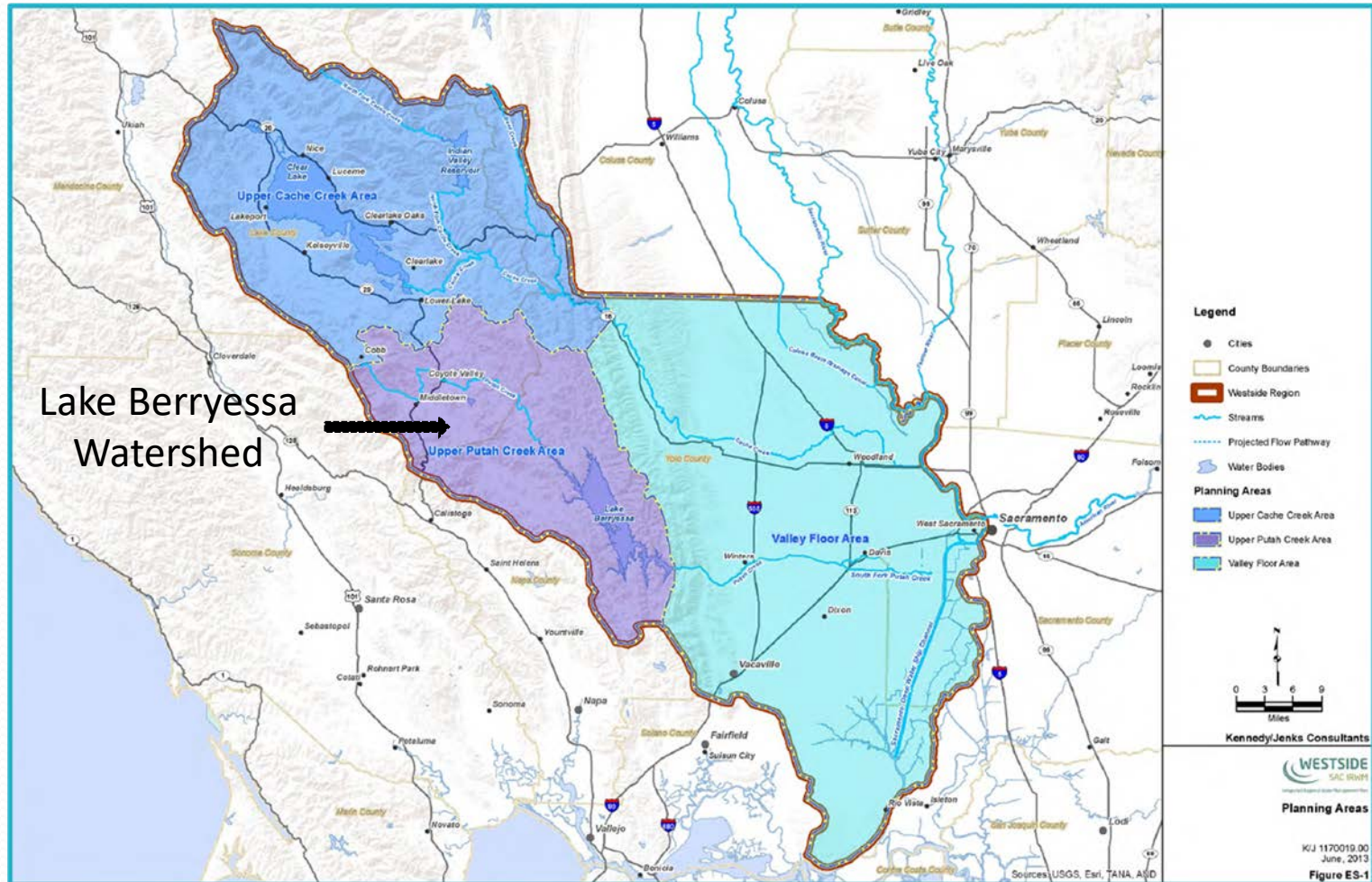


# Post-Fire Treatment Impacts on Berryessa

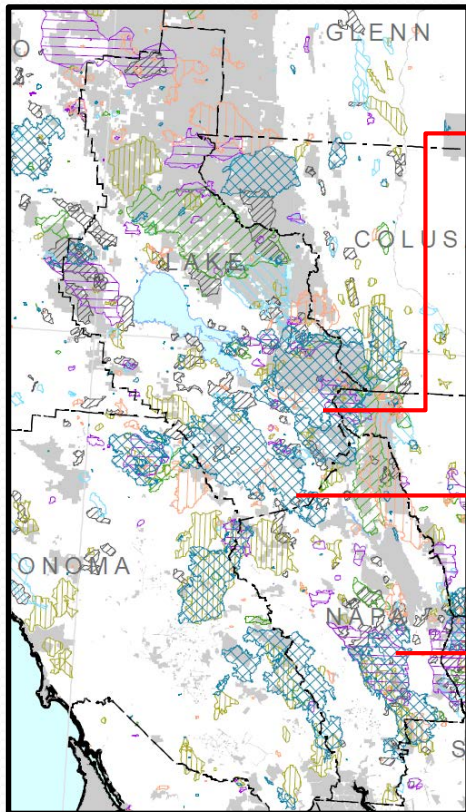


Christopher Silke, P.E. – Engineering Manager  
Certified Treatment / Distribution Operator

# Lake Berryessa / Upper Putah Creek Watershed



# Recent Wildfires in Berryessa Watershed



Source – Cal Fire Incident Map

Name	County	Year	Acres <sup>1</sup>
Butts	Napa	2014	4,300
Rocky	Lake	2015	69,438
Jerusalem	Lake	2015	25,118
Valley	Lake / Napa	2015	76,067
Wragg	Napa / Solano	2015	8,051
Cold	Yolo	2016	5,731
Knoxville	Napa	2016	36
Atlas	Napa	2017	51,624
Snell	Napa	2018	2,490
Steele	Napa	2018	135
County	Yolo / Napa	2018	90,288

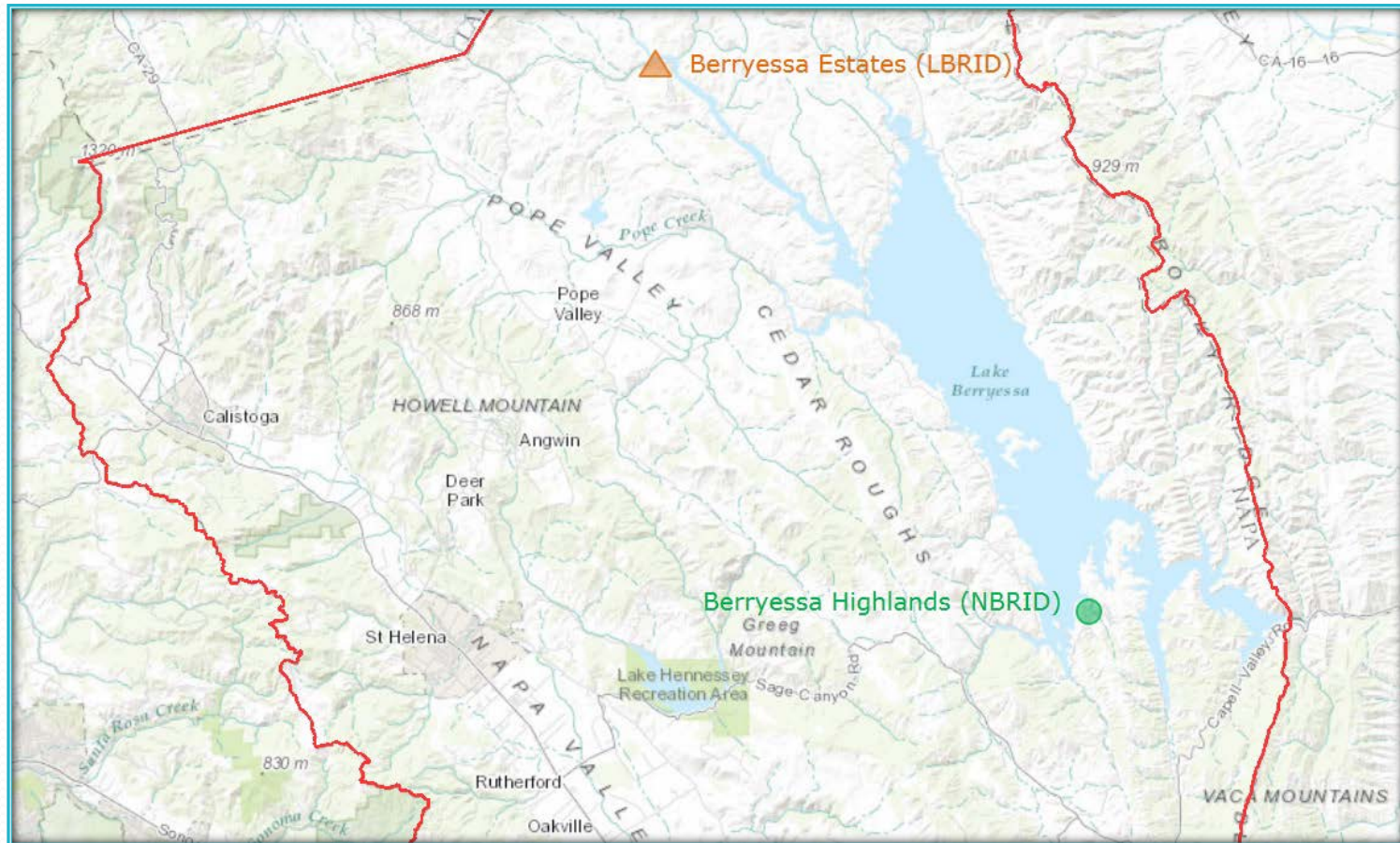
<sup>1</sup>Note: Cal Fire acreage estimates include areas both within and outside Berryessa watershed.



# Valley Fire Environmental Destruction

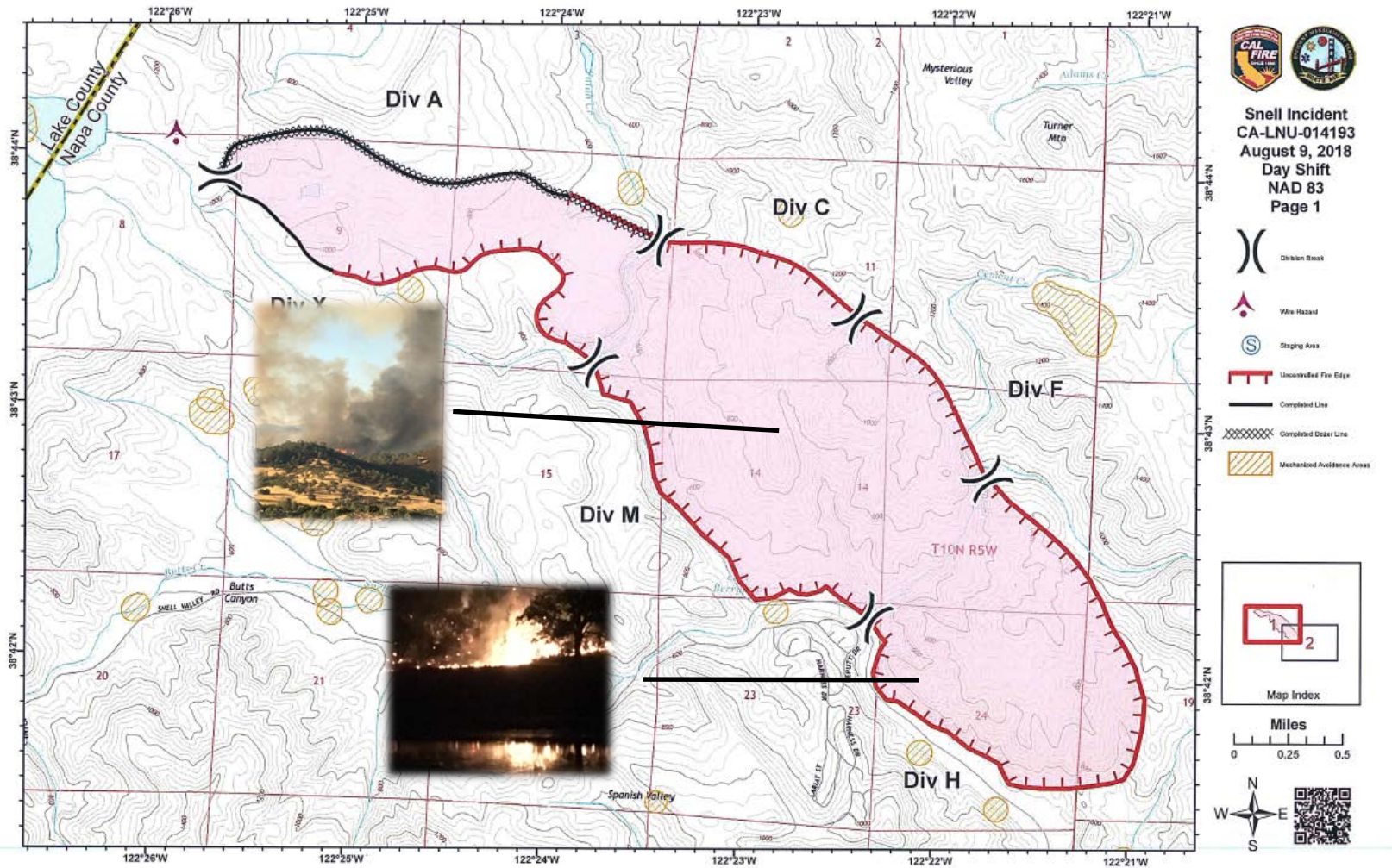


# Largest Napa County Berryessa Communities





# LBRID Snell Fire – August 2018



# Berryessa Estates (LBRID) Background

- Lake Berryessa Resort Improvement District – 1965
- Legislatively Established by PRC Section 13000
- Approx. 337 Developable Parcels @ Full Build-Out
- 170 Active Water & Sewer Service Accounts
- FY 18/19 Operating & Capital Budget - \$2.74M
- Revenue – Assessments, T-1 Tax, User Rates, Prop Tax
- Public to Contract Utility Operations in 2012
- Average Bimonthly Water / Sewer Bill - \$575
- Disadvantaged Community (DAC) - \$43,200 MHI

# LB Water System Infrastructure

- Surface Supply – Upper Putah Creek
- Average Treated Water Production – 20 to 60 kgal/day
- Pre-KMnO<sub>4</sub> + Membrane Filtration Plant
- Three (3) Water Storage Tanks – 380 kgal Capacity
- Two (2) Booster Pump Stations
- Three (3) Pressure Reducing Valve Stations
- Distribution Pipe – 6" / 8" / 10" Water Mains
- 43 Fire Hydrants
- 100% Metered Water Services



# LB Seasonal Putah Creek Source Water Quality



“Flood n Mud”  
(December – February)



“*Didymo Du Jour*”  
(June – July)



“Planktonic Invasion”  
(July – October)

# LB Winter 2016 Wildfire Ash and Sediment Load



Upper Putah Creek



Buoyant Carbon Deposits



Metals Analyses



Turbidity ~ 500 NTUs

# LBRID Putah Creek Water Quality

- Total Organic Carbon (1.6 to 7.8 mg C/L)
- Perennial Algae Bloom Events
- Moderate-to-High Alkalinity (100 to 400 mg/L)
- SUVA 2 to 4 – Intermediate Humic Content
- Charge Neutralization Sensitive – Coagulation
- Flocculation Time – 6 to 9 minutes
- Extreme Clay and Wood Ash Winter Loads
- Turbidity (1 to 500 NTUs)
- Very High TTHM Formation Potential
- Year Round pH (low 7s to mid 8s)

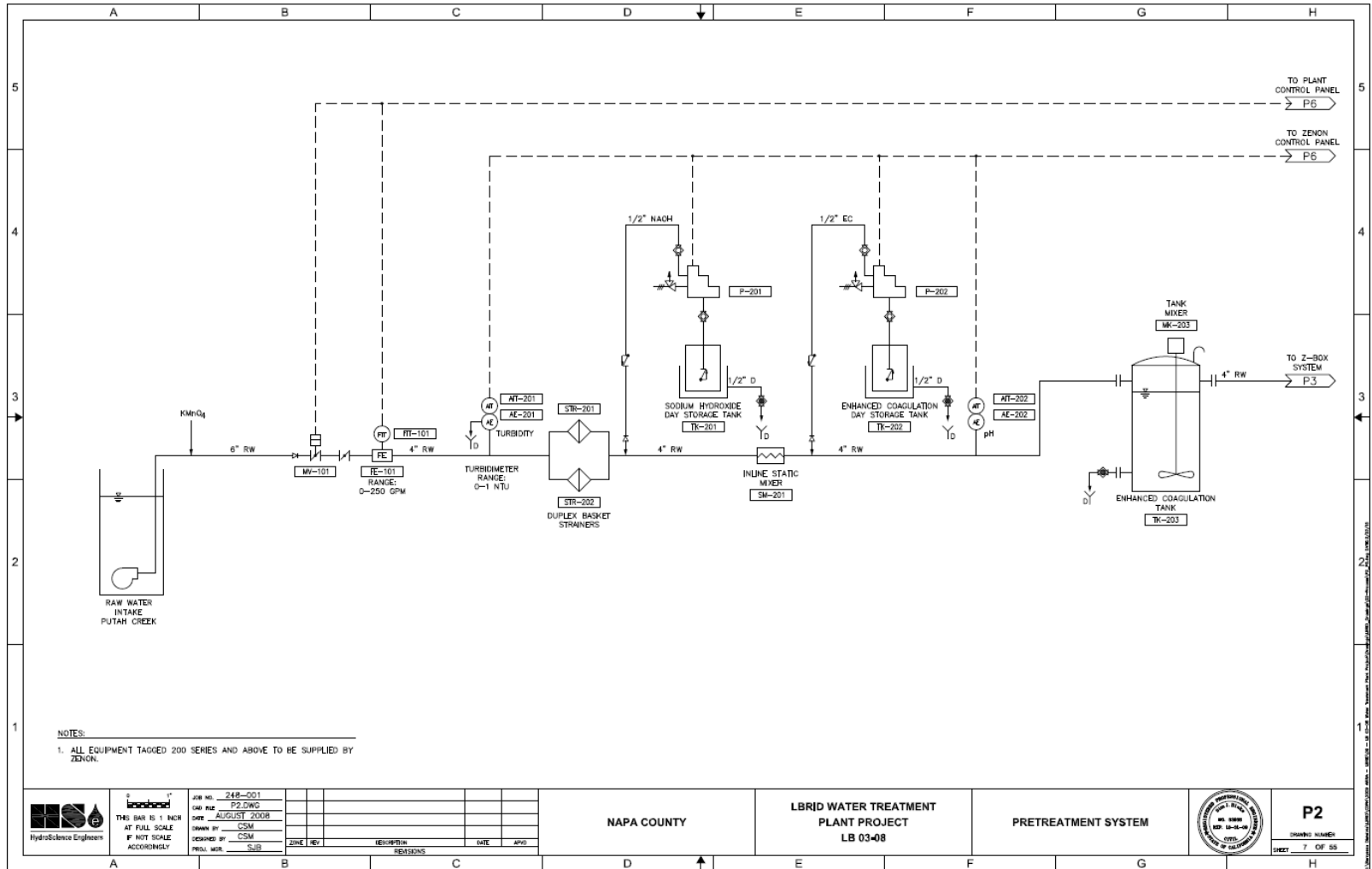


# LBRID Water Treatment Plant

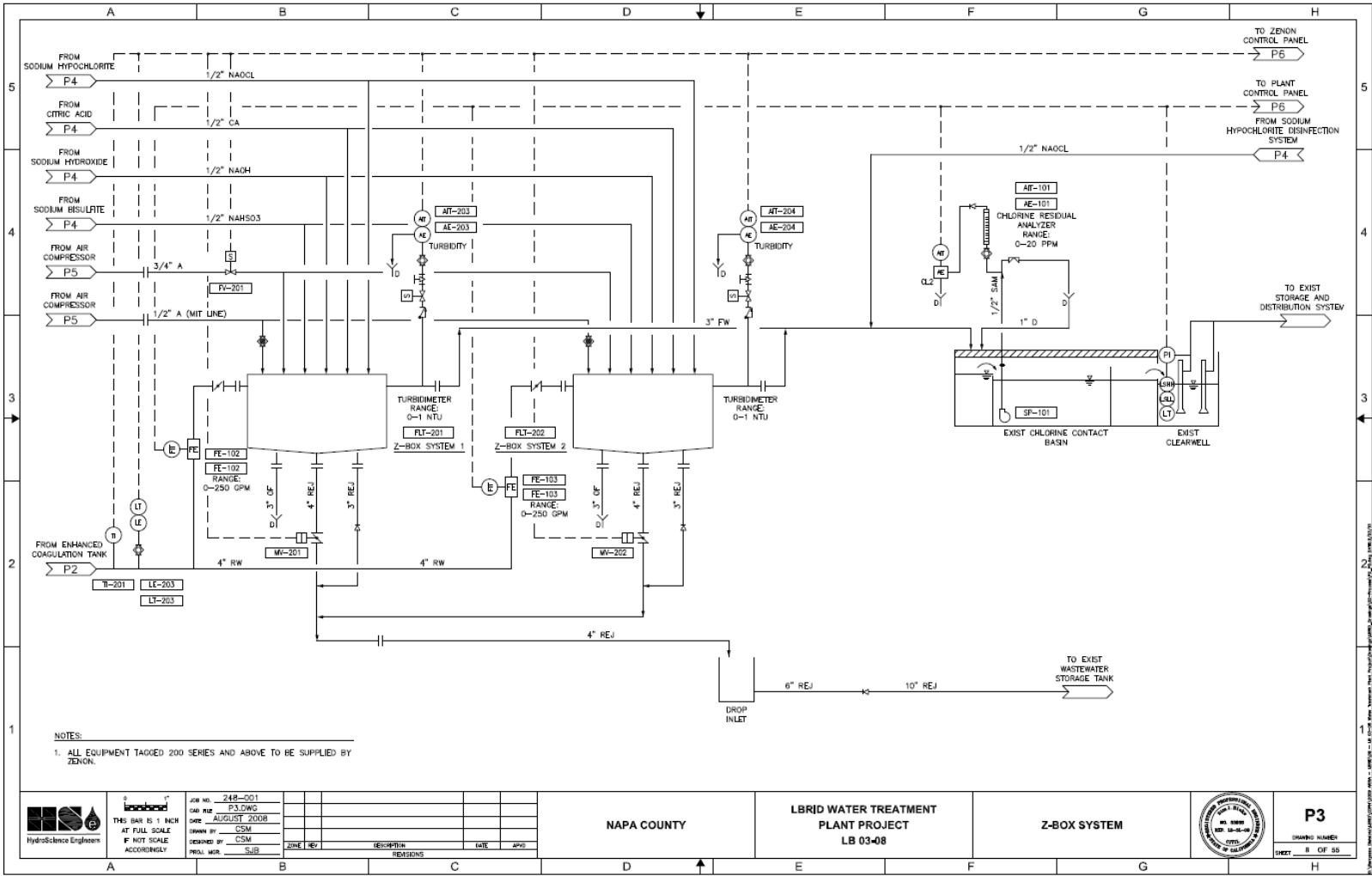


- GE Zenon Ultrafiltration Membranes – Two Trains
- Production Capacity – 200 gpm
- ACH Primary Coagulant
- NaOCl Disinfection
- Roof Structure Clearwell

# LBRID Pre-Filtration Process Schematic



# LBRID Filtration / Disinfection Process Schematic





# LBRID Water Treatment Challenges

- Runoff Turbidity Plumes (100 to 500 NTUs)
- Strainer Wood Ash Plugging (< 5 minutes)
- Drain Settled Solids from Floc Tank
- Decreased Membrane Flux Rates
- Charge Fluctuation
- Frequent Backpulses / Tank Drains / CIPs
- Abrasive Grit / Membrane Filaments / ↓MIT
- Reduced Membrane Life Cycle by 30%
- July – October Algae Blooms / Aquatic Plants
- Taste and Odor Aromatic Compounds

# Premature Membrane Cassette Replacement



Treatment Train No. 1

# LBRID Proposed Water Treatment Appendages

- Backwash Recovery + Supernatant Filtration
- Anchored Floating Surface Water Intake  
(Move Away From Plants & Less Metals)
- Type 3 Turbidity Curtain + UV Light Barrier
- Insert 8,000 gallon Pre-Settling Tank  
(Downstream of Flocculation Tank)
- Move  $\text{KMnO}_4$  Injection Location
- Pilot Test Powdered Activated Carbon?



# Berryessa Highlands (NBRID) Background

- Napa Berryessa Resort Improvement District – 1965
- Legislatively Established by PRC Section 13000
- 586 Total Parcels in Development
- 332 Active Water & Sewer Service Connections
- FY 18/19 Operating & Capital Budget - \$2.5M
- Revenue – Assessments, User Rates, Avail Charge
- Public to Contract Utility Operations in 2013
- Average Bimonthly Water / Sewer Bill - \$400

# NB Water System Infrastructure

- Surface Supply – Lake Berryessa Dual Intakes
- Average Treated Water Production – 35 to 70 kgal/day
- Contact Clarification / Deep Bed Filtration Plant
- Bolted Steel Tank – 69 kgal Clearwell Capacity
- One (1) Water Storage Tank – 500 kgal Capacity
- Five (5) Pressure Reducing Valve Stations
- Approx. 7 mi. Distribution Mains – 6" / 8" / 10" Dia.
- 75 Fire Hydrants
- 100% Metered Water Services

# NBRID Lake Berryessa Water Quality

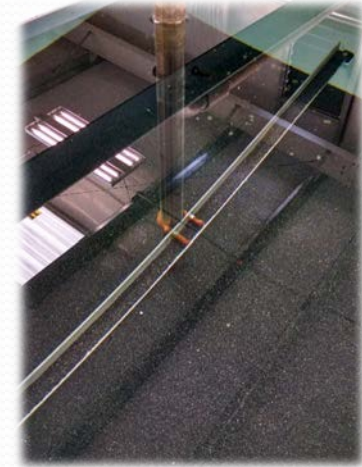
- Low Total Organic Carbon (2.1 to 3.6 mg C/L)
- Historical Algae Blooms
- Moderate-to-High Alkalinity (150 to 180 mg/L)
- SUVA 2 to 4 – Intermediate Humic Content
- Charge Neutralization Sensitive – Coagulation
- Flocculation Time – 6 to 9 minutes
- Extreme Clay and Wood Ash Winter Loads
- High TTHM Formation Potential
- Turbidity (1 to 120 NTUs)
- Year Round Higher pH (low 7s to low 8s)

# NB Lake Berryessa Harsh Winter Realities





# NBRID Water Treatment Plant



- Roberts Pacer II Contact Clarification / Filtration Units
- Production Capacity – 300 gpm
- PACl Primary Coagulant
- NaOCl Disinfection
- Bolted Steel Tank Clearwell

# Roberts Pacer II Design Parameters

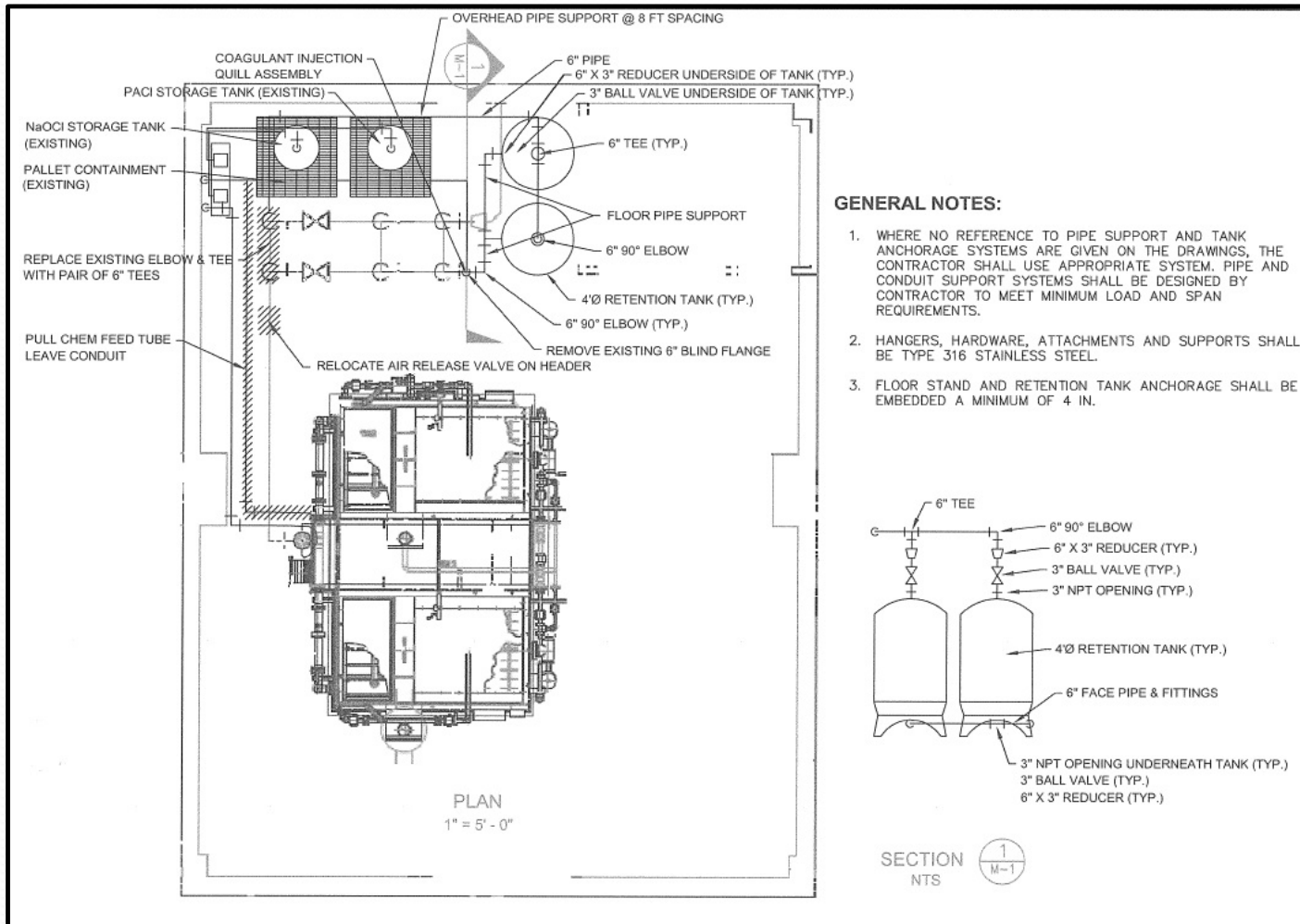
## CONTACLARIFIER®

Area	17.63 SF
Bed volume	70.5 cu.ft.
Hydraulic loading	10.0 gpm/SF
In-service/rinse rate (Note: 25 ft. TDH required at CONTACLARIFIER® inlet)	175 gpm
Clarifier wash volume @ 6 min.	1050 gallons
Air scour rate @ 6 cfm/SF	106 cfm

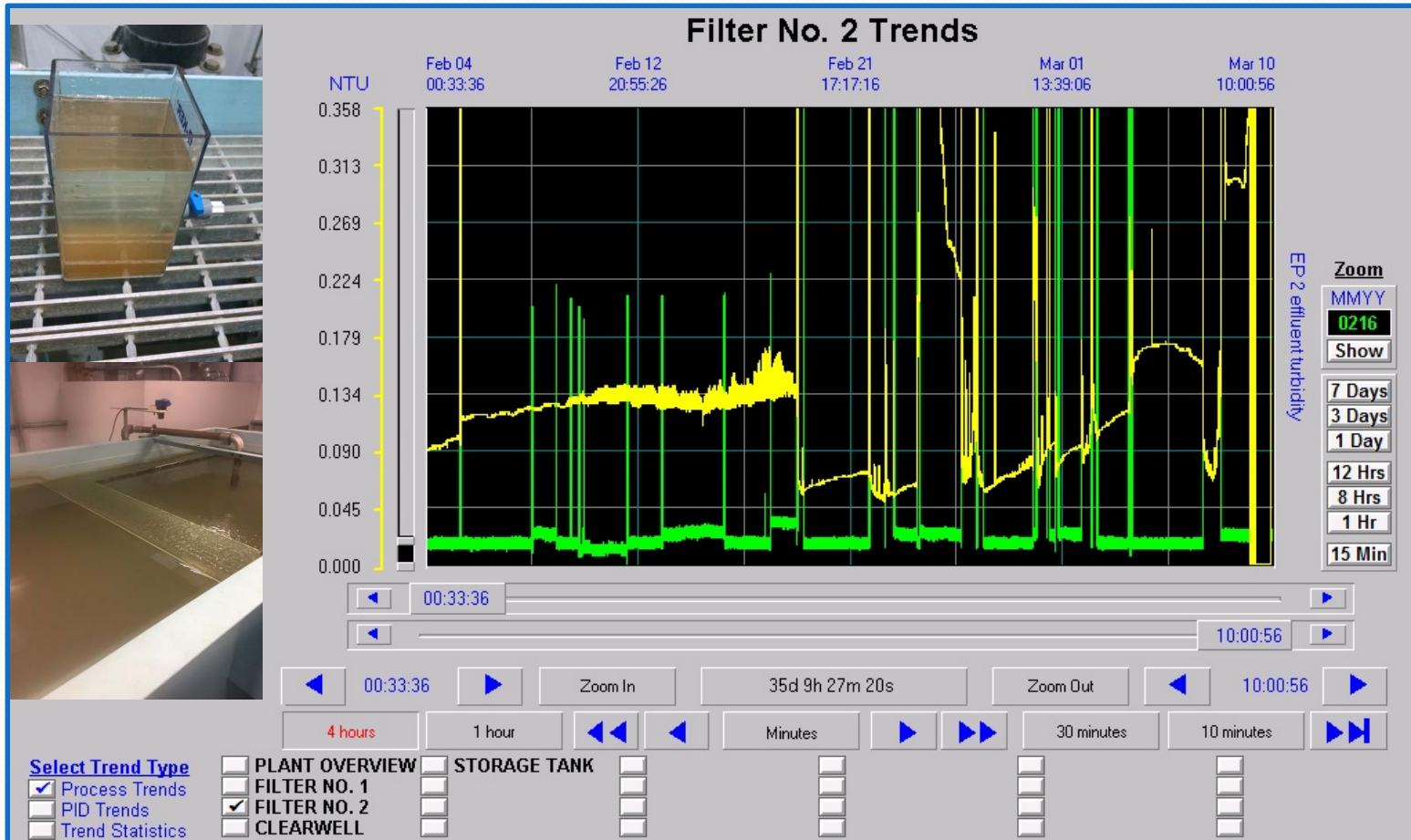
## Polishing Filter (PF)

Area	35.25 SF
Filtering rate	5.0 gpm/SF
Air scour rate: @ 3.0 cfm/SF	106 cfm
Backwash rate: @ 18 gpm/SF (Note: 30 ft. TDH required at the filter backwash inlet)	635 gpm
Backwash volume @ 8 min.	5,080 gallons
Dual media bed	

# NBRID Water Treatment Process Floor Plan



# February 2016 Storm Event



Raw Water Turbidity – 40 to 60 NTUs



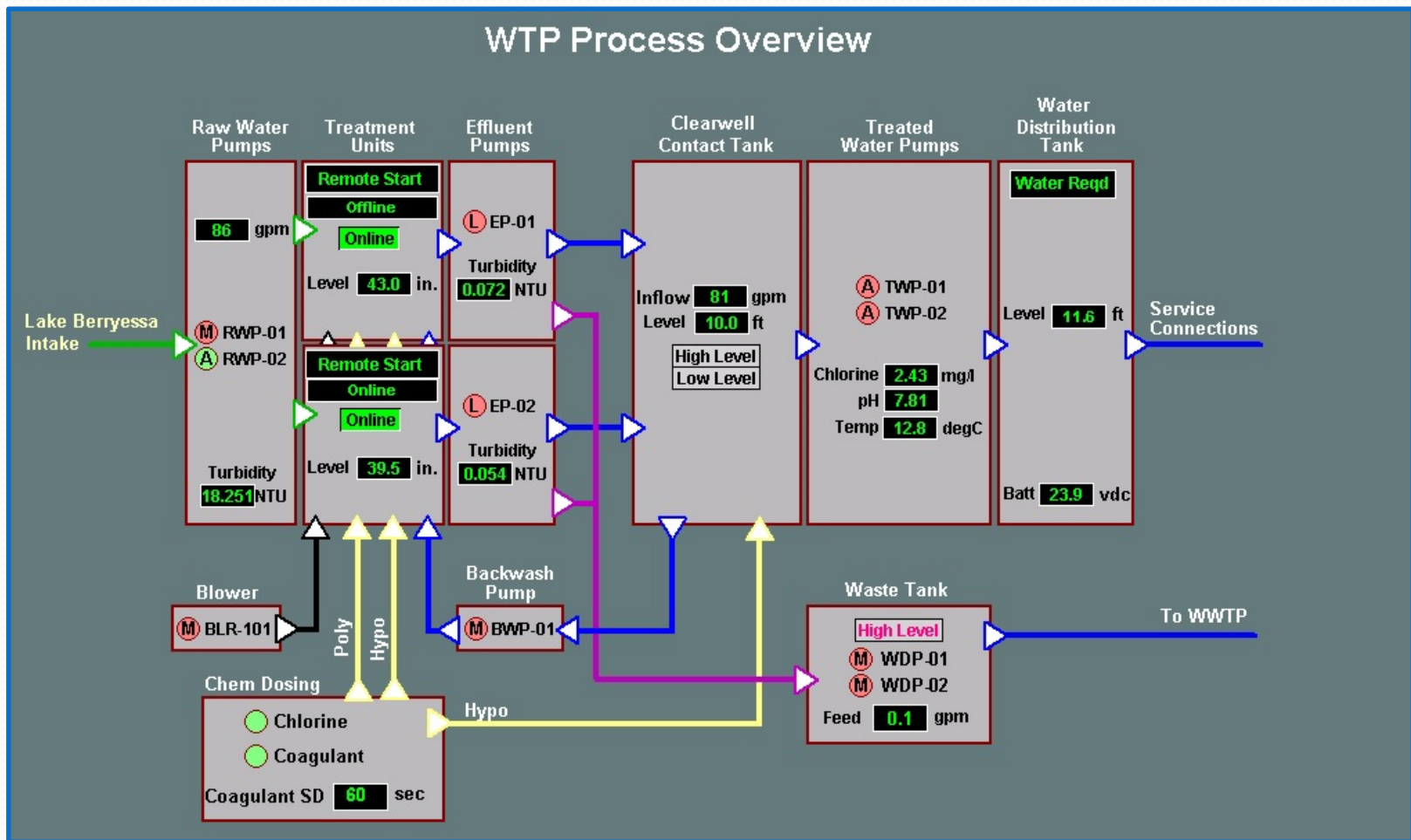
# NBRID February 2016 Jar Test Trials



## Jar Test Trial Observations

- Pin-Floc 4 to 12 mg/L
- Restabilization 12 to 20 mg/L
- Sweep Floc greater than 20 mg/L
- Optimal Dose – 4 to 6 mg/L (Most of Year)
- Best pH Range 7.8 to 8.0 units
- Flocculation Time – 6 to 9 minutes
- Clarifier / Filter Particle Load Imbalance

# NBRID January 2017 Storm Event



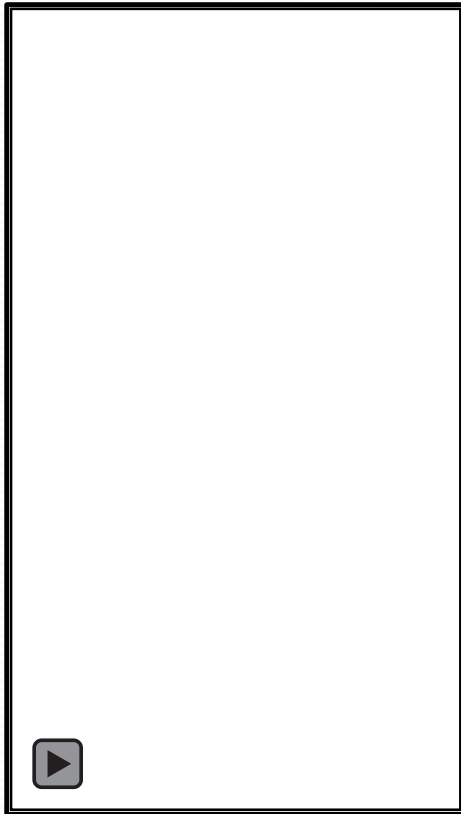
Clay and Ash Plume in Lake Migrating Towards Intake Structure

# NBRID Water Treatment Challenges

- Runoff Turbidity Plumes (20 to 120 NTUs)
- Decrease Clarifier / Filter Loading Rates
- One Hour Clarifier Runtime
- Four Hour Filter Runtime
- Charge Fluctuation
- Acceleration of Clarifier / Filter Headloss
- Every 100 kgal Produced Yields 40 kgal Waste
- Max. Raw Turbidity for Contact Clarification / Filtration – 40 NTUs
- Insert 8,000 gallon Pre-Settling Tank



# Legacy Phos-Chek Effects on Watersheds?



- Mono- & Diammonium Phosphate
- DC-10 Very Large Tanker  
Payload Capacity - 12,000 gallons
- Boeing 747 Very Large Tanker  
Payload Capacity - 24,000 gallons

DC-10 Air Drop

2017 Atlas Fire – Capell Valley

# Questions



Jerusalem Fire



Algae Bloom & Plant Infestation