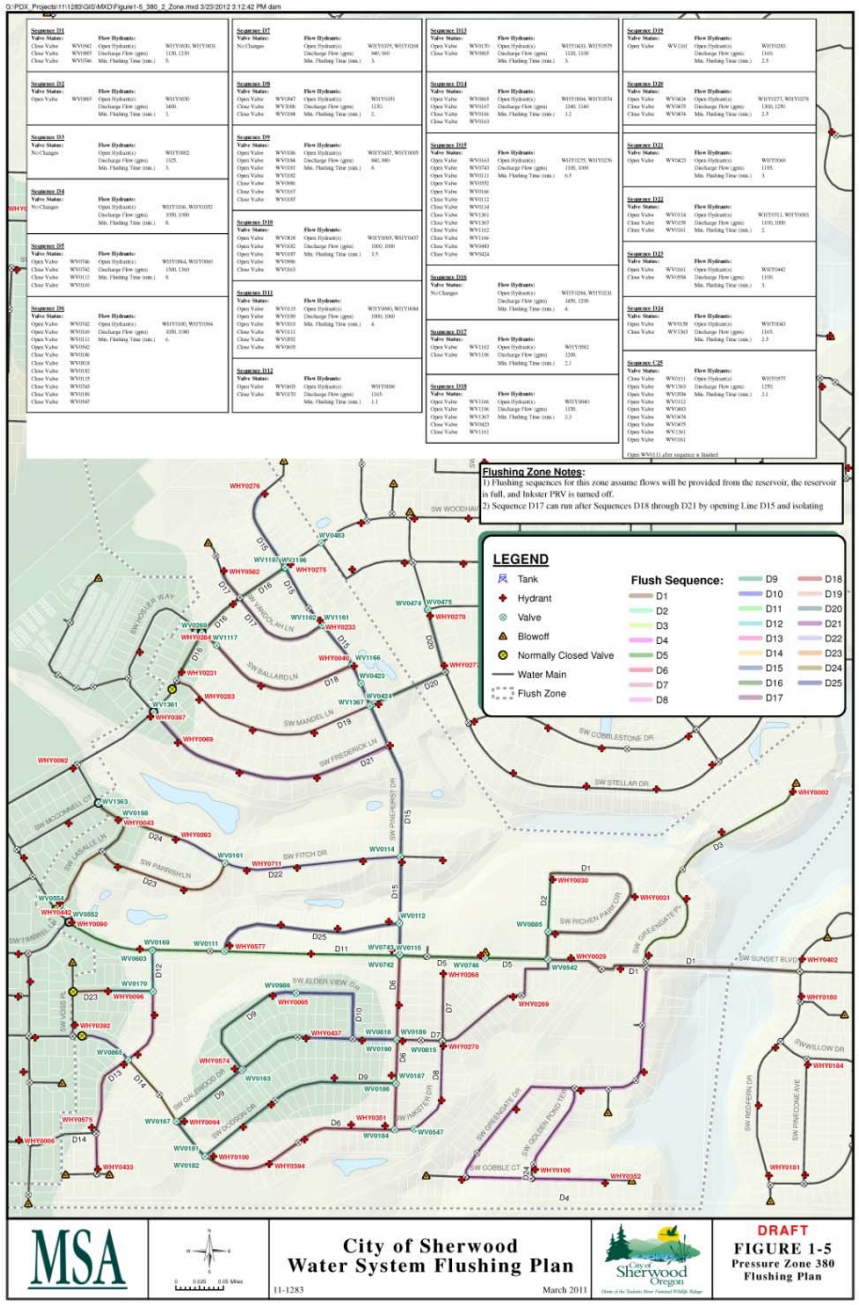


Sample Custom Flush Sequence Map




Flushing Zone Notes:
1) Flushing sequences for this zone assume flows will be provided from the reservoir, the reservoir is full, and Inkster PRV is turned off.
2) Sequence D17 can run after Sequences D18 through D21 by opening Line D15 and isolating
LEGEND
Tank
Hydrant
Valve
Blowoff
Normally Closed Valve
Water Main
Flush Zone
Flush Sequence:
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
MSA
City of Sherwood
Water System Flushing Plan
11-1283
March 2011
DRAFT
FIGURE 1-5
Pressure Zone 380
Flushing Plan

Summary

- **UDF**
  - Ensures adequate flushing velocities are being achieved
  - Can reduce the number of hydrants operated
  - Can reduce the amount of flushed water used
  - Can reduce the frequency of required flushing
    - Does a more effective job of removing debris, biofilm and dirty water
  - Provides a target flow rate for flushing
    - Should help identify areas of potential low pressure

Summary cont.

- **AWWA and industry supports UDF plan development beyond traditional flushing**
- **Software tools are becoming more effective/efficient as additional enhancements are made**

- **If a utility has:**
  - Invested in a hydraulic model
  - Focused modeling staff or consultant
  - Relatively accurate valve/hydrant information

  they should consider developing a UDF model and plan

So Flush Away!

- **Questions?**

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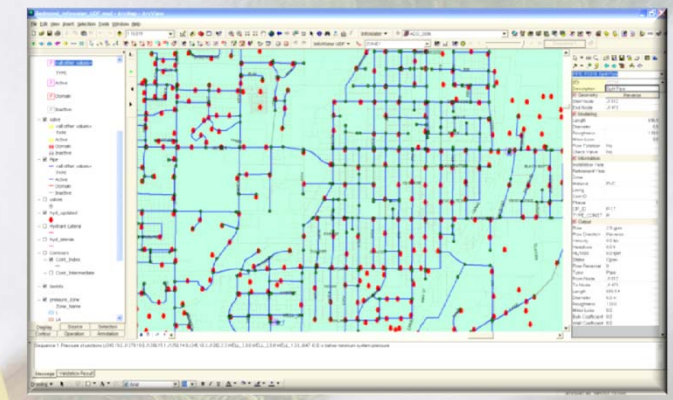
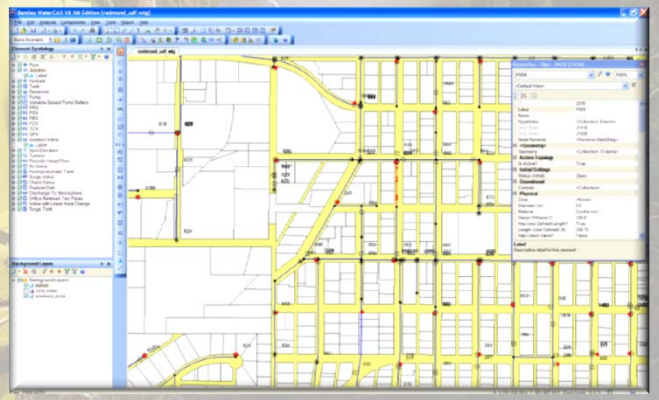
Available Tools

- **MWH Soft & Bentley Systems**
- **MWH Soft**
  - UDF - separate module
  - Requires InfoWater (ArcGIS) license
- **Bentley**
  - Includes UDF with all platforms (stand alone, CAD, ArcGIS)

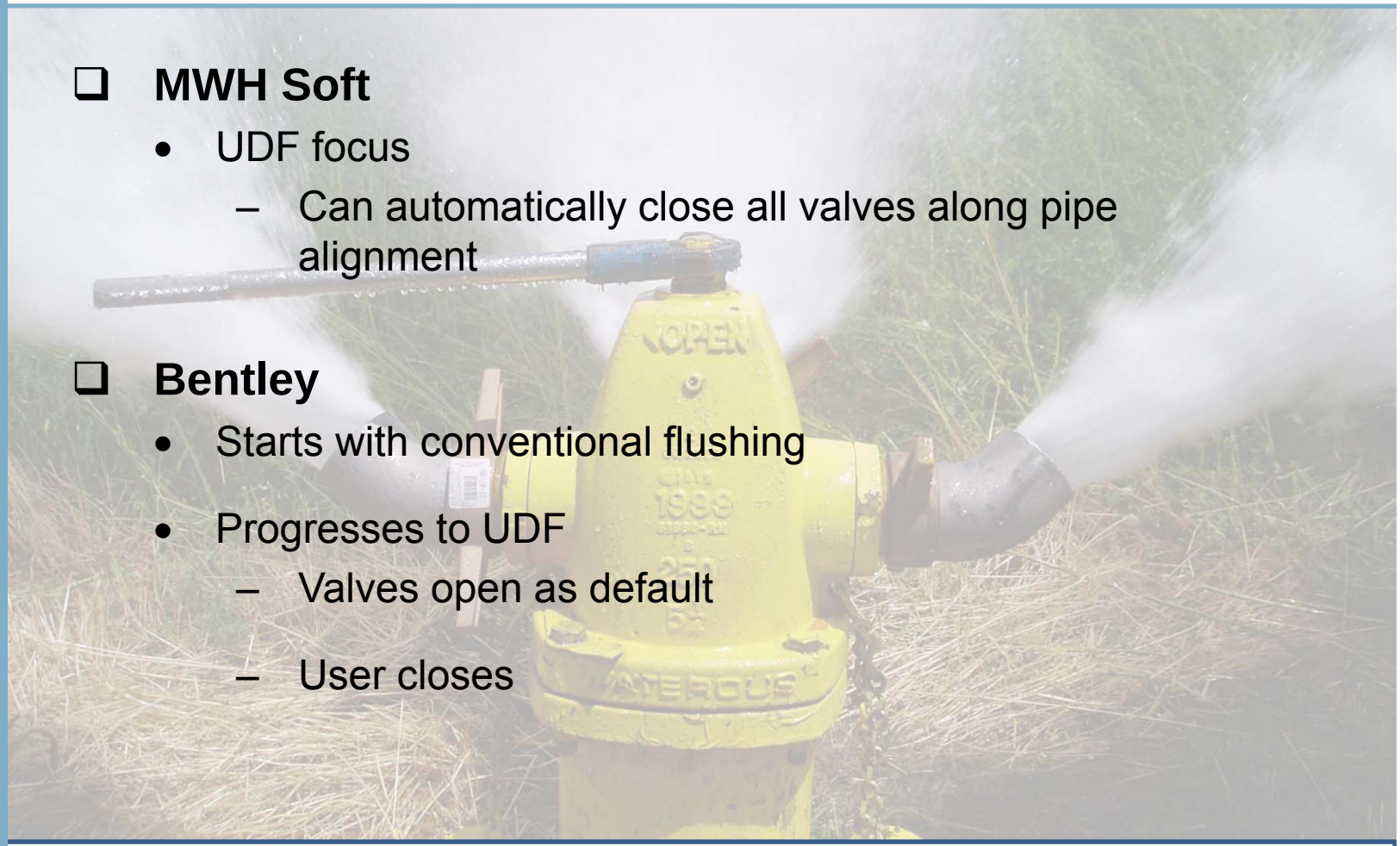




Caveats Ad Nauseam

- **Example List Prices for 5,000 and 6,000 pipe models**
  - 5,000 Pipes
    - Bentley – WaterGEMS $12k + cost of AV
    - MWH Soft - InfoWater $8k + UDF $7k + cost of AV
  - 6,000 Pipes
    - Bentley – WaterGEMS $20k + cost of AV
    - MWH Soft – Infowater $9k + UDF $8k + cost of AV
- **MWH Soft**
  - Valves and hydrant laterals do not increase pipe count
  - Can buy increments of 1,000 pipes
- **Bentley**
  - Requires a split where hydrants intersect pipes
  - Laterals must be entered
  - No split for valves

Approaches to UDF



- **MWH Soft**
  - UDF focus
    - Can automatically close all valves along pipe alignment
- **Bentley**
  - Starts with conventional flushing
  - Progresses to UDF
    - Valves open as default
    - User closes