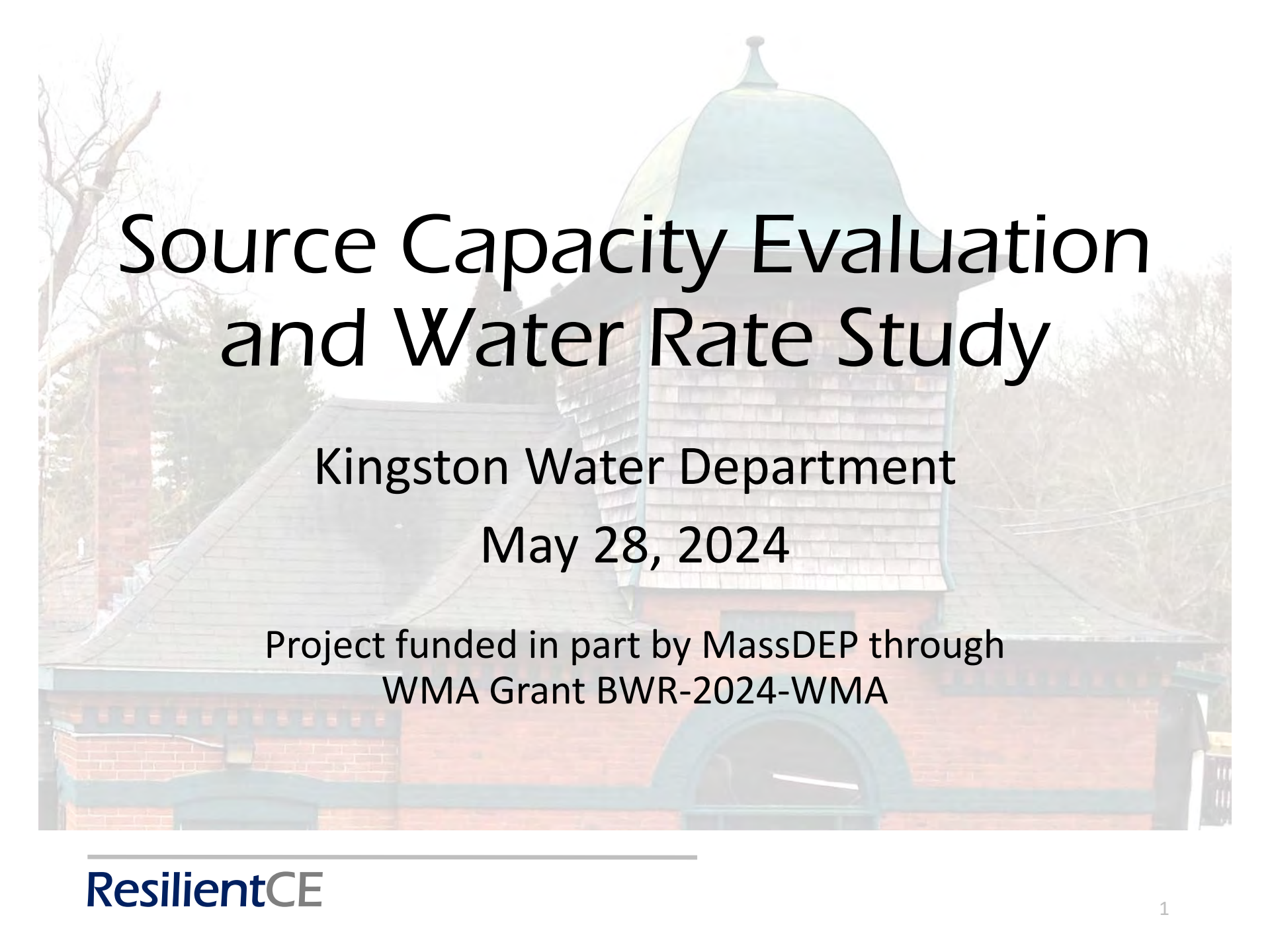




Source Capacity Evaluation and Water Rate Study

Kingston Water Department

May 28, 2024

Project funded in part by MassDEP through
WMA Grant BWR-2024-WMA

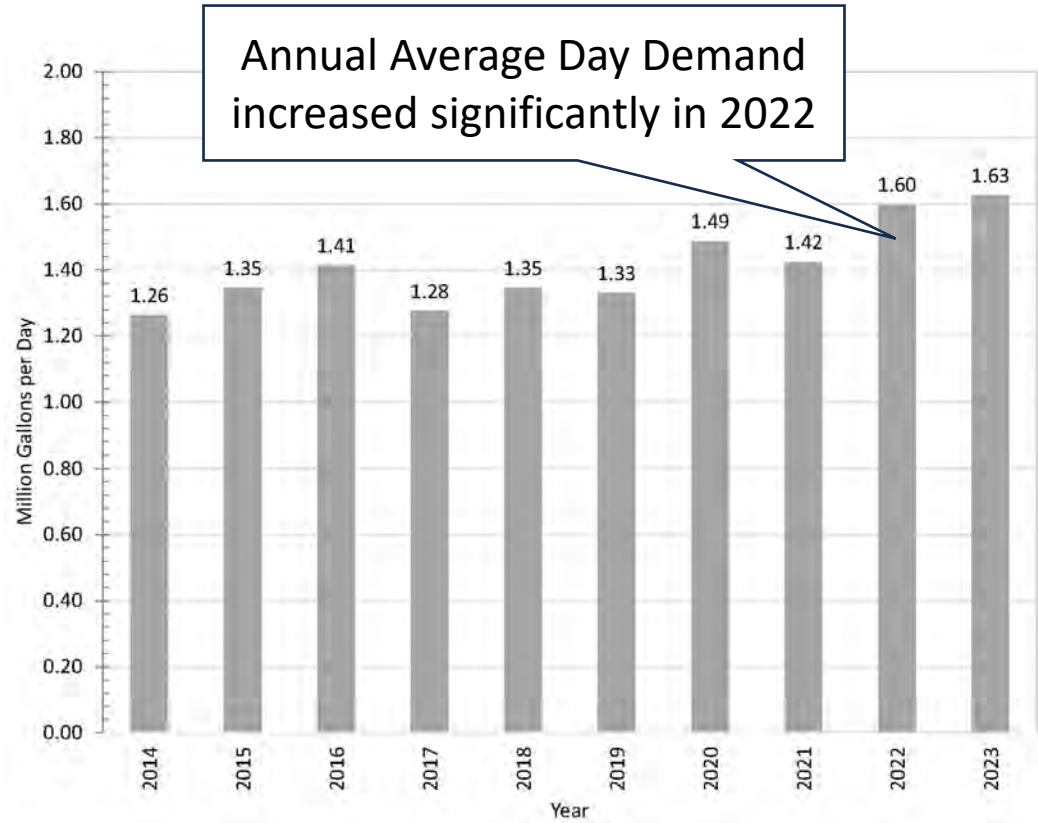
Project Scope

- Water Demand Analysis
- Water Conservation Method Review
- Source Capacity Evaluation
- Storage Capacity Evaluation
- Water Rate Study



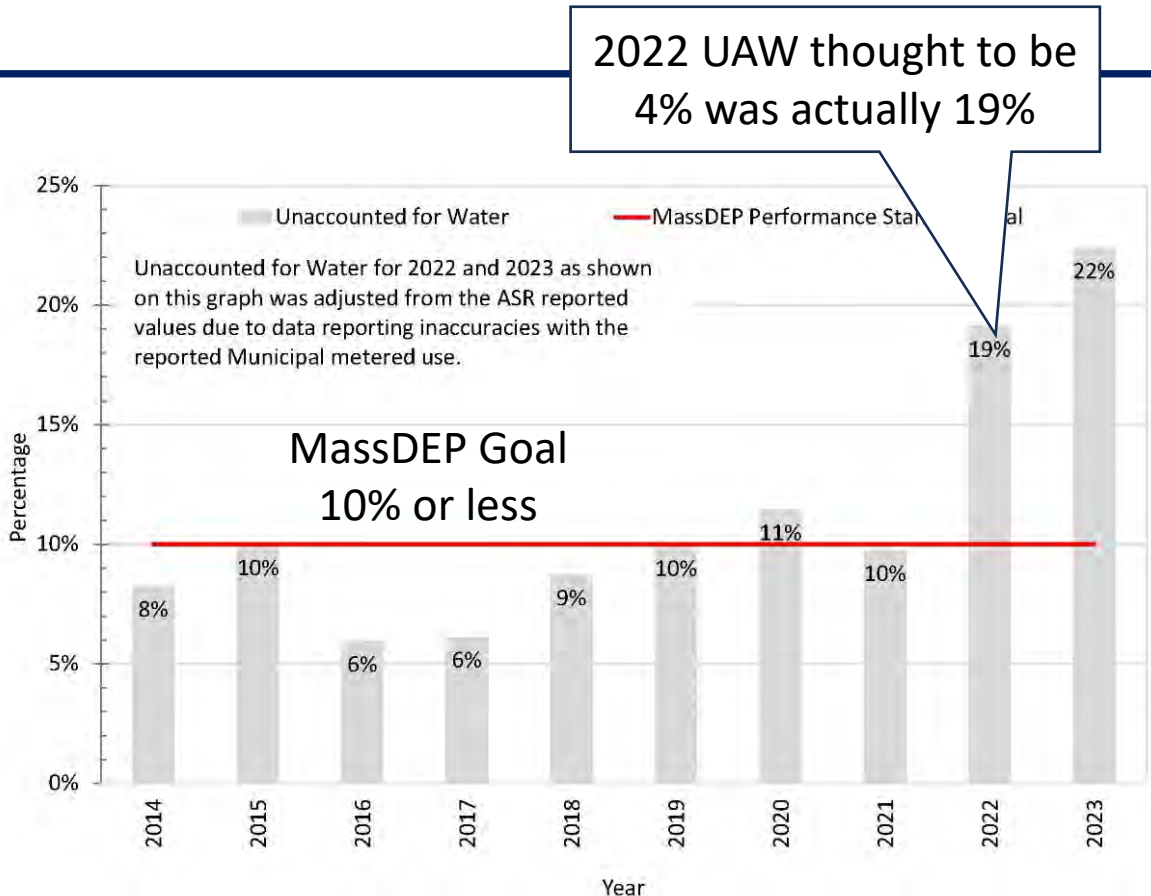
Water Demand Analysis

- 2014 to 2023 average day demand ranged from 1.26 to 1.63 million gallons per day (mgd) and averaged 1.41 mgd
- Annual average day demand increased by about 13% from 2021 to 2022
- Customer connections increased from a total of 4,018 services in 2014 to 5,094 services in 2023, a 27% increase in service connections, the majority being for residential customer connections
- July average day demand is about 1.8 times the January average day demand, indicating a high outdoor water use in the summer



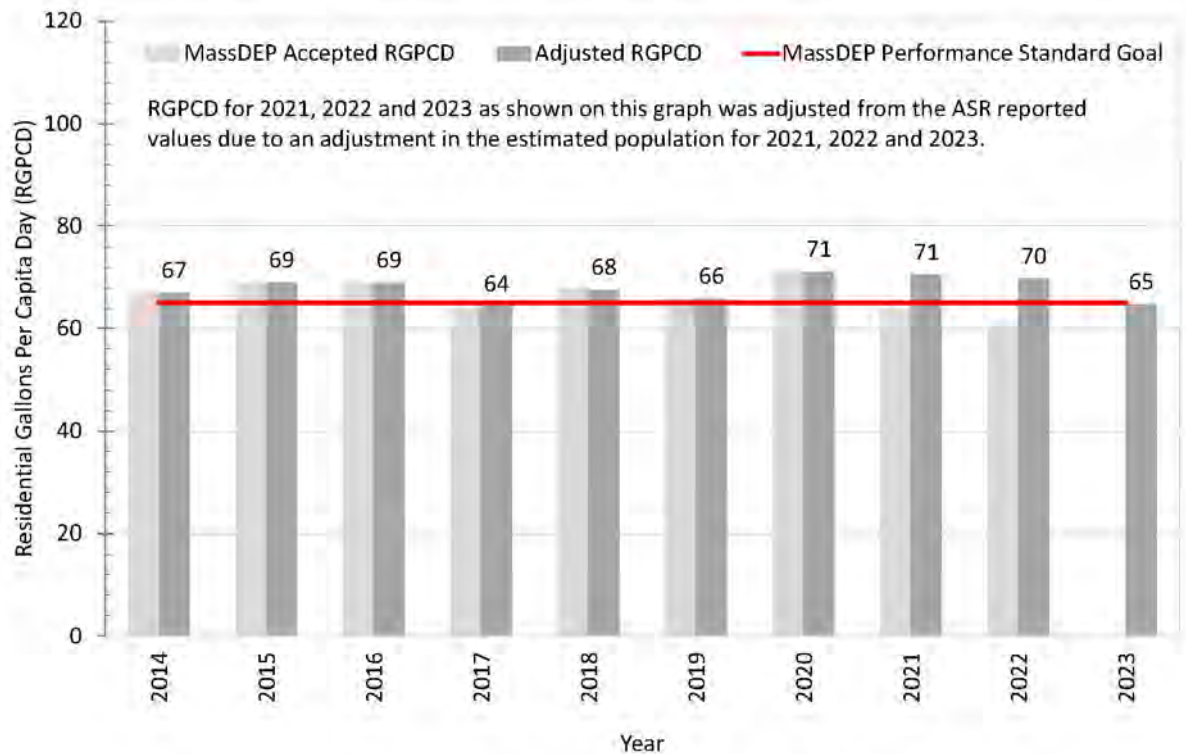
Water Demand Analysis (cont.)

- Metered use for 2022 and 2023 was adjusted from the amounts reported in the ASRs since it was determined through this project that Municipal metered use was incorrectly reported due to record inaccuracies and UAW was adjusted accordingly.
- UAW increased during 2022 and 2023 to 19% and 22% respectively indicating that water losses have increased possibly resulting from water leaks



Water Demand Analysis (cont.)

- Using adjusted population estimates to correct ASR data reporting inaccuracies for the years 2021, 2022 and 2023, RGPCD has been greater than the MassDEP standard of 65 RGPCD for 8 of the past 10 years, indicating that water conservation efforts are required.
- 2023 residential use was 65 RGPCD however 2023 was a particularly wet growing season.



Water Demand Analysis (cont.)

- DCR Water Needs Forecast (WNF) – follows methodology adopted by Water Resources Commission
- Scenario 1 – Maintaining Current RGPCD and UAW of about 70 RGPCD and 15% UAW (Based on 5-Year Average)
- Scenario 2 – Meeting Compliance with 65 RGPCD and 10% UAW
- Both account for increasing residential population and decreasing employment projections
- Both include water used for residential, commercial, municipal and water losses
- Estimates provided in May 23, 2024 letter increased from January 31, 2024 letter

DCR WNF Projections

Year	Population	Average Day Demand (mgd) Current Trends	Average Day Demand (mgd) 65 RGPCD and 10% UAW
2023	14,628	1.63	--
2026	14,838	1.56	1.40
2031	15,378	1.60	1.43
2036	15,840	1.64	1.46
2041	16,222	1.66	1.48
2046	16,286	1.74	1.55

Water Conservation, Methods in Place

- Water Dept. completes an ASR each year providing an informal water audit by in-house staff.
- Water Dept. meters water pumped from each of its water supply wells and calibrates source meters annually.
- Water Dept. meters 100% of customers including all municipal facilities.
- Customer meters are sealed against tampering and Town has ability to fine customers for meter tampering.
- Water Dept. budgets for meter calibration and replacement in its annual budget.
- Customer meters are read quarterly through a radio read system as part of quarterly billing process.
- Customer usage is compared with prior use to help identify customers with unusually high use.
- Water Dept. is operated as an Enterprise Fund. Water rates have been established based on the costs required to operate, maintain and protect the water system, in other words Full Cost Pricing.
- Current water rates use an eight-block increasing tier or block structure designed to encourage conservation.
- Water Dept. prohibits the connection of inground irrigation systems to be connected to the public water supply.
- Water Dept. participates in WaterSMART program each year and has public education about water conservation on their website.
- Water Dept. implements Odd/Even and before 9 am and after 5 pm restrictions on outdoor water use each year from May through September. This restriction meets compliance with the WMA Permit requirement when the RGPCD is less than or equal to 65 RGPCD. However, when greater than 65 RGPCD, more stringent restrictions on nonessential outdoor water use are required.
- Water Dept. owns leak detection equipment and the water operators routinely utilize this equipment to identify and isolate leaks.

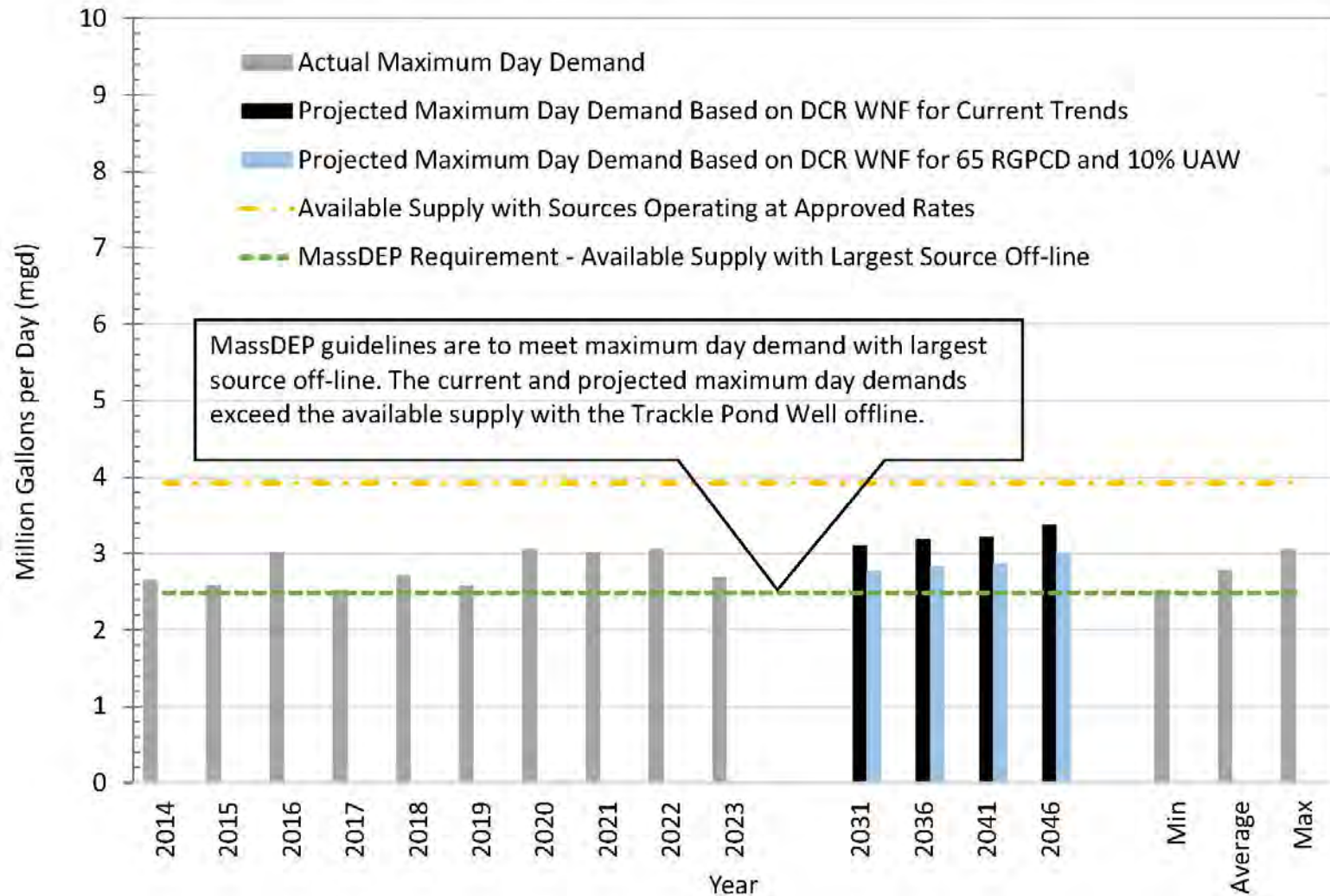
Water Conservation – Methods to Consider

- Completion of a formal water audit would provide a more in depth review of water use and reporting practices.
- Adoption of more stringent restrictions on nonessential outdoor water use.
- Conduction of a more focused public education and outreach about water conservation.
- Identification of large water use customers and specifically approaching them about ways to conserve water.
- Adoption and implementation of water-use restriction bylaw, ordinance or regulation following the current MassDEP template. While the current Town By-Law and Rules and Regulations have allowed the Town to implement water use restrictions, the Town should consider adopting the MassDEP recommended Outdoor Water Use By-Law/Ordinance which more specifically defines nonessential outdoor water use and declaration of a State of Water Conservation versus State of Water Supply Emergency.
- Current UAW exceeds 10%, Town should retain a specialty leak detection consultant to perform system-wide leak detection.

Water Supply Capacity Evaluation

- MassDEP Guidelines for Public Water Suppliers Chapter 7 requires that with any supply pump out of service, the remaining pump(s) shall be capable of providing the maximum daily pumping demand of the system. The Town does not meet this threshold for the current or future maximum day demand with its existing sources of supply.
- Maximum Day Demand (Most recent 5-Year Average) is 2.88 mgd
- Maximum Day Demand (Projected Future) is 3 to 3.4 mgd
- Available 24-hour Operation Supply with Largest Source Off-line is 2.616 mgd
- Current deficit is 0.264 mgd or about 200 gpm
- Future deficit could be 0.784 mgd or about 550 gpm
- Source capacity evaluation identified that Water Dept. needs to construct a new well to meet current and future water demands, to provide supply redundancy and to increase supply resiliency. New source to provide at least 550 gpm.

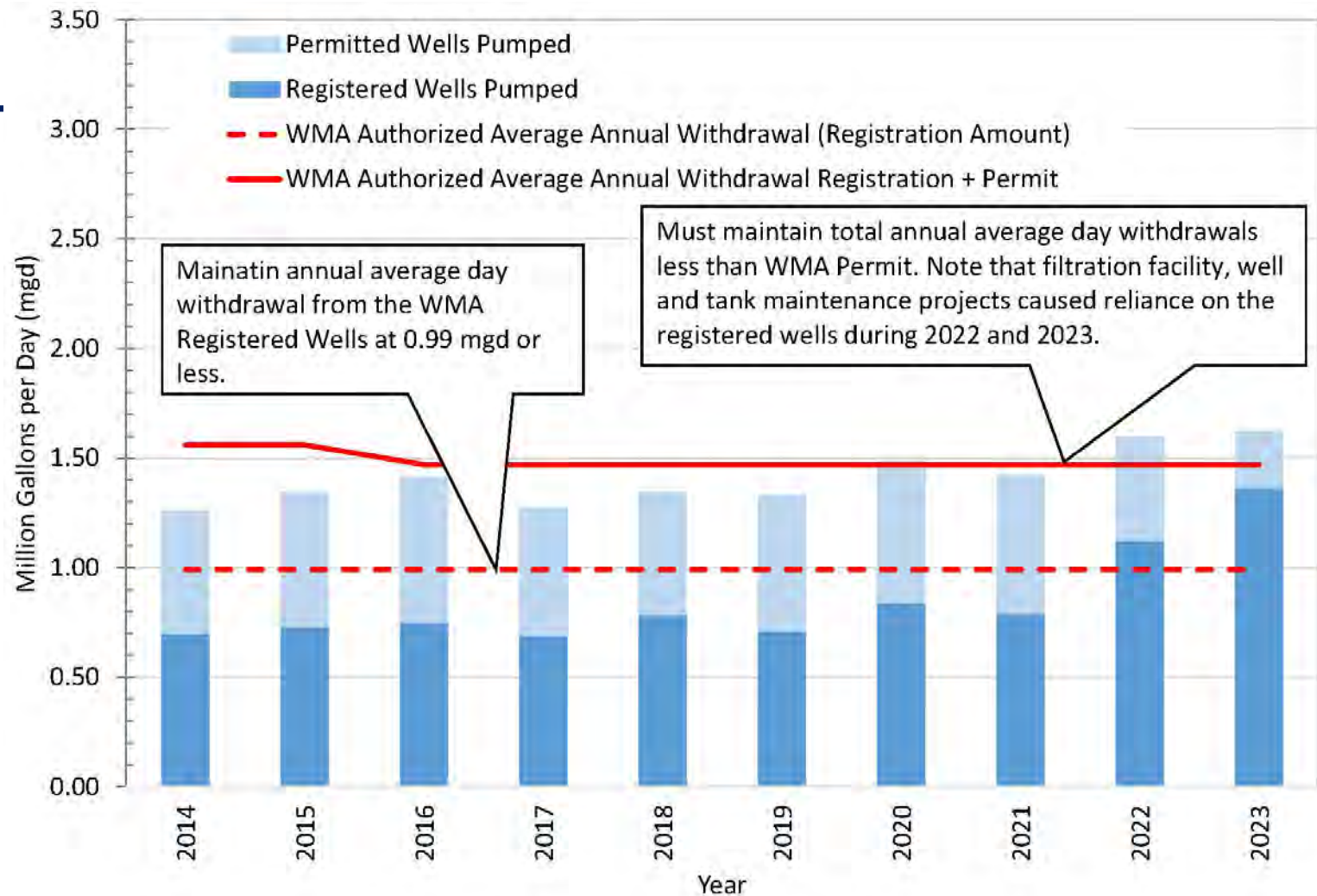
Water Supply Capacity Evaluation



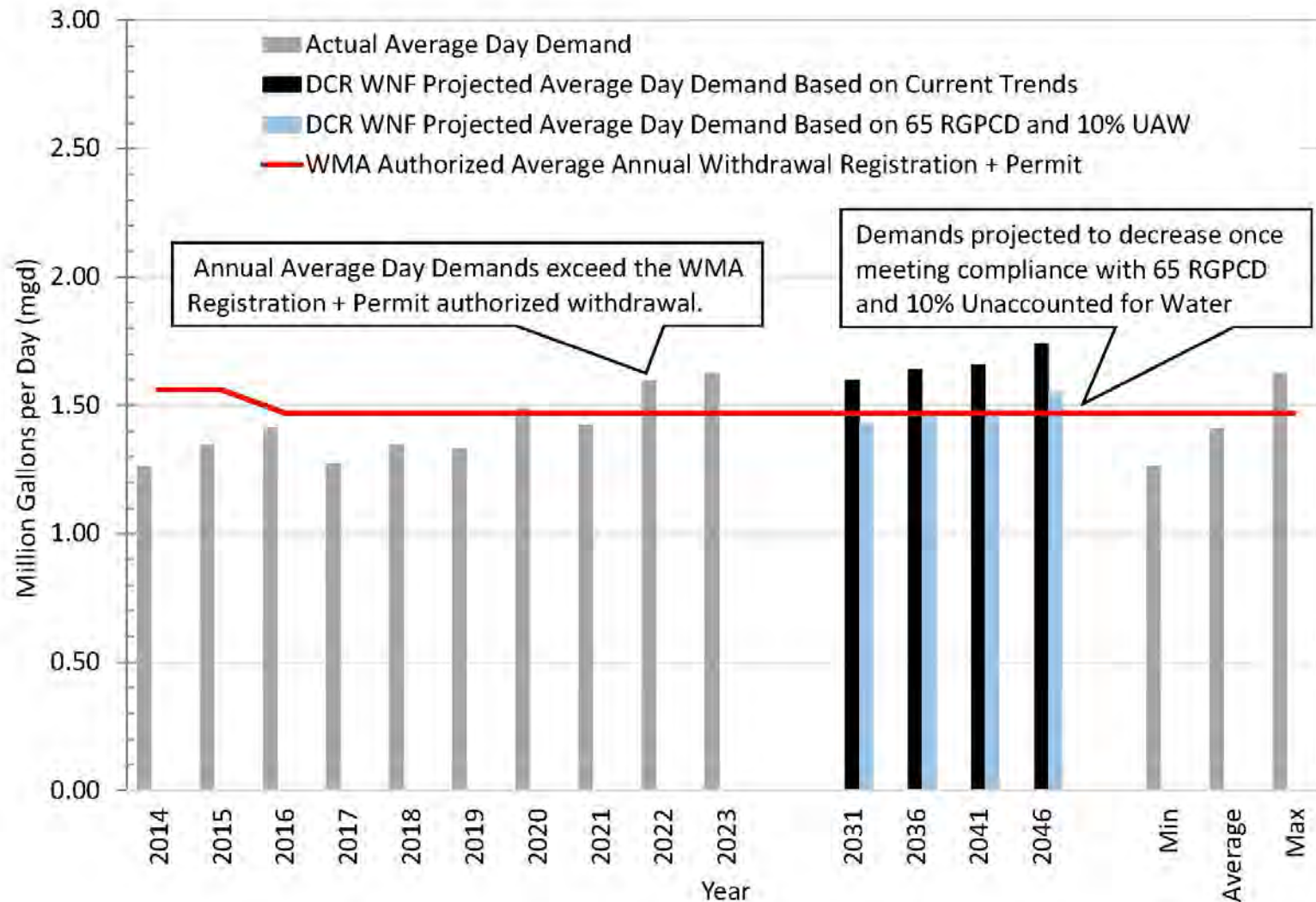
Water Supply Capacity (cont.)

- Current WMA registration plus permitted authorized withdrawal is 1.47 mgd and the average withdrawal from 2014 to 2023 was 1.41 mgd.
- Withdrawal limit was exceeded in 2022 and 2023 in part due to an increase in UAW.
- If the increase in UAW is from system leaks and Water Dept. is able to successfully identify and repair these leaks, they may be able to reduce their total withdrawal close to or below 1.47 mgd.
- However, WNF shows the required withdrawal will continue to increase with population growth, therefore, Water Dept. should consider filing a new WMA Permit application as part of the New Source Approval permitting process for the new well.

Annual Average Day Demand



Anticipated Future Withdrawals



Potential Additional Water Supply

- Water Dept. conducted extensive groundwater exploration throughout Town.
- Water Dept. identified site for new well southwest of Trackle Pond. Preliminary test well work indicates that well with yield similar to existing Trackle Pond Well may be possible.
- Alternative Sources
 - Duxbury Water – could only supply for small area of Kingston for short term emergency (up to one week) during summer and not during July 4th week.
 - Plymouth Water – Town Center Pressure Zone (El. 187 ft), connection at Route 3A, could supply but unknown gpd and duration, would need their engineer to evaluate. Interconnect would require Town of Plymouth approval and intermunicipal agreement.
 - Plymouth Water – West Plymouth Pressure Zone (El. 295 ft) by Kingston Collection has supply firm capacity deficit so they have required developer for proposed apartment complex (similar to complex at mall) to fund booster pump station to transfer water from Town Center Pressure Zone to address deficit in West Plymouth Pressure Zone.
 - Pembroke Water – does not have additional supply, also does not meet maximum day demand with largest source off-line. Pembroke is installing new well (estimate next fall) and water treatment facility (estimate 3 years out). Emergency interconnect is located at Rte 27. Pembroke operates at El. 280 ft.

Water Supply Capacity Recommendations

- Continue to pursue new well
 - Water Dept. is in process of purchasing land for well. Once land purchase is complete, Water Dept. should proceed with permitting and installation of the new well.
 - New well will require pump station with chemical feed systems and water transmission main to Trackle Pond Well Manganese Removal Facility, which has capacity for the new well, for filtering prior to distribution.
 - Detailed cost estimate for the new well and pump station is presented in Section 5 of the report. Total cost for well and pump station with chemical feed systems is estimated to be \$4.5 to \$5.43 million.

New Well Next Steps

Preliminary next steps for implementation of the new well are:

1. Conduct pump testing of the 4-inch diameter test wells installed in 2018.
2. Larger diameter test well – To be determined if needed.
3. Initiate New Source Approval permitting process.
4. Design and permit contract documents for new well.
5. Bid and construction of the new well.
6. Design and permit contract documents for the pump station.
7. Bid and construction of the pump station.
8. Pump test and activation.

The above process generally takes three to five years to complete.

Steps and schedule to be better defined for the next meeting.

Water Storage Capacity Evaluation

- Current tanks in both the Low Zone and the High Zone provide about 1.5 MG of combined equalization, fire and emergency storage. This meets the current needed volume but as the demand increases the equalization storage need increases. The current storage does not meet the future storage needs.
- High Zone only has one storage tank, providing no storage redundancy for the High Zone. When the Elm Street Tank is off-line, the High Zone becomes a pumped system reliant on the Soules Pond booster pumps to supply water from the Low Zone.
- High Zone has grown and has additional growth potential.
- Additional storage is required in the High Zone to (1) provide currently needed storage redundancy in the High Zone, (2) provide additional storage for to meet future demands, (3) provide resiliency to the Low Zone.

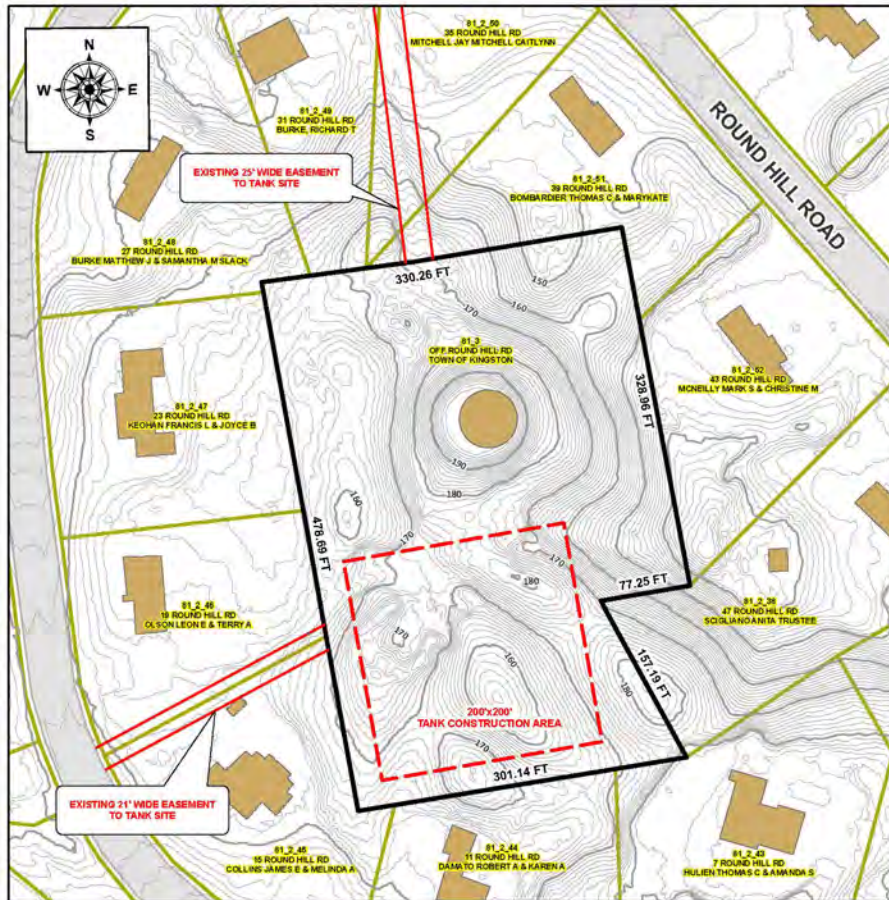
Water Storage Site Evaluation

4 Potential Tank Site Evaluated:

1. Site 1: Indian Pond Tank Property
2. Site 2: Country Club Way Property
3. Site 3: 1-86 Well Site Property
4. Site 4: Monks Hill Property

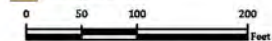
Tank Site 1: Indian Pond Tank Property

- Figure 6-1 shows site, parcel is land locked and abuts residential properties.
- Town has two utility and access easements to the parcel.
- Space for construction work area of 200 feet by 200 feet.
- Based on the available topographic information, it appears that a ground elevation of El. 170 feet could be attained through grading of the construction area.
- With a tank overflow of El. 281 feet, site could be suitable for a 0.5 MG spheroid style elevated tank approximately 111 feet to overflow.
- With the proximity of homes on the abutting parcels, tank would be visible from these homes even if a tree buffer is provided.
- Approximately 800 feet of 16-inch diameter main would connect with the existing 8-inch diameter main on Round Hill Road (Figure 6-2).
- Hydraulic model was used to simulate the effects on the hydraulic grade line during a 2,000 gpm fire flow event in the High Zone at Gallen Road and compare current conditions with the additional tank. Gain about 20 psi with Site 1 Tank.



Legend

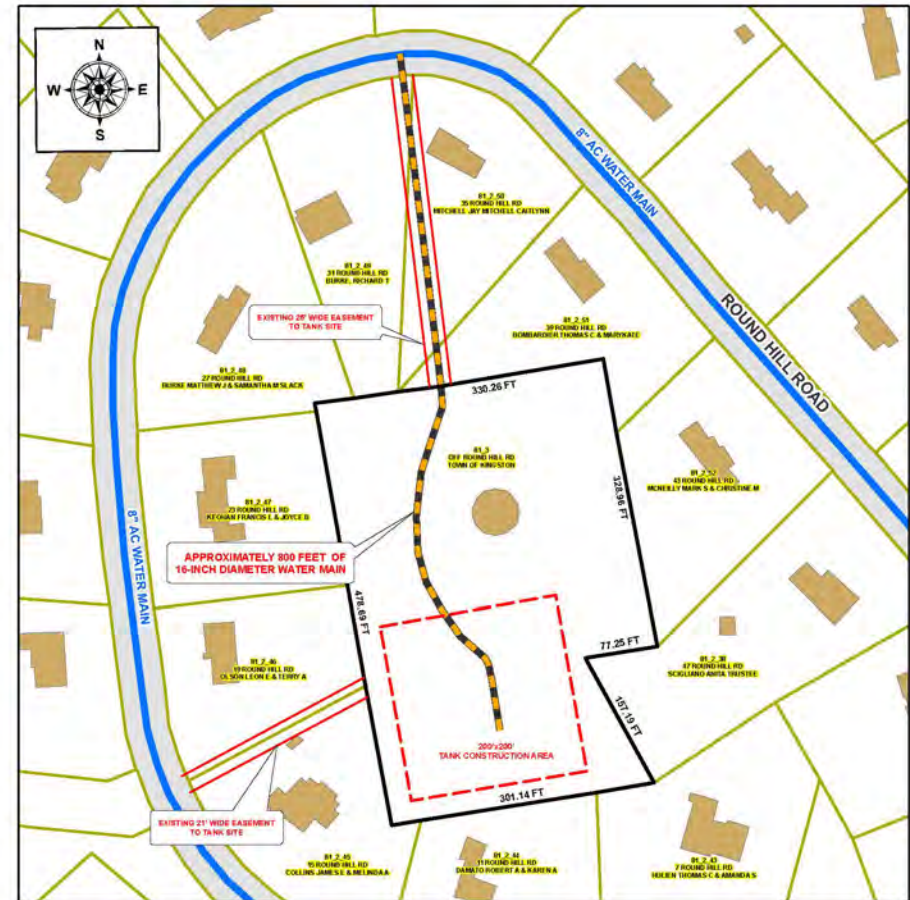
- Elevation Contour (10')
- Town Owned Parcels - Undeveloped
- Town Owned Parcels - Developed or Outbuilding
- Parcel Boundary
- Building/Structure



Data Source: Town of Kingston, MassGIS

Figure 6-1
Site 1
Proposed Tank at
Indian Pond Tank Property
 Kingston Water Department
 22 Elm Street
 Kingston, Massachusetts

ResilientCE
 Resilient Civil Engineering, P.C.



Legend

- Potential Water Main Route
- Existing Water Main
- Town Owned Parcels - Developed or Outbuilding
- Parcel Boundary
- Building/Structure



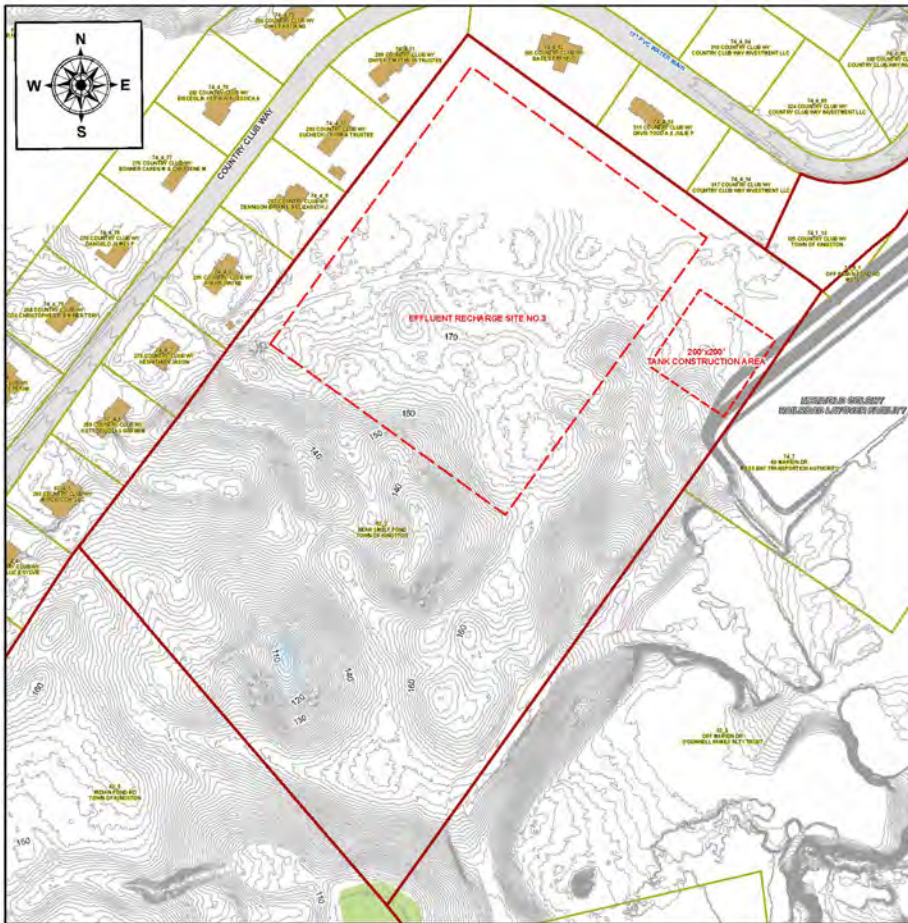
Data Source: Town of Kingston, MassGIS

Figure 6-2
Site 1
Proposed Tank at
Indian Pond Tank Property
Potential Water Main Route
 Kingston Water Department
 22 Elm Street
 Kingston, Massachusetts

ResilientCE
 Resilient Civil Engineering, P.C.

Tank Site 2: Country Club Way Property

- Figure 6-3 shows parcel is land locked but the Town also owns an abutting parcel allowing for access and utilities via Town-owned land from Country Club Way.
- Space for construction work area of 200 feet by 200 feet.
- Based on the available topographic information, it appears that a ground elevation of El. 165 feet could be attained through grading of the construction area.
- With a tank overflow of El. 281 feet, site could be suitable for a 0.5 MG spheroid style elevated tank approximately 116 feet to overflow.
- Site provides more buffer from abutting parcels than Site 1 and the tank would be less visible from the neighboring properties.
- Approximately 425 feet of 16-inch diameter main would connect with the existing 12-inch diameter PVC main on Country Club Way (Figure 6-4).
- Hydraulic model was used to simulate the effects on the hydraulic grade line during a 2,000 gpm fire flow event in the High Zone at Gallen Road and compare current conditions with the additional tank. Gain about 30 psi with Site 2 Tank.



Legend

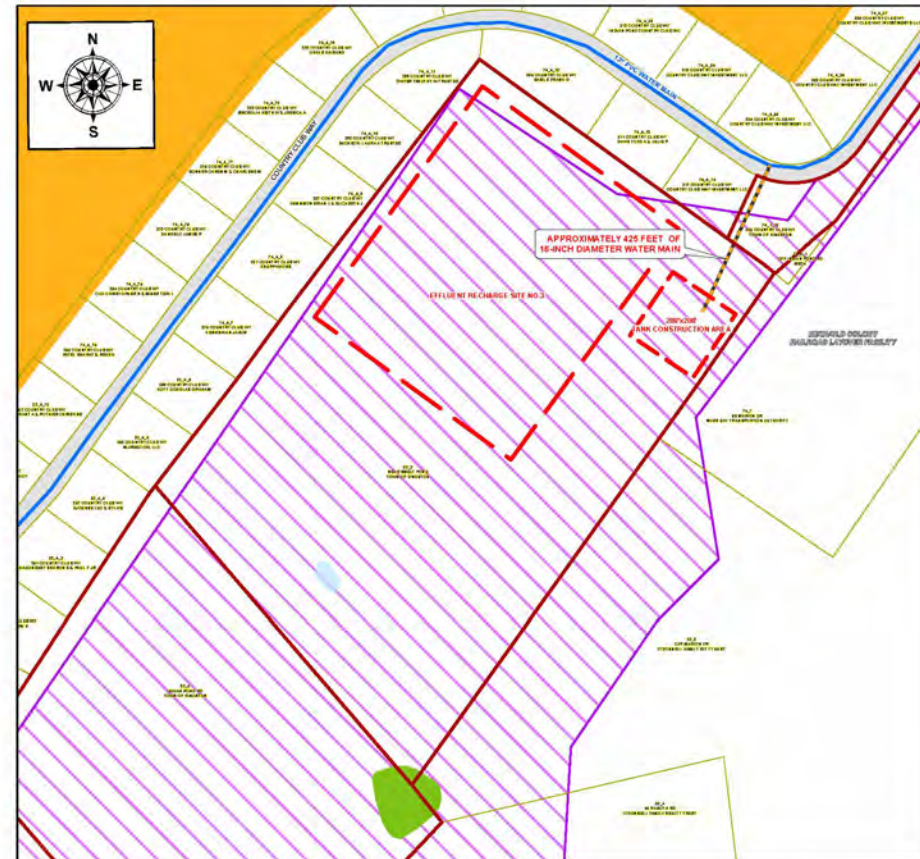
- Elevation Contour (1ft)
- Town Owned Parcels - Undeveloped
- Parcel Boundary
- Building/Structure
- Open Water
- Wetland



Data Source: Town of Kingston, MassGIS

Figure 6-3
Site 2
Proposed Tank at
Country Club Way Property
 Kingston Water Department
 22 Elm Street
 Kingston, Massachusetts

ResilientCE
 Resilient Civil Engineering, P.C.



Legend

- Potential Water Main Route
- Existing Water Main
- Town Owned Parcels - Undeveloped
- Parcel Boundary
- MassGIS Protected and Recreational OpenSpace
- Private
- Open Water
- National Wetlands Inventory
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- NHESP Priority Habitats of Rare Species



Data Source: Town of Kingston, MassGIS

Figure 6-4

Site 2
Proposed Tank at
Country Club Way Property
Potential Water Main Route

Kingston Water Department
 22 Elm Street
 Kingston, Massachusetts

ResilientCE
 Resilient Civil Engineering, P.C.

Tank Site 3: 1-86 Well Site Property

- Figure 6-5, parcel is land locked and Town currently has an access and utility easement to reach the 1-86 Well through land owned by the Kingston Collection property owners.
- Space for construction work area of 200 feet by 200 feet but within the Zone I of the 1-86 Well.
- Based on the available topographic information, it appears that a ground elevation of El. 165 feet could be attained through grading of the construction area.
- With a tank overflow of El. 281 feet, the site could be suitable for a 0.5 MG spheroid style elevated tank approximately 116 feet to overflow.
- Site provides more buffer from abutting parcels than Site 1 and Site 2.
- Approximately 4,420 feet of 16-inch diameter main would connect with the existing 16-inch diameter PVC main on Gallen Road (Figure 6-6).
- Hydraulic model was used to simulate the effects on the hydraulic grade line during a 2,000 gpm fire flow event in the High Zone at Gallen Road and compare current conditions with the additional tank. Gain about 30 psi with Site 3 Tank.

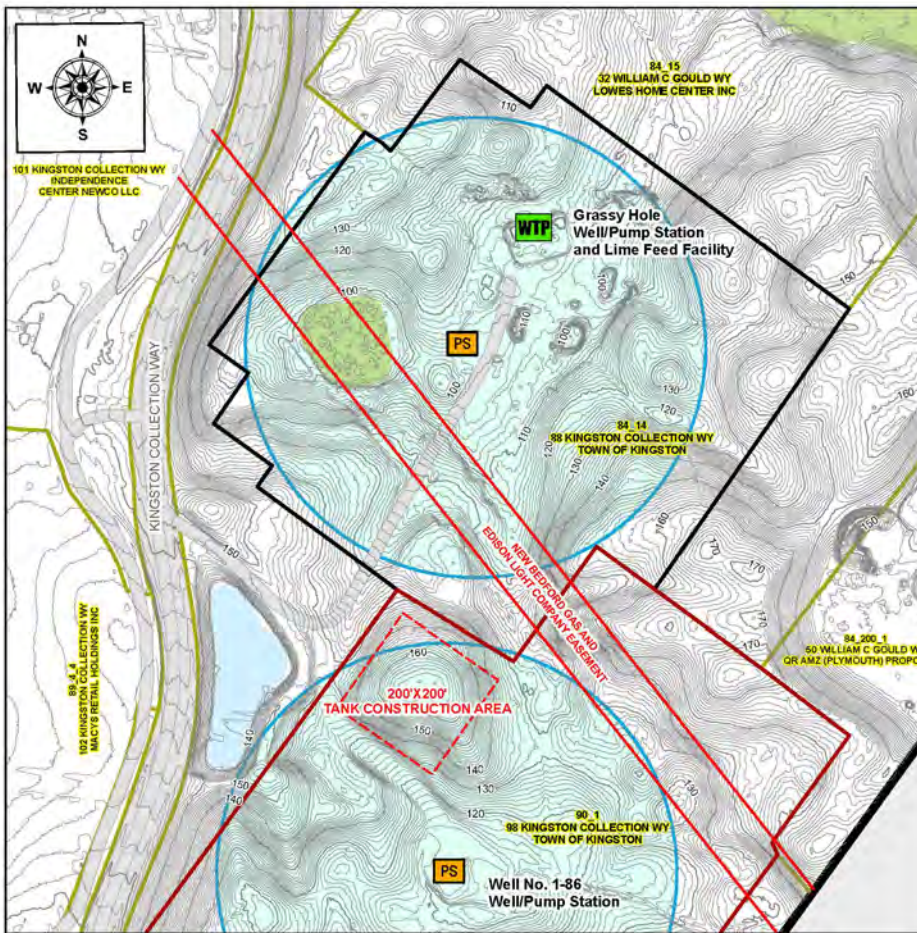


Figure 6-5

Site 3 Proposed Tank at 1-86 Well Property

Kingston Water Department

22 Elm Street
Kingston, Massachusetts

ResilientCE
Resilient Civil Engineering, P.C.

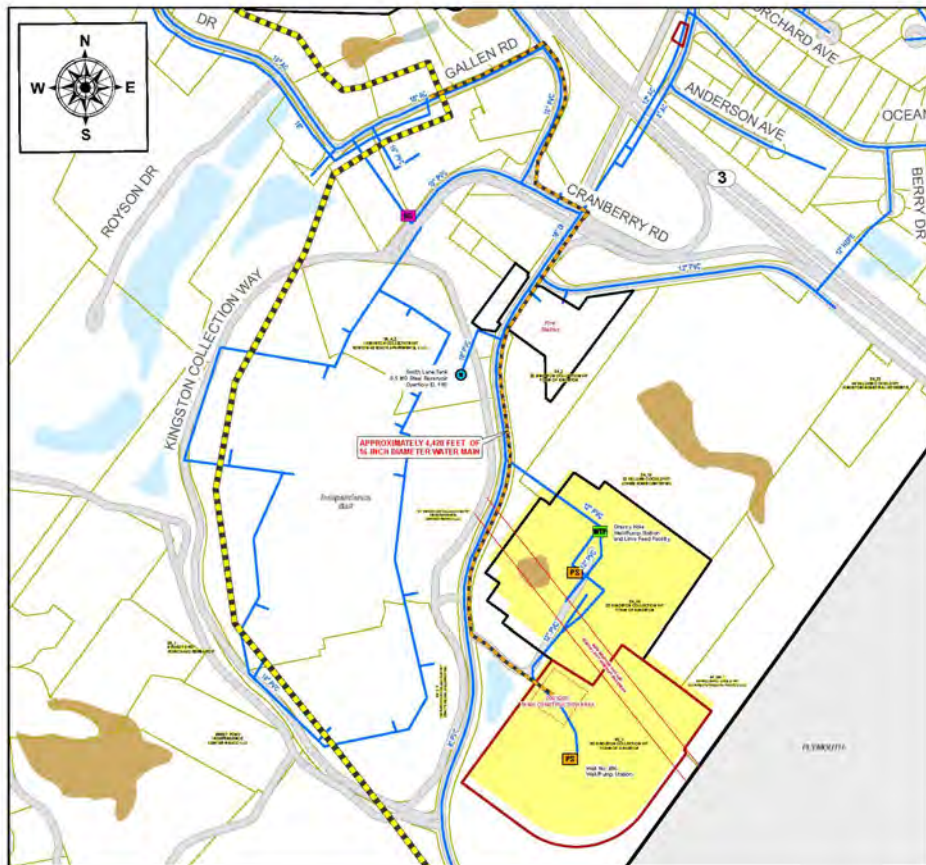


Figure 6-6

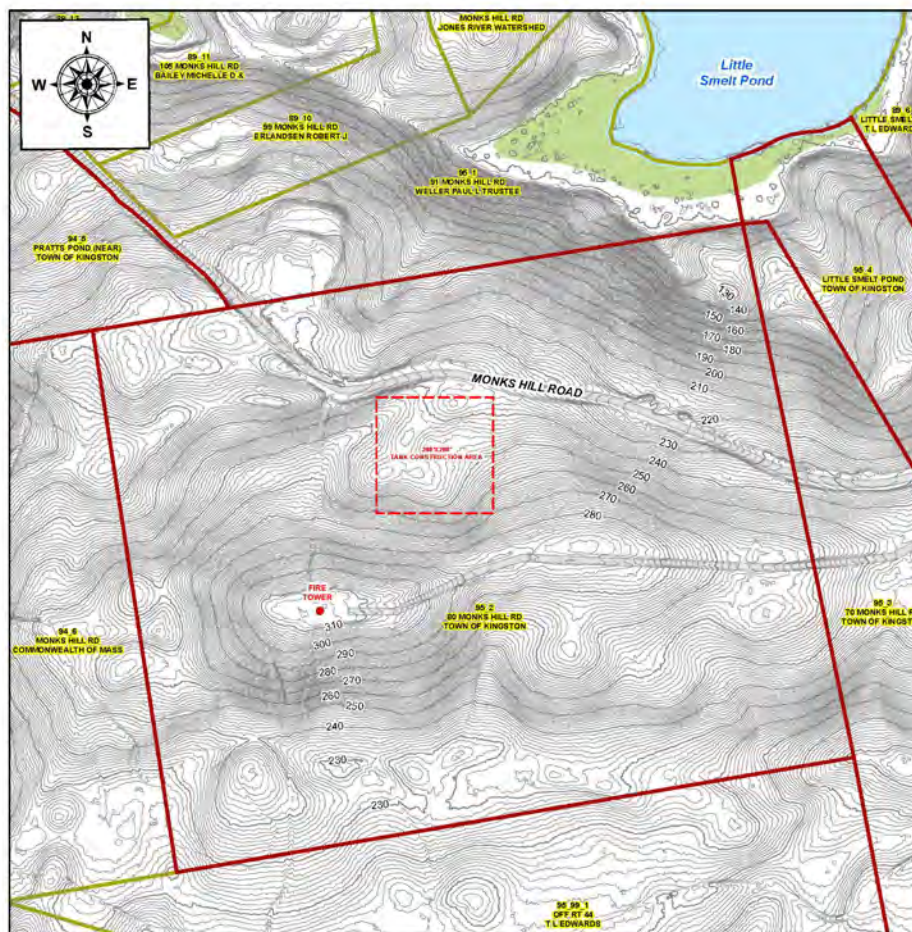
Site 3 Proposed Tank at 1-86 Well Property Potential Water Main Route

Kingston Water Department
22 Elm Street
Kingston, Massachusetts

ResilientCE
Resilient Civil Engineering, P.C.

Tank Site 4: Monks Hill Property

- Figure 6-7, Monks Hill property is owned by the Town. There is an existing fire lookout tower on this parcel.
- Space for construction work area of 200 feet by 200 feet.
- Based on the available topographic information, it appears that a ground elevation of El. 245 feet could be attained through grading of the construction area.
- With a tank overflow of El. 281 feet, site could be suitable for a 0.5 MG reservoir style tank approximately 36 feet to overflow.
- Site provides more buffer from abutting parcels than Site 1 and Site 2.
- Approximately 6,600 feet of 16-inch diameter main would connect with existing 12-inch diameter PVC main on Country Club Way (Figure 6-8).
- Potential water transmission main route involves crossing Town owned properties currently with conservation restrictions and crossing near or through wetland areas. Additionally, to make the connection with the main on Country Club Way from Town owned land would require getting an easement from a private home owner on Country Club Way.
- Hydraulic model was used to simulate the effects on the hydraulic grade line during a 2,000 gpm fire flow event in the High Zone at Gallen Road and compare current conditions with the additional tank. Gain about 20 psi with Site 4 Tank.



Legend

- Elevation Contour (1ft)
- Town Owned Parcels - Undeveloped
- Town Owned Parcels - Developed or Outbuilding
- Parcel Boundary
- Open Water
- Wetland

0 100 200 400 600 Feet

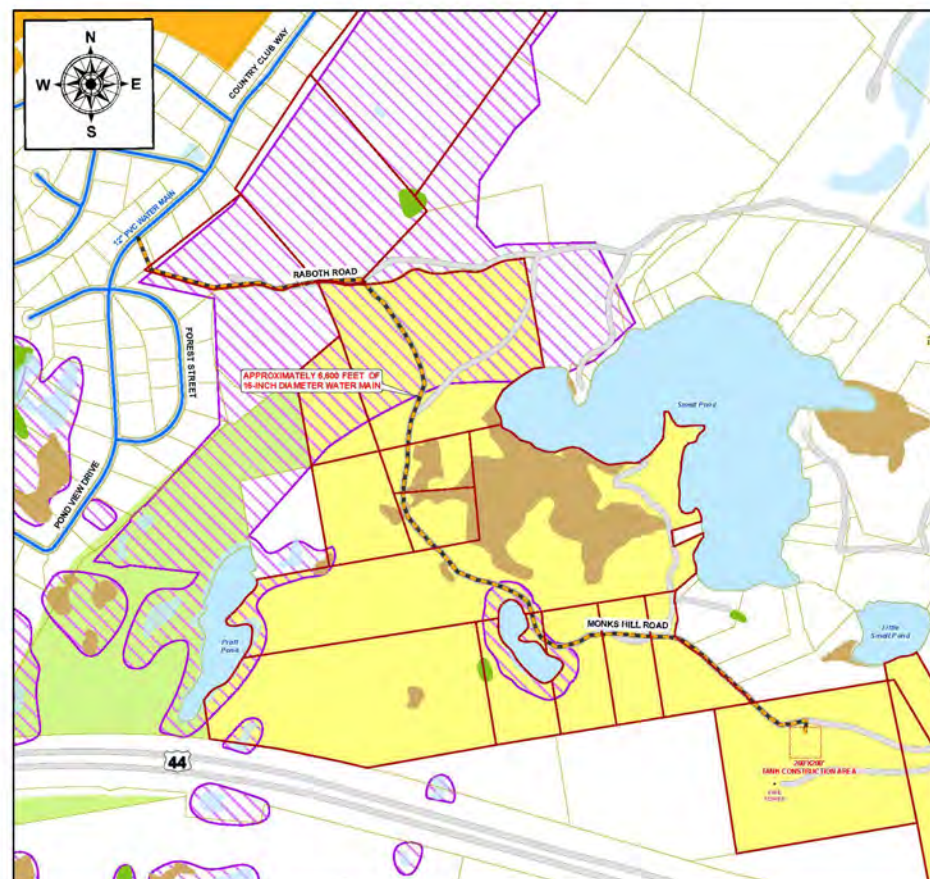
Data Source: Town of Kingston, MassGIS

Figure 6-7

Site 4 Proposed Tank at Monks Hill Property

Kingston Water Department
22 Elm Street
Kingston, Massachusetts

ResilientCE
Resilient Civil Engineering, P.C.



Legend

- Potential Water Main Route
- Existing Water Main
- Town Owned Parcels - Undeveloped
- Town Owned Parcels - Developed or Outbuilding
- Parcel Boundary
- MassGIS Protected and Recreational OpenSpace
- DCR State Parks & Recreation
- Municipal
- Private
- NHESP Natural Communities
- NHESP Priority Habitats of Rare Species
- Open Water
- National Wetlands Inventory
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

0 375 750 1,500 2,250 Feet

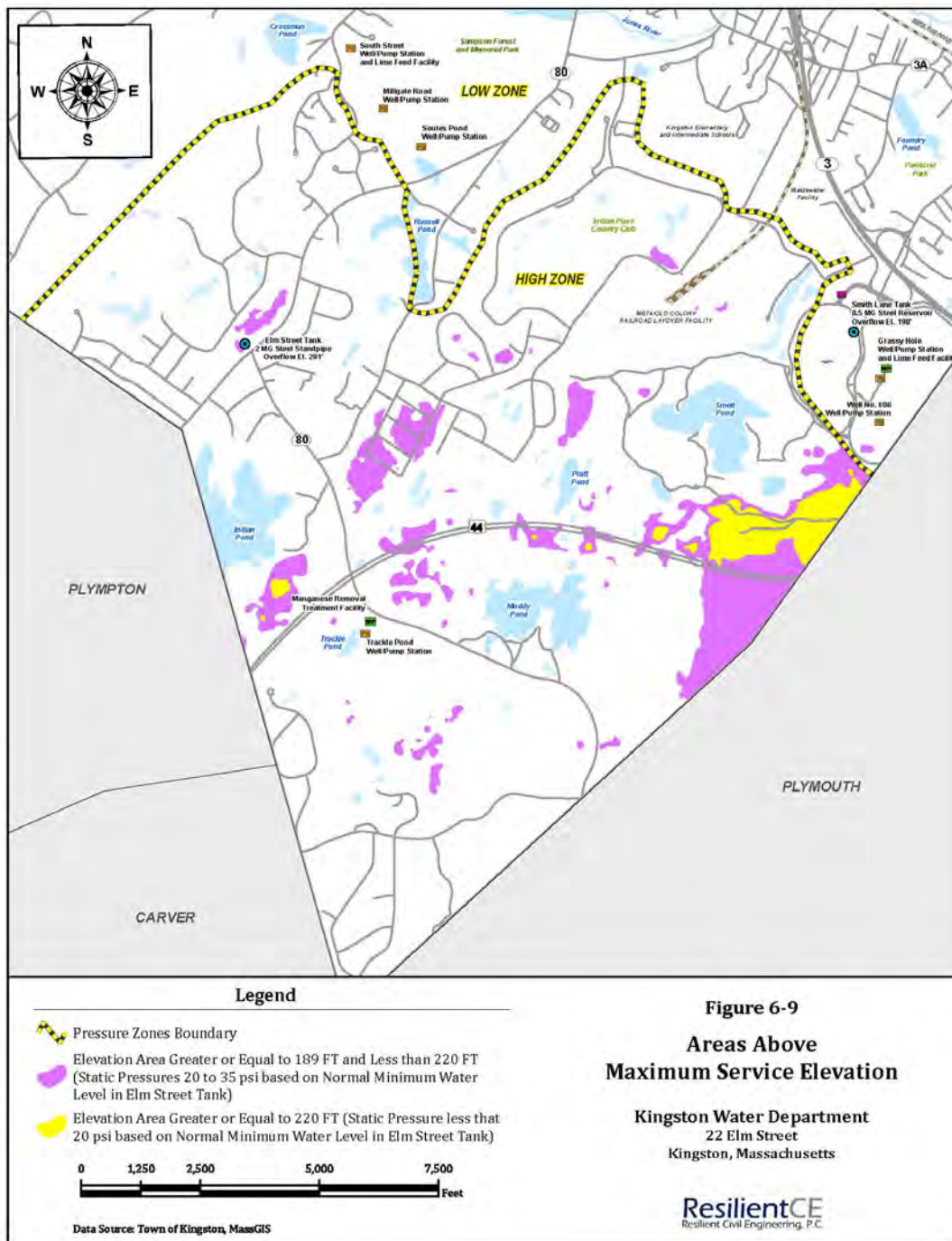
Data Source: Town of Kingston, MassGIS

Figure 6-8

Site 4 Proposed Tank at Monks Hill Property Potential Water Main Route

Kingston Water Department
22 Elm Street
Kingston, Massachusetts

ResilientCE
Resilient Civil Engineering, P.C.



- Figure 6-9 presents areas within the High Zone at elevations that, if served, would have pressures:
- 20 to 35 psi – Purple
- Less than 20 psi – Yellow
- Minimum pressures must be maintained greater than 20 psi throughout distribution under both normal and emergency conditions.

Tank Site Comparison

Site 1: Indian Pond Tank Property

- Advantages
 - Town owned property with an existing abandoned water storage tank.
 - Close proximity to the High Zone distribution system approximately 800 feet of 16-inch diameter main would connect with the existing 8-inch diameter main on Round Hill Road.
 - Existing access and utility easements.
 - Site elevation would allow for a shorter elevated tank.
 - Hydraulic model indicated favorable hydraulics in comparison with the existing conditions.
- Disadvantages
 - Proximity to homes.
 - Existing easements are infrequently used and construction traffic and noise would be disruptive to the neighbors.
 - Site is not level and would require significant grading.

Tank Site Comparison

Site 2: Country Club Way Property

- Advantages

- Town owned property in a commercial and light industrial area.
- Closest proximity to the High Zone distribution system.
- No easements required.
- Site requires minimal grading to level.
- Site elevation would allow for a shorter elevated tank.
- Hydraulic model indicated favorable hydraulics in comparison with the existing conditions.

- Disadvantages

- Site will be adjacent to wastewater treatment plant effluent infiltration beds.
- Area designated as NHESP Priority Habitat of Rare Species (additional permitting)

Tank Site Comparison

Site 3: 1-86 Well Site Property

- Advantages
 - Town owned property.
 - Existing access and utility easements.
 - Site elevation would allow for a shorter elevated tank.
 - Hydraulic model indicated favorable hydraulics in comparison with the existing conditions.
- Disadvantages
 - Site is within the Zone I of the 1-86 Well.
 - Site is not level and would require significant grading.
 - Site is further from the High Zone distribution system requiring approximately 4,420 feet of 16-inch diameter main to connect with the existing 16-inch diameter PVC main on Gallen Road.

Tank Site Comparison

Site 4: Monks Hill Property

- Advantages
 - Town owned property.
 - Site elevation would allow for a reservoir style tank instead of an elevated tank.
 - Hydraulic model indicated favorable hydraulics in comparison with the existing conditions.
- Disadvantages
 - Site is not level and would require significant grading.
 - Site is further from the High Zone distribution system requiring approximately 6,600 feet of 16-inch diameter main would connect with the existing 12-inch diameter PVC main on Country Club Way.
 - Potential water transmission main route involves crossing Town owned properties currently with conservation restrictions and crossing near or through wetland areas and areas designated as NHESP Priority Habitats of Rare Species.
 - To make connection with main on Country Club Way from Town owned land would require getting an easement from a private home owner on Country Club Way.

Tank Site Comparison

Order-of-Magnitude Cost Estimates

	Tank Site 1	Tank Site 2	Tank Site 3	Tank Site 4
Water Main Cost	\$240,000	\$150,000	\$1,547,000	\$2,310,000
Tank Construction Cost	\$2,640,000	\$2,640,000	\$2,640,000	\$1,100,000
Paint Containment	\$150,000	Not needed	Not needed	Not needed
Site Construction Cost	\$700,000	\$500,000	\$800,000	\$1,000,000
Engineering and Contingency	\$746,000	\$658,000	\$997,400	\$882,000
Total Construction	\$4,480,000	\$3,950,000	\$5,980,000	\$5,290,000

The order-of-magnitude estimate assumes the following:

- Cost estimates for planning purposes only. Detailed cost estimates for each phase need to be determined for appropriation purposes as the project moves forward.
- Cost estimate does not include any environmental remediation work (unknown) or legal fees.
- Cost estimate assumes a standard tank foundation.

Tank Site Comparison – Decision Matrix

1 = Less Advantageous

2 = Moderately Advantageous

3 = Advantageous

4 = Highly Advantageous.

Factor	Factor Weight	Rating Score			
		Tank Site 1	Tank Site 2	Tank Site 3	Tank Site 4
Effect on system hydraulics	10%	4	4	4	3
Additional flow available	10%	3	4	4	3
Property owned by Town	5%	4	4	4	4
Property restrictions	5%	3	3	1	1
Site within Well Zone I	5%	4	4	1	4
Community opinion	10%	1	4	4	4
Ease of water main construction	15%	3	4	2	1
Ease of tank construction	15%	2	2	2	4
Ease of site construction	15%	2	4	3	1
Ease of maintenance	10%	1	1	1	3
Relative Score	100%	2.50	3.35	2.65	2.65

Water Storage Recommendations

1. Additional storage is required in High Zone to (1) provide currently needed storage redundancy in the High Zone, (2) provide additional storage for to meet future demands, (3) provide resiliency to the Low Zone.
2. Potential water storage tank Site 2 on Country Club Way is the most advantageous of the four sites evaluated in the High Zone. Proposed tank would be a 0.5 MG spheroid style elevated tank approximately 116 feet to overflow.
3. Hydraulic model indicated that potential tank may not fill completely before Elm Street Tank fills signaling Trackle Pond Well pump to stop. This is due to proximity of Elm Street Tank to Trackle Pond Well pump. It may be necessary to make potential tank the tank that controls operation of the well pump.
4. Detailed cost estimate is presented in **Section 6.4**. Total cost for water storage tank and water transmission main is estimated to be \$4 million.

Next Steps

- Identify implementation schedule for new well
- Water Rate Study findings to be presented at June 11th Board of Water Commission meeting
- Draft Report
- Final Report