



Massachusetts Water Resources Authority

Presentation to

**MWRA Water Supply Citizen
Advisory Committee**

Hydropower and MWRA

October 2013



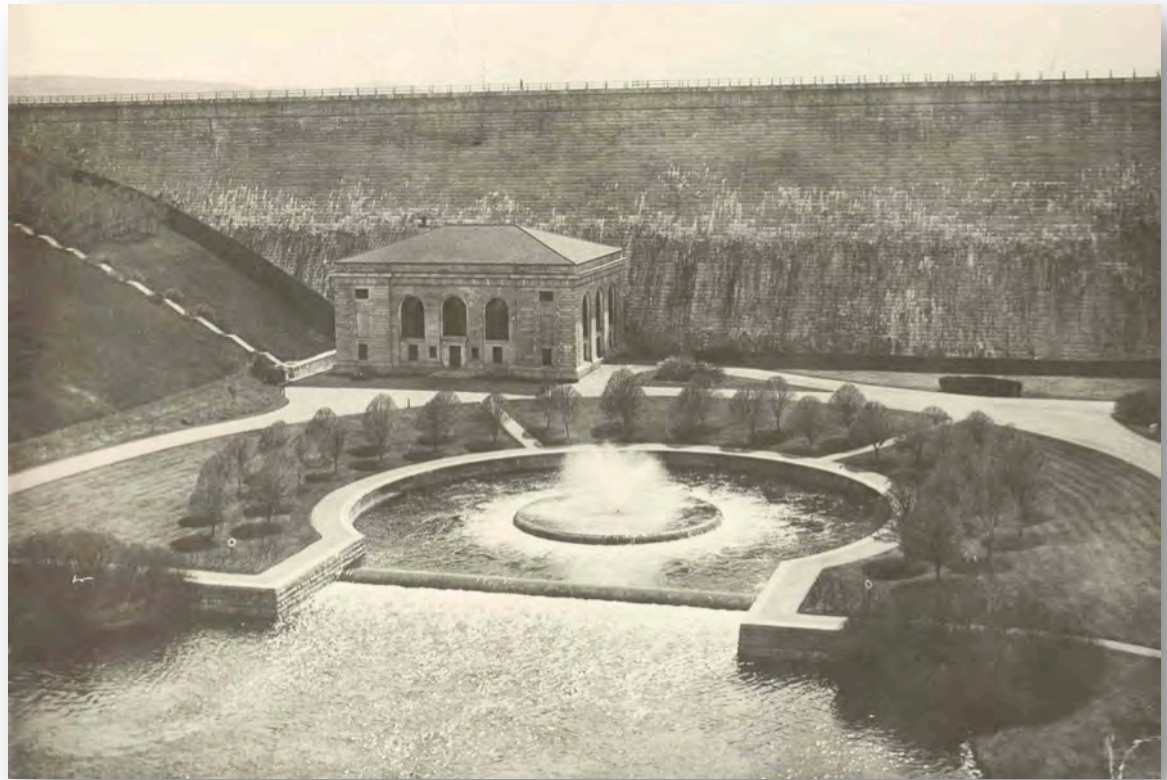
Hydropower at MWRA: History of Innovation

- Provisions of 1895 Metropolitan Water Act gave Water Board authority to exploit hydropower at facilities under its control. Led to development of both hydropower at Wachusett and Sudbury.
- Transmission of electricity from Wachusett in 1911 marked first known instance of hydroelectric power generation from a domestic water supply.
- Set the precedent for utilization of head (distance which water falls) available at dams and on aqueducts to produce power: subsequent projects incorporated hydropower generation into facilities at design stage: Winsor Dam, Quabbin Aqueduct, Cosgrove Tunnel.



Wachusett Reservoir

- Wachusett Dam Lower gatehouse was used to convey water into Wachusett Aqueduct, formerly the primary transmission line from Wachusett to Hultman Aqueduct. Prior to water being introduced into Aqueduct, it passed through four hydro turbines.
- Wachusett Aqueduct now a back-up aqueduct, and turbines dormant





Sudbury Reservoir

In 1915, hydropower installed at existing gatehouse at Sudbury Dam.

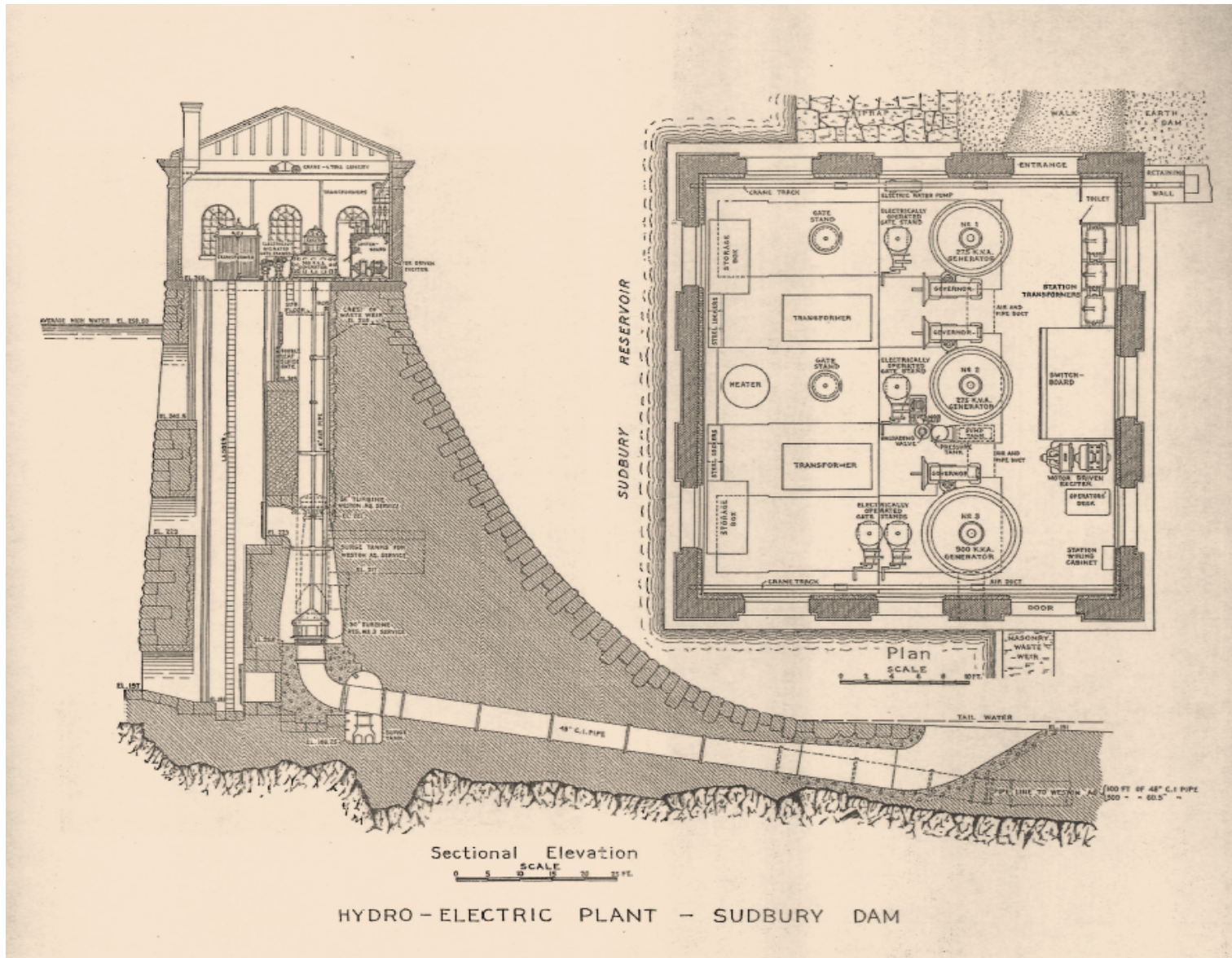
Three turbines: one capturing flow discharged into Stony Brook/Framingham Reservoir #3, the other two capturing flow discharged into Weston Aqueduct. Generated approximately 1,000,000 kWh annually.

Facility ceased operation and equipment was removed.

Prior configuration does not work today. Aside from Weston Aqueduct no longer being in use, today's standards can not be met.



Sudbury Reservoir





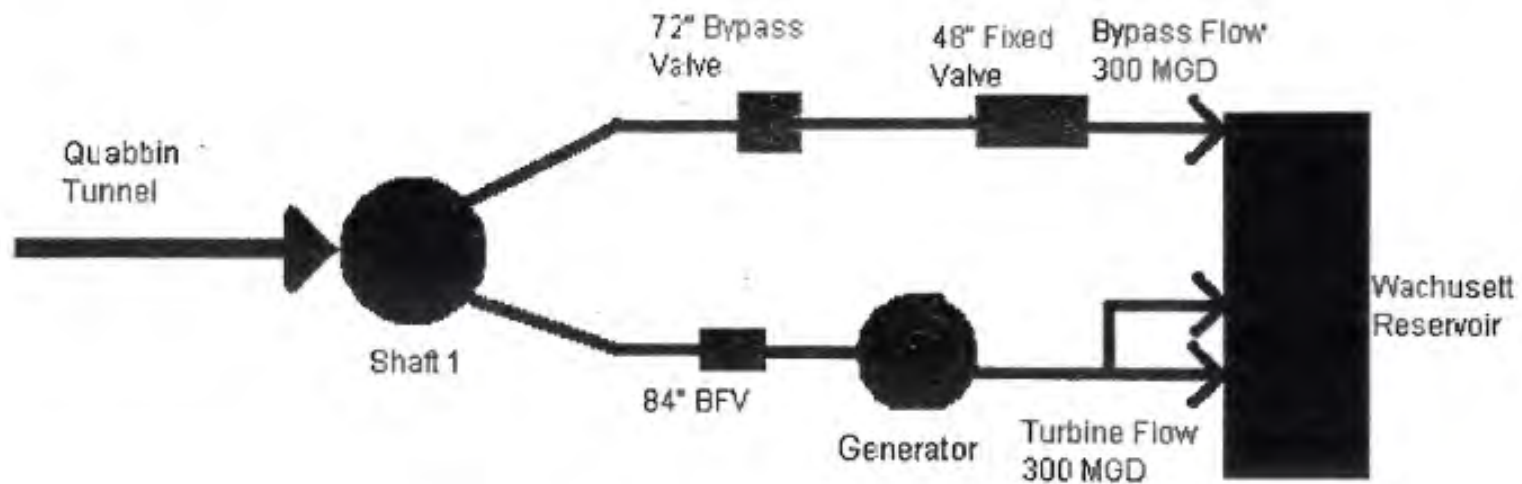
Winsor Dam

- Located at outlet of Quabbin Reservoir. Hydroelectric power first generated around 1946.
- Installed capacity of 1100 kW. Design to operate at flows of 110 cfs .
Discharges through turbine designed to meet:
 - Acts of 1927: 20 mgd at Bondsville
 - War Department Permit [110 cfs (70 mgd) to be released when flows at Montague gage drop below 4500 cfs]
- When in operation, turbine typically operated 5-7 hours a day.
- Winsor Hydro never licensed by FERC. In 1989, FERC directed MWRA to license Winsor Hydro.
- 1991, Fire destroyed switchgear. Winsor has remained inoperative. Equipment at this point not designed for modern practices.



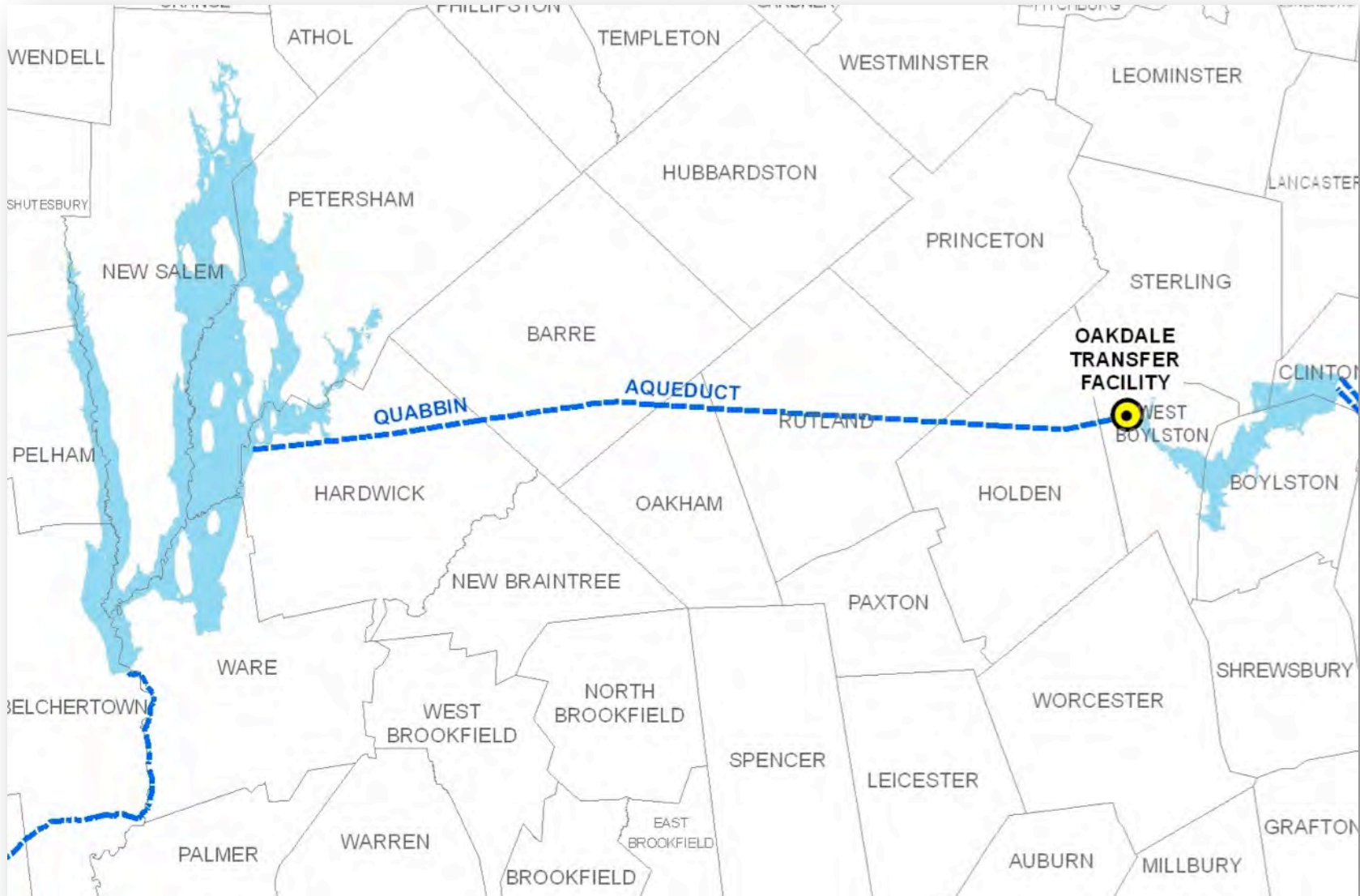
Hydropower Resources Today - Oakdale

- Oakdale station constructed in 1929 as outlet works of Quabbin Tunnel.. Originally used to transfer water from Ware River into Wachusett Reservoir. Hydropower added in 1949, after Quabbin Reservoir was constructed. Power generated on transfer of water from Quabbin Reservoir to Wachusett Reservoir.





Hydropower Resources Today - Oakdale





Hydropower Resources Today - Oakdale

- Installed capacity of 3,500 kW, with a typical net head of approximately 100 feet, and hydraulic capacity of approximately 300 mgd.
- Annual generation as much as 13,000,000-14,000,000 kWh a year.
- Original turbine in place. Some upgrades in 1990s. Electrical upgrades in 2012-2013.
- 99% of power generated is sold to NGRID via a new power purchase agreement.



Hydropower Resources Today - Oakdale



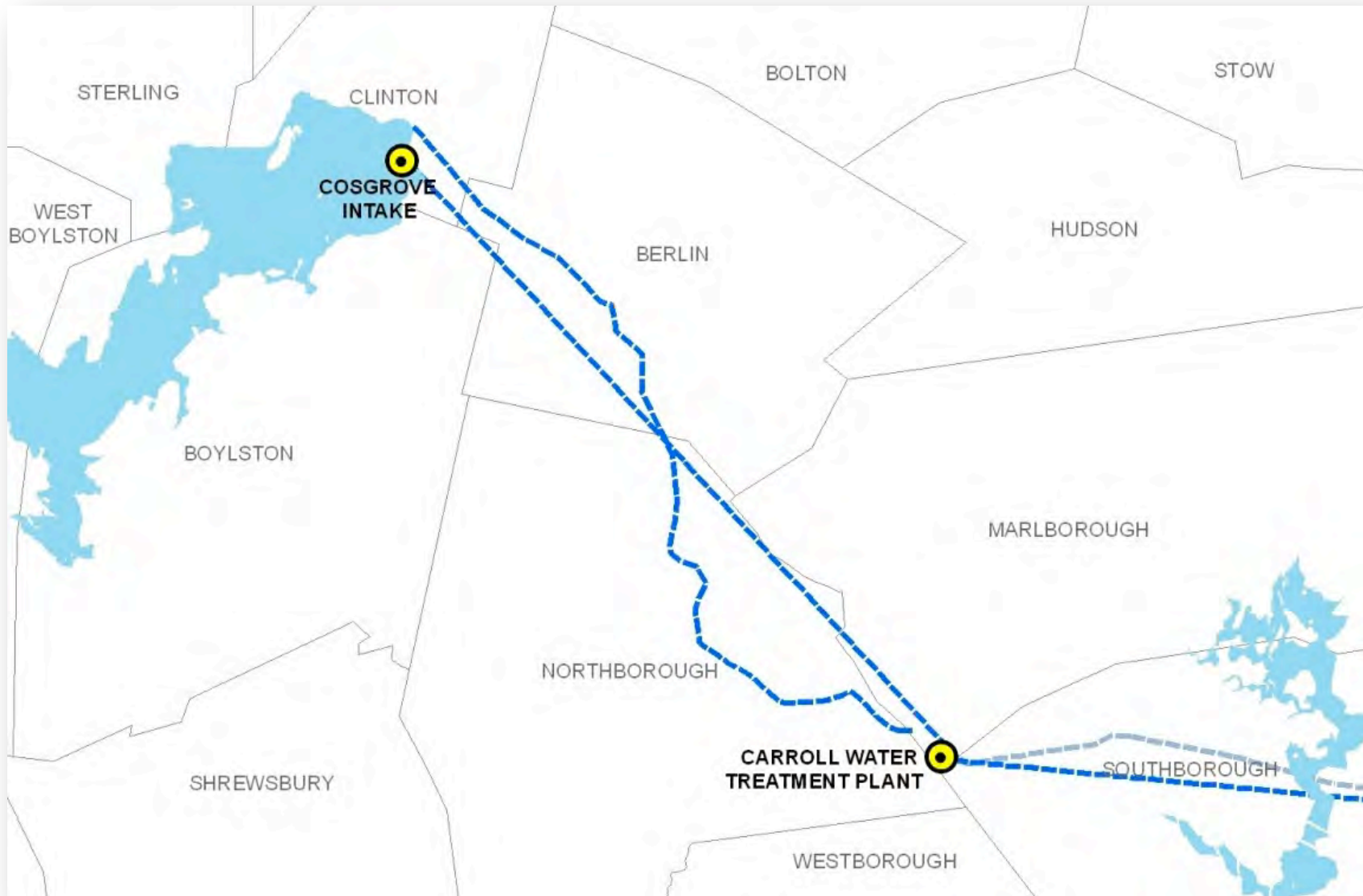


Hydropower Resources Today - Cosgrove

- Cosgrove Aqueduct was constructed in 1965. Two turbine/generators, which were put into operation in 1969.
- Cosgrove intake and hydroelectric facility regulates flow of water from Wachusett Reservoir into Cosgrove Aqueduct .
- Turbines rehabilitated and upgraded when John J Carroll Treatment Plant constructed to integrate turbines' operation with newly configured water supply system.
- Turbines now operate at flow head of approximately 55 feet, with flow through each turbine varying from 60-180 mgd. Annual generation of approximately 4,000,000-5,000,000 KWH.

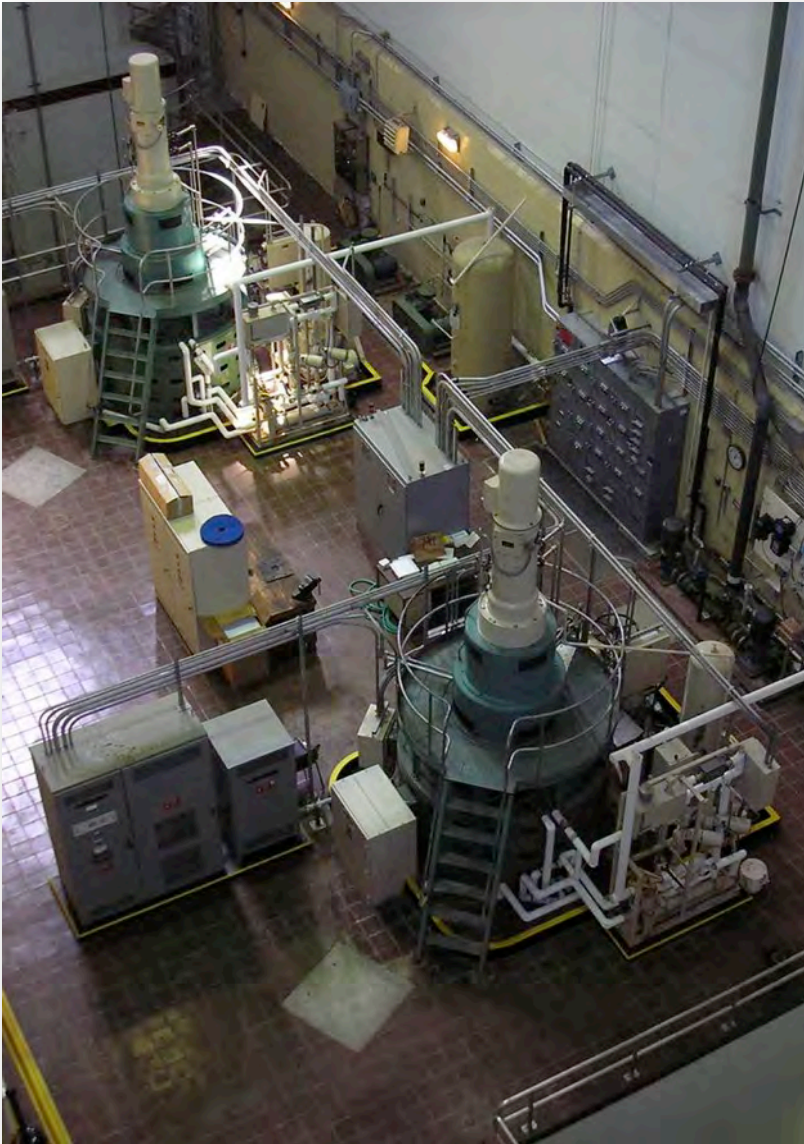


Hydropower Resources Today - Cosgrove





Hydropower Resources Today - Cosgrove





Hydropower Resources Today – Loring Road

- The Loring Road Covered Storage Facility establishes the hydraulic grade line of the MWRA's Low Service Area.
- A 200 kilowatt turbine was installed in existing underground vault in 2011. Turbine performs same function as a pressure-reducing valve (Loring Road receives flow from Norumbega at much higher gradeline than Low Service area requires).
- Project cost was \$1.88 million dollars. Stimulus funding and a grant from the Mass Clean Energy Center covered approximately 96% of the construction costs. MWRA also received grants for the design and feasibility study phases.
- Project generates approximately 1.3 million kWh annually. Power is used on site, with excess (approximately 80%) exported to the grid.



Hydropower Resources Today – Loring Road





Hydropower Resources Today – Loring Road





Hydropower Resources Today – Deer Island

- 2000 kW. Two 1,000 kW turbines, each with flow capacity of approximately 500 cfs (320 mgd). The maximum flow (640 mgd) is approximately equivalent to the maximum flow through secondary treatment at DITP.
- Once wastewater has undergone secondary treatment, it is disinfected and discharged into a hydropower facility that takes advantage of the flow and fall (approximately 29 feet) of treated wastewater.
- After the turbines, the turbine effluent conduit joins the outfall chute which discharges into the outfall shaft which drops the effluent into the 9.5 mile outfall tunnel to Massachusetts Bay.
- Units generate 5,000,000-6,000,000 kWh annually.



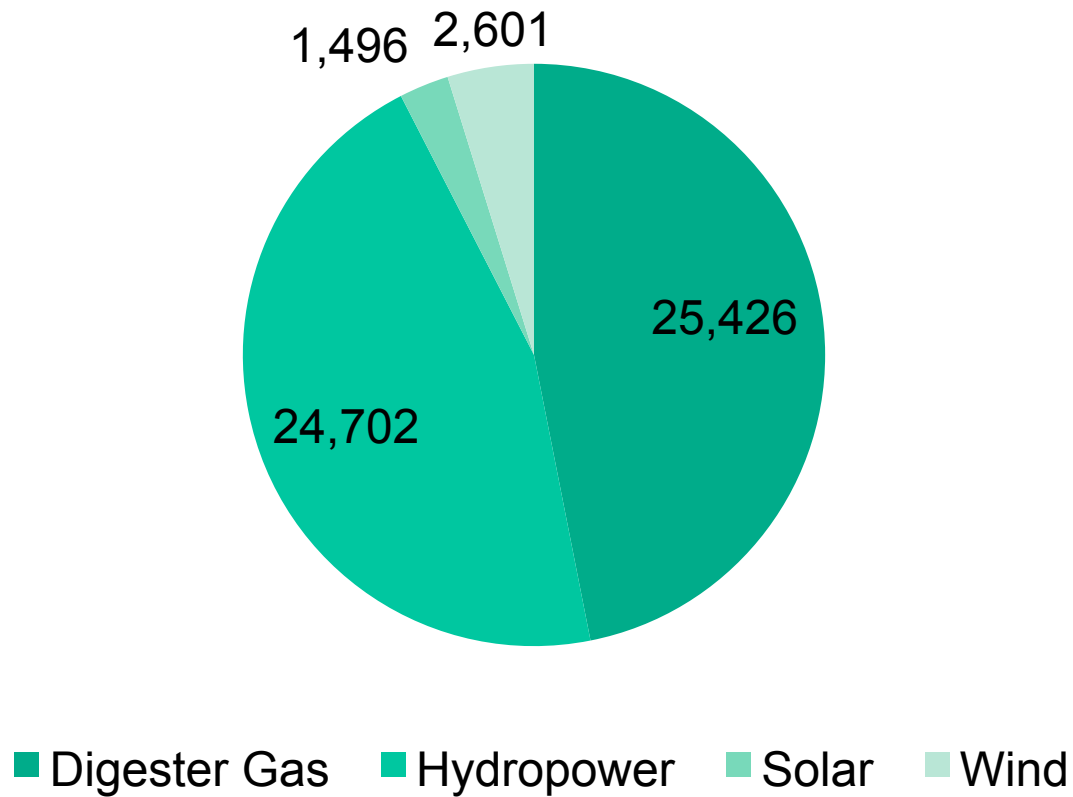
Hydropower Resources Today





Hydropower Resources Today

Clean Energy Generation at MWRA (FY12)- Megawatt Hours



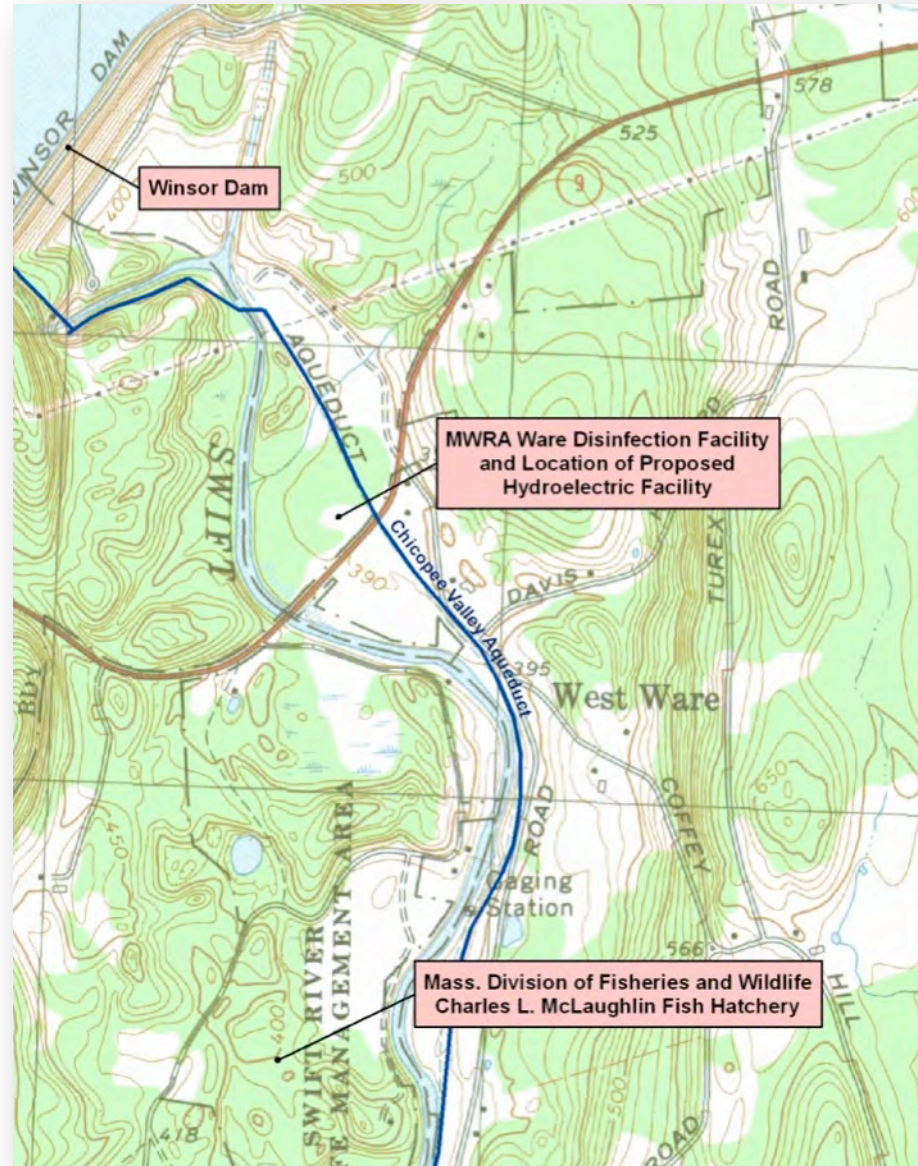


Projects in Development – CVA-Hatchery Pipeline

- Approximately 55-60 kW unit, associated with a pipeline that will tap water from the CVA to convey up to six million gallons a day of water (except during periods of drought) to the MDF's McLaughlin Fish Hatchery (Hatchery).
- Hydroelectric facility would generate approximately 465,000 kilowatt hours (kWh) annually.
- Projected costs of hydro component funded entirely by grants: ½ from Clean Energy Center, the other ½ from Leading By Example Program.
- Additional clean energy benefits: hatchery's need to pump river water will be almost entirely eliminated, resulting in an estimated 588,000 kWh reduction in electricity consumption.



Projects in Development CVA-Fish Hatchery Pipeline





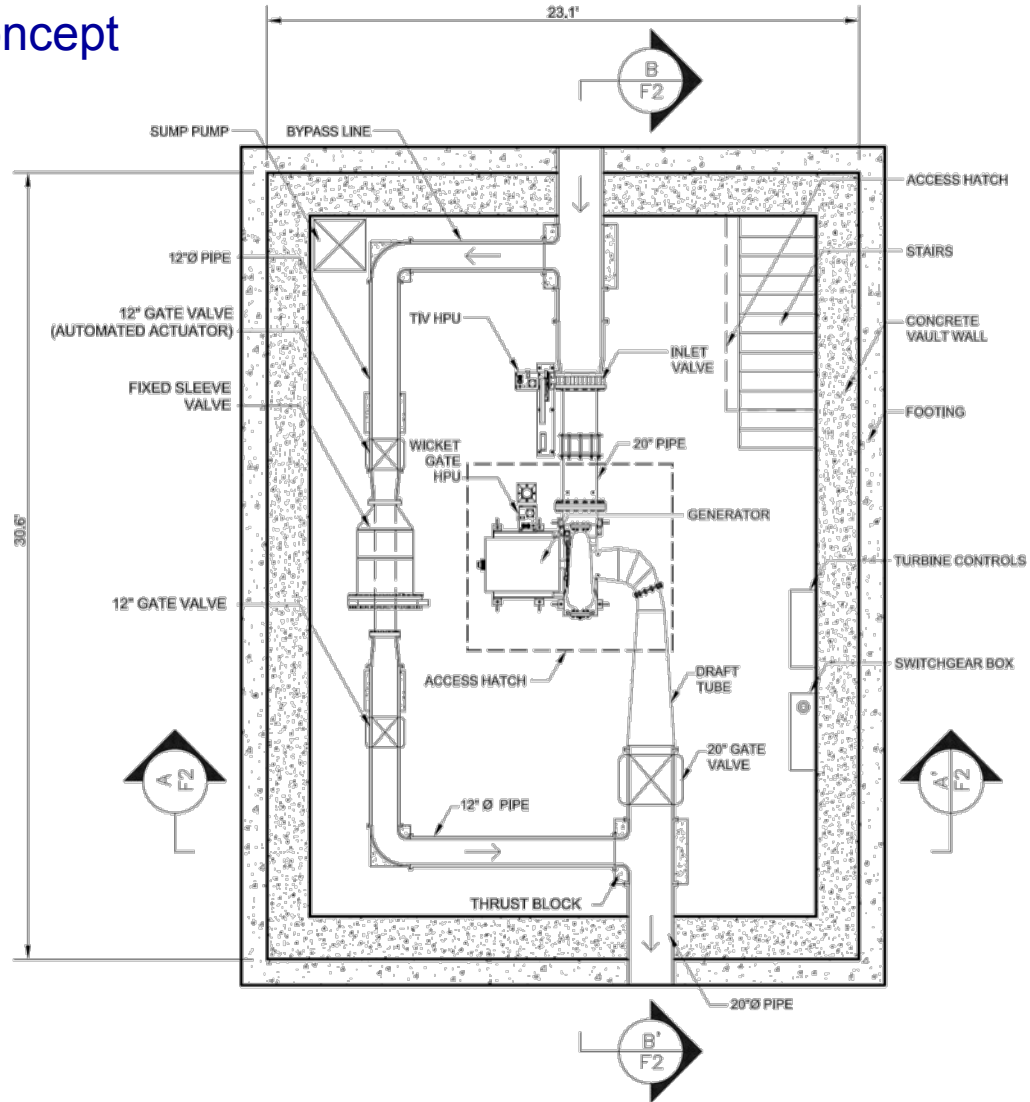
Projects in Development CVA-Fish Hatchery Pipeline





Projects in Development CVA-Fish Hatchery

- Preliminary Concept





Developing a Hydropower Project - Regulatory

FERC Jurisdiction Triggers

- The Federal Power Act (FPA) grants FERC authority over most nonfederal hydropower projects located on navigable waters of the United States or projects that affect the interests of interstate or foreign commerce. In sum, this includes almost all hydro projects.
- In terms of what is considered navigable, the FPA defines navigable as streams or other bodies of water that either in their natural or improved condition are navigable, notwithstanding interruptions between navigable parts of such streams or waters.
- FERC considers projects that sell electricity to an interstate grid as affecting interstate commerce. In a recent inquiry, FERC also indicated they consider projects that consume electricity on site as affecting interstate commerce, as it displaces power otherwise provided by the grid.



FERC Regulations for Conduit Projects

Prior to Hydropower Reform Act

- Conduit Exemption
 - 3 stage consultation process, unless one or more stages are waived
 - Preparation of Exemption Application (per set template) with Environmental Report commensurate with project impacts
 - Detail drawings Submissions
 - Pre-construction, and post-construction visits
 - Reporting Requirements

Post-Hydropower Reform Act of 2013

- Exempts certain conduit hydro projects from licensing requirements of Federal Power Act.
 - Eligible conduit projects can file Notice of Intent (includes basic facility info, plans, maps)



FERC Regulations for Non-Conduit Hydropower Projects

FERC Approval Options for Non-Conduit Facilities:

- Minor Project (Existing Dam) License or Exemption for than 5 MW
- The “Exemption” is not an exemption from a FERC process, but rather an exemption from Part 1 of the FPA that relates to a comprehensive development standard contained in Section 10 (a) (1).
- Procedures for an exemption essentially same as those that govern license applications. Extensive consultation processes and including a multi-stage consultation process with relevant state, federal, and interstate resource agencies, and the public, and many studies.

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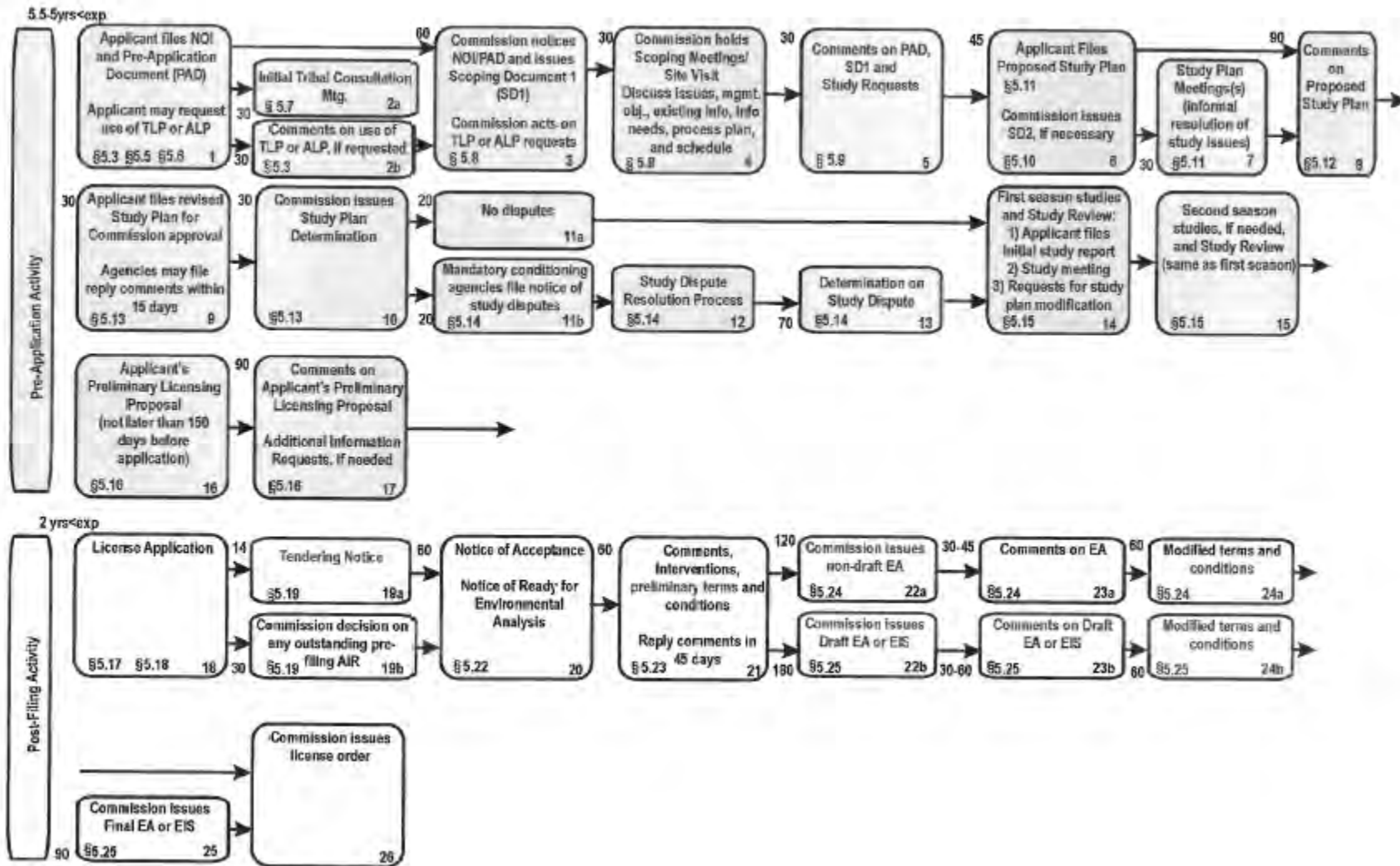


FERC Regulations – Exemptions and Licenses

- Main differences between license and exemption (non-conduit):
- Equal Consideration (License Applications only) to developmental and environmental values. Developmental values include power generation, irrigation, flood control and water supply.
- Mandatory Terms and Conditions (Exemption Applications only)
Exemptions from licensing are subject to mandatory terms and conditions from Fisheries agencies (USFWS, NMFS, MADFW)
- Time Frame (License vs. Exemption). Time to correct deficiencies in application differ as do post filing requirements.



FERC Regulatory Process – Time and Costs Can Mount





Regulatory Process and Winsor Dam Hydropower Rehabilitation

- Risks far outweigh any benefits. Regulatory uncertainty: potential for changed directives for long standing operating rules for discharges, affecting MWRA's Safe Yield and MWRA's primary mission.
- Hydro generation potential not that significant. Existing turbine/generator far oversized for current day operation and protection of fishery resource
 - Sizing turbine for 20 mgd discharged over 24 hours would result in turbine only moderately larger than Loring Road
 - Development costs considerably higher than Loring Road
 - No subsidies available for non-conduit projects.
 - Little on-site need for power (power consumed on site has higher value than power sold to grid, if project not eligible for net metering)



Other Potential Hydropower Projects by MWRA

- MWRA continues to explore opportunities for both conventional and non-conventional hydropower projects in its water system.





QUESTIONS????

MORE INFORMATION:

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