Reservoir Rehabilitation – Increasing Storage Without Increasing Capacity

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MSA

INTRODUCTION

- **Water Quality Issues - Common Occurrence In Storage Reservoirs**
  - Inlet design, inadequate mixing and low water turn over can contribute to water quality issues
- **Reservoir Storage Volumes are Often Reduced to Maintain Water Quality**
  - Inability to maintain residual levels
  - Distribution system water quality
  - Must meet water quality standards
- **Reducing Volumes = A Reduction in Overall Storage Capacity**

INTRODUCTION

- **What Causes the Problem?**
  - Reservoir volumes are underused
  - Piping configurations that do not address water quality considerations (single inlet/outlet)
  - Shoreline Water District case study

- **How Can Water Quality Be Improved Without Loosing Storage Capacity?**
  - Operationally
  - Modifying piping configurations
  - Adding mixing valve systems

STORAGE FACILITY HYDRAULICS

- **Reservoirs are Designed for Large Amounts of Storage While Daily Use Equates to Much Smaller Demands**
  - Fire Suppression - (1500 gpm x 120 min = 180,000 gal)
  - Emergency Storage - (DOH Recommends - 200 gal/day/conn)
  - Future Growth
  - Small Band of Operational Storage

STORAGE FACILITY HYDRAULICS

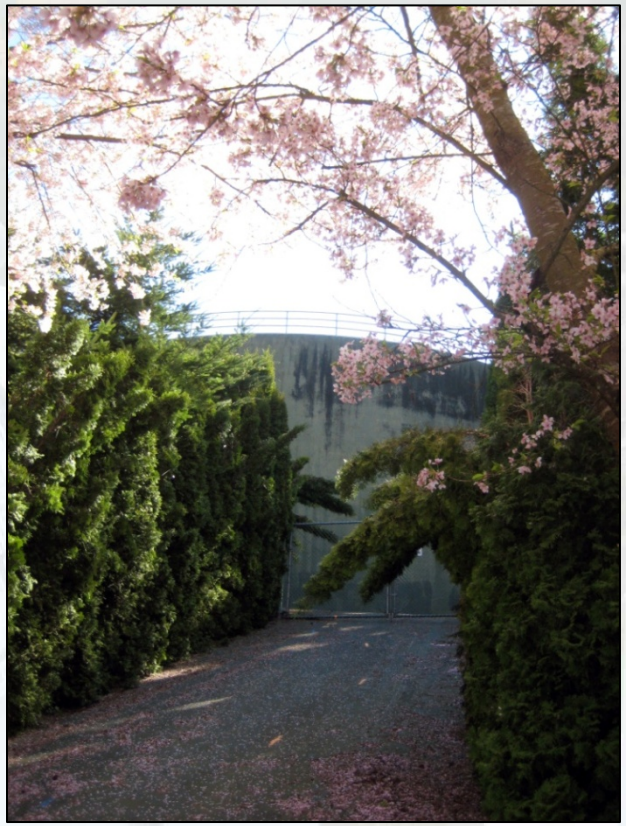
- **Excess Storage Can Create Water Quality Problems**
  - Loss of Disinfectant Residual
  - Possibility of:
    - Bacterial Growth
    - Disinfectant By-Product (DBP) Formation
    - Algae Growth
    - Biofilm Growth
  - Taste & Oder Problems

STORAGE FACILITY HYDRAULICS

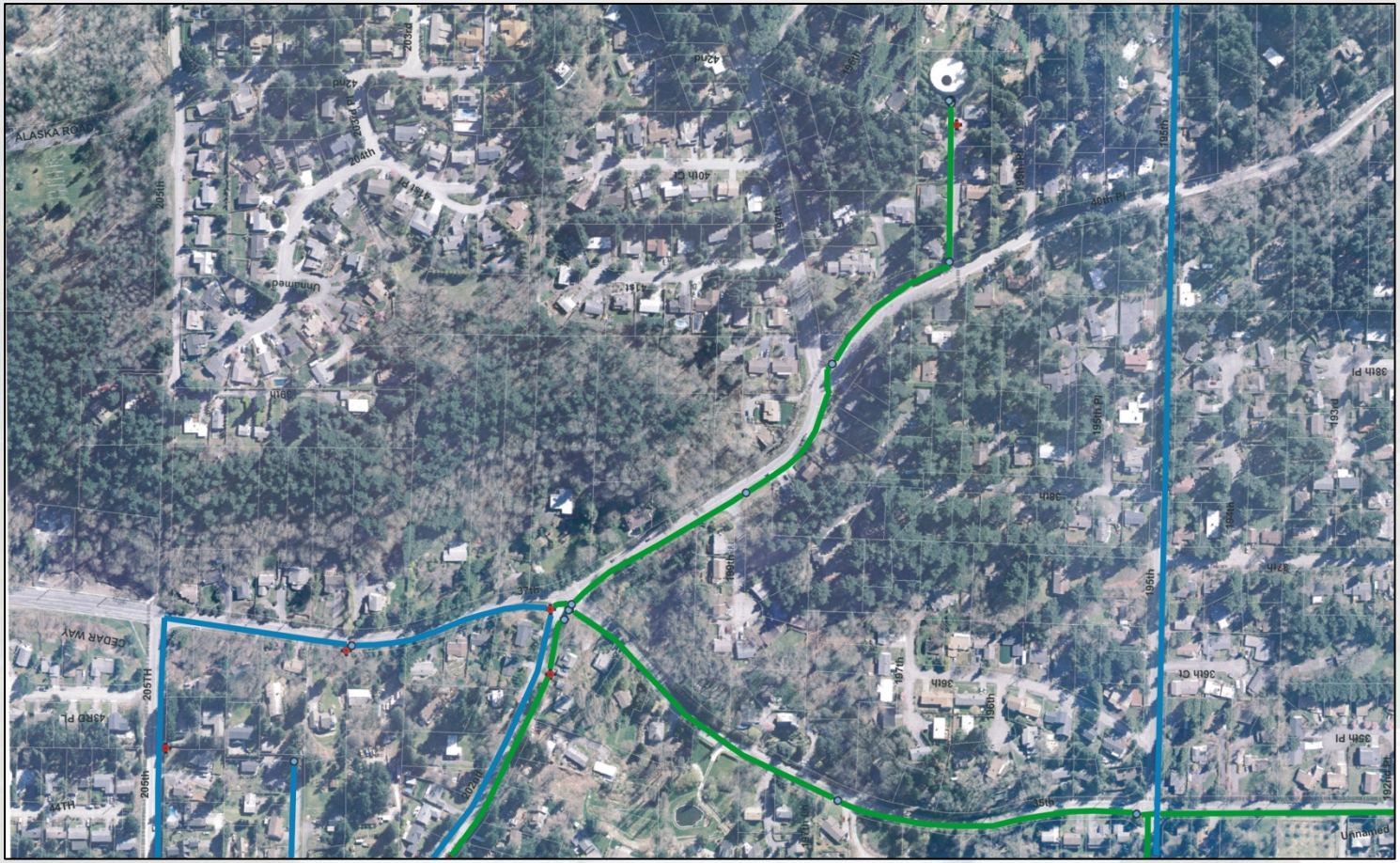
- **Often Reservoirs are Designed with a Single Inlet/ Outlet Pipe**
  - Sized for max day & fire flow discharge
  - Water enters and leaves through same pipe
  - Short circuiting (last in - first out)
  - Minimal mixing – creating dead zones
  - Water can be days or weeks old

CASE STUDY

- **Shoreline Water District 2.0 MG Reservoir**
  - 98’ diameter, 35’ tall
  - Pre-stressed concrete tank
  - Constructed in 1988
  - Single inlet/outlet with floor drain and overflow pipe
  - Located outside District’s service area
  - Served by 2,000 ft. dead-end main



CASE STUDY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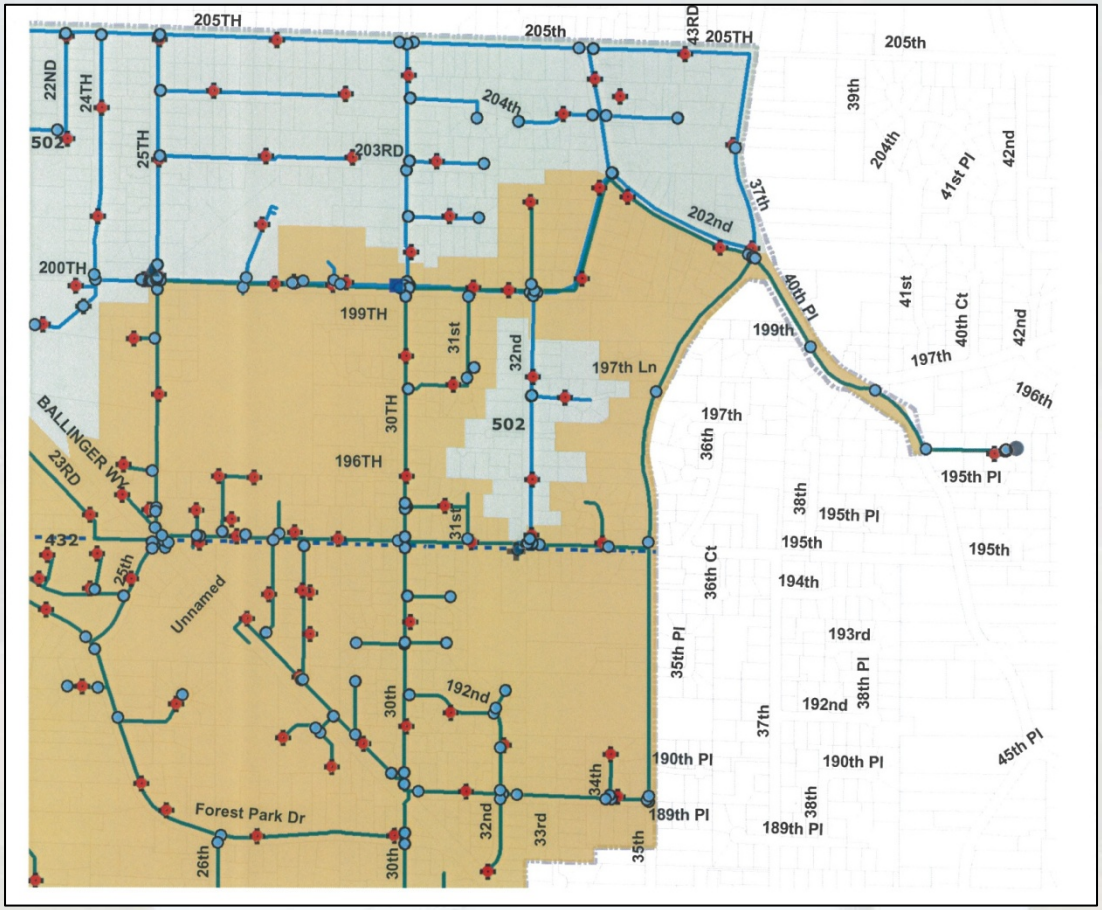
CASE STUDY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CASE STUDY

- **Issues**
  - Inability to maintain chlorine residual levels
  - Operational level reduced to 10 ft. In effort to maintain residual levels
  - Eventually reservoir was taken out of service for roof repair
  - While out of service, design was started to correct problems

CASE STUDY

- **Project Considerations**
  - Reservoir located in residential neighborhood
  - Limited access to reservoir site along steep driveway
  - Initial project – Construct mixing manifold system to promote mixing within reservoir

PROJECT APPROACH

- **How Can Water Quality be Improved Within a Reservoir**
  - Create completely mixed system
  - Homogenous in age & chlorination content
  - Considerations in mixing design
    - Adequate volume turnover
    - Fill time
    - Inflow rate
    - Inlet velocity
- **Shoreline Water District – Design Aspects**
  - New supply from City of Seattle
  - Modify site piping to create separate inlet/outlet
  - Construct mixing manifold to promote mixing

THE SOLUTION

- **New Supply Line From Seattle System**
  - Seattle's 66-inch pipeline is located approximately 1,200 ft. To the east
  - New tap on Seattle line with 12-inch transmission line to control valve structure

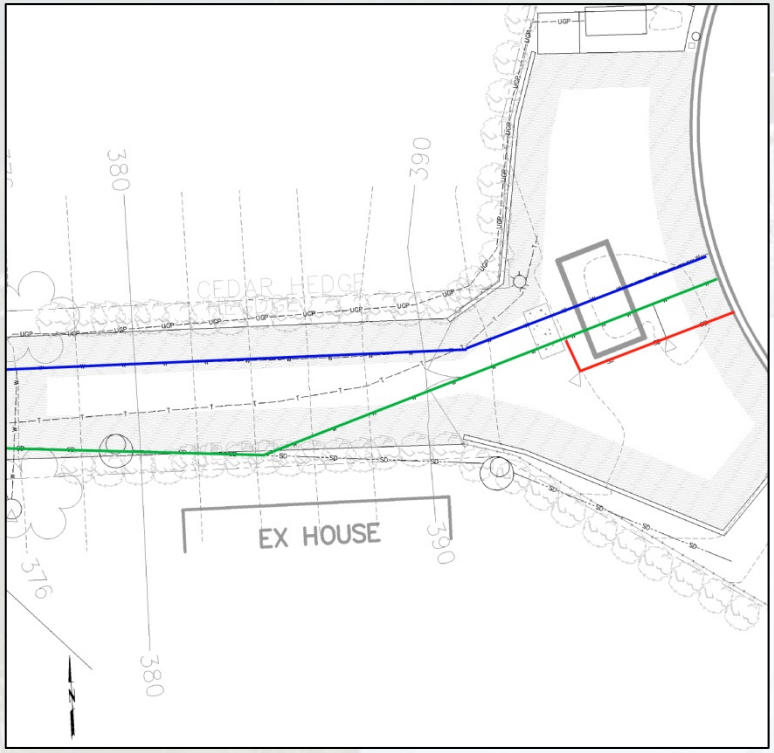
THE SOLUTION

- **Control Valve Structure Between Seattle System and Reservoir**
  - 10 ft. X 20 ft. underground vault with:
  - 3-inch and 8-inch Control Valves
  - Mag-Meter
  - 12-inch motor controlled gate valve for overflow protection

THE SOLUTION

- **Separate Inlet and Outlet**
  - Reconfigure existing site piping and valves to provide separate Inlet and outlet into reservoir
  - Drain line incorporated into outlet line
  - Additional valves added to allow reservoir to be taken off-line for maintenance

THE SOLUTION



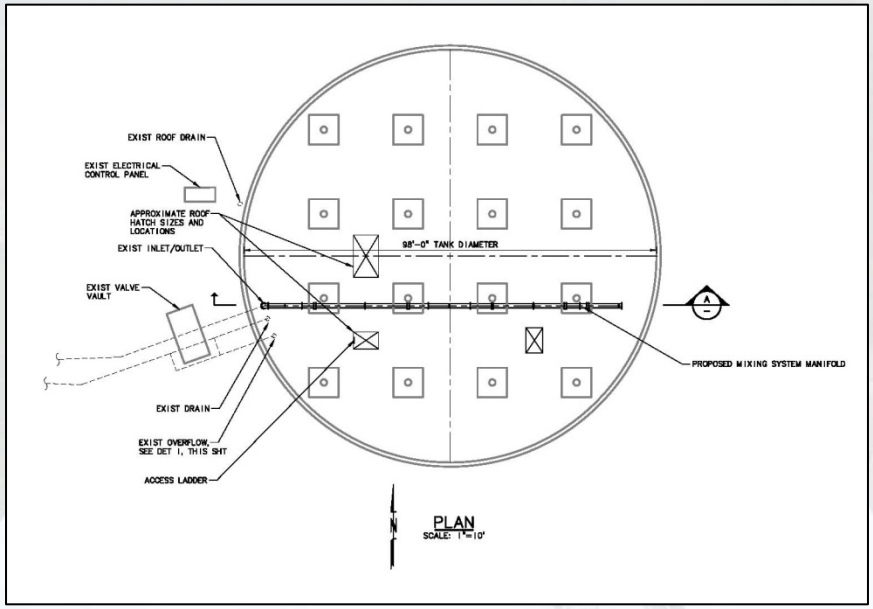
THE SOLUTION

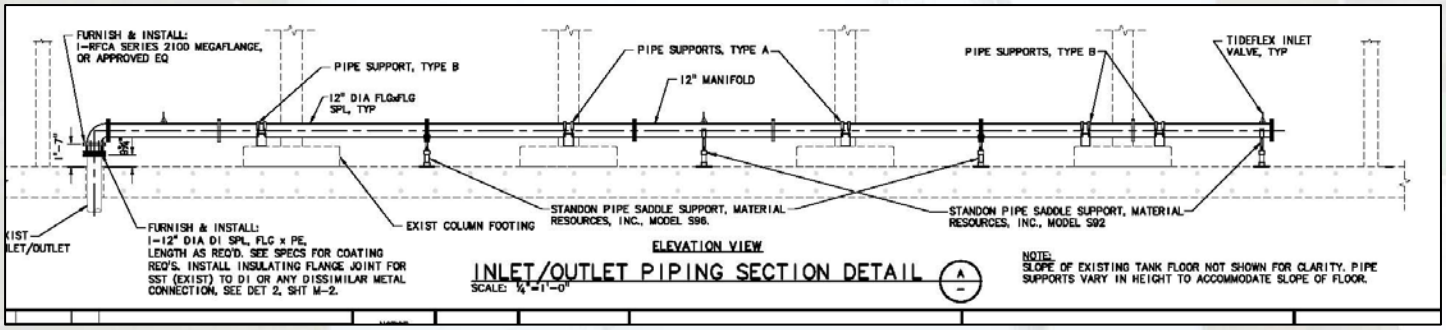
- Approved Backfill Material?

THE SOLUTION

- **Construct Mixing Manifold to Promote Internal Mixing**
  - Mixing manifold with duck-bill inlet valves running along floor of reservoir
  - 12-inch epoxy coated steel header pipe supported along column piers
  - Inlet valve in center and at each end
  - Manifold and valves sized by manufactur
  - Single inlet/outlet design included inlet and outlet valves along manifold
  - New design – manifold is for inlet only

THE SOLUTION





THE SOLUTION

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CONCLUSION

- **Maintaining Water Quality In Reservoirs Can Be Challenging**
  - Large “excess” storage for emergencies & fire flows
  - Reservoirs sized for future growth
  - Limitations in existing piping configurations
  - Operational procedures often dictate use
- **Water Quality Can Be Improved**
  - Operationally
  - Retrofitting existing reservoirs to improve mixing with specialized mixing valves or modified piping configurations

CONCLUSION

- **References**
  - Kirmeyer, G.J. et al, 1999, Maintaining Water Quality in Finished Water Storage Facilities, AWWA Research Foundation, 90763
  - Mahmood F. et al, 2005, Evaluation of Water Mixing Characteristics in Distribution System Storage Tanks. Jour. AWWA 97:3
  - Additional information provided by Red Valve Company, Inc.

QUESTIONS