Date of Meeting: February 14, 2023

#10

BOARD OF SUPERVISORS
FINANCE/GOVERNMENT OPERATIONS AND
ECONOMIC DEVELOPMENT COMMITTEE
ACTION ITEM

SUBJECT: **Waterford Water Feasibility Study Findings**

2011 ELECTION DISTRICT(S): Catoctin

2022 ELECTION DISTRICT(S): Catoctin

CRITICAL ACTION DATE: At the pleasure of the Board

STAFF CONTACT(S): Scott Fincham, General Services
Dennis Cumbie, General Services
Ernest N. Brown, General Services

PURPOSE: To provide the Finance/Government Operations and Economic Development Committee (FGOEDC) with findings from the Waterford Water Feasibility Study and to provide staff recommendations.

RECOMMENDATION(S): Staff recommends that the FGOEDC recommend that the Board of Supervisors (Board) endorse a communal water system in the Village of Waterford. and direct staff to continue evaluation of potential interconnected communal systems to address water and wastewater needs for the Villages of Waterford and Paeonian Springs. Staff further recommends that the FGOEDC recommend the Board create a Village of Waterford Communal Water System capital project and direct staff to move funds in the amount of $1.5 million from the Capital Improvement Program Water and Wastewater Fund (C02091) to the new project in order to complete Preliminary Design Work for a Village of Waterford communal water system.

BACKGROUND: The Village of Waterford (Waterford) is an unincorporated area of northwestern Loudoun County (County) located within the Catoctin District, approximately three miles north of Paeonian Springs and five miles northwest of the Town of Leesburg. Waterford, established in 1733, with its surrounding countryside, was granted the National Historic Landmark (NHL) status in 1970. This NHL is one of only a few that encompasses an entire village. Following this NHL designation, local citizens, County and state officials, and friends of Waterford from across the nation have continued the work of preserving the landmark.

Currently, homes and businesses in Waterford rely on private wells for potable water and a communal wastewater system for sanitary sewer. The sanitary sewer system was installed in 1975

to address inadequate and failing septic systems. The community is serviced by a collection system that feeds into the Waterford Treatment Plant along Old Wheatland Road (Route 698), west of Catoctin Creek.

Loudoun County Water and Wastewater Program: In 2016, Loudoun County began accepting applications for the newly established Water and Wastewater Program (Program). The Program is a County initiative designed to assist Loudoun County communities experiencing issues with deficient water and wastewater systems. The Program is managed and administered by the Department of General Services (DGS) with support from Loudoun Water (LW).

Communication regarding the Program started with the village of Waterford as early as 2017, resulting in a 2019 application that was accepted into the Program. The application addressed drinking water concerns in the community, primarily the quantity of water available.

As prescribed by the Water and Wastewater Program Prioritization Manual, a Feasibility Study (Study) was approved by the Responsible Implementation Agents in 2020 to be conducted by LW (responsible party for feasibility studies commissioned under the Program) per a 2015 Memorandum of Understanding between the County and LW. In 2020, following input from the community, DGS and LW developed a Scope of Work (Scope) for the Study. The existing service area boundary established for the wastewater system, consisting of 154 parcels completely or partially within the boundary, was used for the study area.

In March of 2022, the final Study was completed. In early 2022, the community was provided access to a recorded presentation detailing the results of the Study. The presentation was well received by the community, and staff addressed community questions in writing.

Feasibility Study Results: The Study (Attachment 1) was completed by Dewberry Engineers Inc. (Dewberry), under agreement with Loudoun Water. The Study was designed to evaluate the water concerns identified by the community application and to determine the technical feasibility of potential solutions to those identified issues. The Study reviewed the existing conditions, presented the estimated existing and future water demands, provided an analysis of the existing water supply systems, and evaluated five potential options to improve or mitigate the water supply concerns. Prior to analyzing the feasibility of solutions, an analysis of the overall community was performed to better understand the existing characteristics such as topography, historical resources, local planning, and current zoning regulations. A technical memorandum was prepared which assessed potential permitting and regulatory conflicts within the Waterford study boundary relative to all options.

Based on the evaluation presented in the Study and the technical memorandum assessment of any permitting and regulatory conflicts, staff identified two of the Study options as preferred options to address Waterford's water supply problems:

- Shared Private Well System Between Residents.
- Community Public Water System Owned and Operated by Loudoun Water

Shared Private Well System (Study Option 2)

Multiple shared well systems can exist within the community if Loudoun County Health Department (LCHD) guidelines are followed. To remain under the jurisdiction of the LCHD, each well must serve less than 15 service connections, or less than 25 individuals, for at least 60 days out of the year. If these numbers are met or exceeded, the well would be considered a public waterworks, as defined by the Virginia Waterworks Regulations 12VAC5-590, which is regulated and enforced by the Virginia Department of Health Office of Drinking Water (ODW). Based on discussions with ODW and LCHD and an assumption of three or four bedrooms per home, the maximum number of connections considered for this study was four connections per shared well in order to ensure that the system does not exceed population restrictions as required by LCHD.

Each new shared well system would require an existing or new well capable of providing an eight gallon per minute (gpm) yield. Each system would require easements, deeds, and any additional legal covenants or agreements needed to ensure that the well does not meet the definition of a public waterworks, and to clearly define the responsibility for costs (e.g., well improvements) and violations between property owners. The preliminary capital cost estimate for this option, which includes drilling a well and installing 2-inch distribution piping to each property, is approximately $159,500 for each shared well system serving four connections. That cost would be shared evenly among the four properties connected for an approximate cost of $40,000 per property.

This option would only provide a solution to those properties that agree to engage in a shared well system. Capital costs and maintenance responsibilities would be born solely by the property owners. Any challenges associated with maintenance agreements, easements, and building restrictions would be addressed and coordinated by individual property owners.

Communal Public Water System (Study Option 3)

This option would create a new communal system owned and operated by Loudoun Water. Up to six communal wells would be located within or adjacent to the Waterford Study boundary. A water treatment system(s) and distribution piping to convey drinking water would be installed. The recommended demand flow to be used for sizing of water distribution piping and well/treatment systems (as needed) for the Waterford community is 173 gallons per minute.

Additional work would be required to locate and construct high-yield water wells. Based on the information analyzed as a part of the Study, a groundwater treatment system is assumed necessary due to iron and manganese levels prevalent within western Loudoun County; therefore, it is assumed that greensand filtration will be required. However, the specific type of treatment technology required would be confirmed through water quality testing once communal wells have been developed.

The preliminary cost of this option, including the design/permitting/surveying for the project, construction of the water distribution system, and the water treatment system (assuming one

greensand filtration treatment system[1]), individual parcel improvements and road restoration/site work, is approximately $10.5 million.

Option 3 would provide an overall community-wide solution that would be County-driven in partnership with Loudoun Water, who would own and operate the system. Homeowners would be responsible for connection from the house to the water distribution system and quarterly service fees. Table 1 provides a cost comparison of the two Study options.

Table 1. Cost Comparison for Waterford FS Solutions.

Option	Cost	Low Range Estimate (-20%)	High Range Estimate (+30%)
#2 Shared Wells (per system)	$ 159,000	$ 127,000	$ 207,350
#3 Communal System	$ 10,463,000	$ 8,370,000	$ 13,602,000

Although Option 2 is one of two preferred solutions, challenges associated with shared wells prevents it from being the highest scored option[2]. Shared wells are a targeted, and not a community-wide, solution. The costs shown for Option 2 in Table 1 represent the cost for a system serving the maximum of four residences, and that cost would be shared by those homeowners. The matrix scoring included in the Study indicates that the requirements for individual homeowners to permit, design, and construct these systems are challenging. In addition, the complexity of coordinating land acquisition, easements, and potential impacts with future home sales prevents Option 2 from being staff's recommended option.

Community Engagement:

Community input informed the Scope for the Study. Staff used information gathered at community meetings, and input following the draft Scope to develop the Final Scope. As such, the Waterford Feasibility Study has been the most technical study completed under the Program to date.

To assist with messaging and communication in the community, staff sought assistance from community members and organizations. An informal work group was formed that included the primary Citizen Water and Wastewater Program Coordinators, the Vice President of the Waterford Citizens Association (WCA), the Executive Director of the Waterford Foundation Inc., and a member of the WCA Water Committee. This work group helped set up community meetings, provided community input, updated the community on milestones, and maintained important project information on the WCA website, which is the central location for Village correspondence.

[1] A greensand filter is a water treatment system consisting of a sand-sized media effective in removal of iron, manganese, hydrogen sulfide, arsenic and radium.
[2] Table 4.4, Page 37 of Attachment 1; Waterford Water Feasibility Study.

Following the completion of the Study, County and LW staff participated in a Waterford community meeting on October 13, 2022, to further discuss the Study and the next steps forward, which were a community survey designed to evaluate support for the solutions proposed by the Study, to be followed by a household income review to determine the use of the County's Water and Wastewater Fund (Fund). Staff worked with the Office of Public Affairs and Communications to establish an online survey for residents.

Survey Results: Survey notices were sent out to property owners of 154 parcels located either wholly or partially within the study area. A total of 77 individual responses were received, representing 72 parcels. Of those 72 parcels, 68 parcels have habitable structures. Table 2 provides results to selected questions limited to responses representing individual parcels:

Table 2. Village of Waterford Community Survey Results

		Responses	70	97.2%
Do you Support a water Project in Wateroford?	Total Parcels	No	12	17.1%
		Yes	58	82%
	Parcels with Structures	No	12	17.6%
		Yes	54	79.4%
Do You Support Option 2 (shared wells)		No	49	71%
		Yes	20	29%
	Parcels with Structures	No	45	66.2%
		Yes	20	29.4%
Do You Support Option 3 (Communal)	Total Parcels	No	21	30%
		Yes	49	70%
	Parcels with Structures	No	21	30.1%
		Yes	49	69.1%
If Communal System Offered, Would You Connect?	Total Parcels	No	17	23.6%
		Yes	19	26.4%
		Unsure	36	50%
	Parcels with Structures	No	16	24.2%
		Yes	17	25.8%
		Unsure	35	53%

Survey results indicate that among respondents representing parcels with habitable structures favor Options 3 (Communal System) roughly 69% to 31%, while the community overall supports a water solution by 82% to 18%. Results also show some uncertainty about connecting to a communal system, as owners of parcels with structures responded positively to connection at 53%, with 47% either "No" or "Unsure". The survey also included multiple opportunities for community members to provide their thoughts and opinions on the proposed solutions and the needs of the community. The raw results from the survey (personal information redacted) are found in Attachment 2.

ISSUES:

Village of Paeonian Springs: In 2017 the Village of Paeonian Springs (Village) submitted a Water and Wastewater program application for assistance with a communal water and wastewater infrastructure project. The application was reviewed, and Paeonian Springs was approved to move forward with a Feasibility Study (PS Study). In 2019, the PS Study was completed and it outlined alternatives that could address the water and wastewater concerns in the Village.

The initial findings of the PS Study resulted in a recommended wastewater solution that would create a communal system that would collect wastewater and pump to a subsurface discharge treatment facility (mass drainfield), and a water solution that would establish a groundwater sourced communal distribution system. The 2019 estimated costs for those systems was $24 million.

Staff performed a detailed review with other County departments, County Administration and Loudoun Water, upon which it was evident that supplemental technical work was necessary to determine the best approach forward. Consequently, Loudoun Water was asked to work with their consultant to produce a Technical Memorandum that would expand on the original PS Study for the following items:

- Establish criteria and perform detailed research to identify a project boundary that properly reflects the area of public health risks;
- Re-examine and provide further details on other potential alternative solutions following recent policy or practice changes; and
- Complete further research to evaluate whether fixing the wastewater conditions would have a significant impact on the water conditions.

The completed Technical Memorandum resulted in a refined community boundary, evaluation of a potential surface discharge treatment system, and updated cost estimates to better reflect current costs, along with an explanation of how those costs were estimated. Table 3 provides updated potential solutions for Paeonian Springs.

Table 3: Paeonian Springs Cost Estimates[3]

Community System	**Estimated Capital Costs**	
Water System		$11.6M
	Surface System	**Subsurface System**
Wastewater	$17.9M	$16.8M
Land Acquisition	$165,000	$1.5M
Total Project Cost	**$28.5M**	**$31M**

[3] Paeonian Springs Water & Wastewater Boundary and Treatment Alternatives Technical Memorandum, Dewberry, April 2022.

Interconnected Communal Systems: The Paeonian Springs Technical Memorandum, completed in April of 2022, suggests that the County could consider an additional alternative to address Paeonian Springs wastewater needs, which is an interconnection with the Village of Waterford. Loudoun Water owns and operates the existing wastewater system in Waterford and is currently in the design stage of a state mandated system upgrade. The concept would be to connect to the existing system, with the additional load requirement built into the designed upgrade. Staff from both the County and LW have discussed the concept and believe the option should be explored further, to include evaluating a potential interconnected water supply system, as well to address the water needs of both villages located only 2.4 miles apart.

This concept would require detailed review of the policy implications related to interconnection of communal systems in the Rural Policy Area. Staff requested and received County policy reviews from both the Deputy County Administrator, and the Director of the Department of Planning & Zoning (Attachment 3). Both reviews indicated that an interconnected communal system for the purpose of providing solutions to environmental health problems and the updated proposed service boundary for Paeonian Springs are generally consistent with the General Plan. These reviews are indicative of staff opinion. Staff anticipates that a commission permit will be necessary to confirm plan compliance.

At the request of County staff, LW and its consultant have determined the following potential advantages and impacts of making interconnected communal systems between Waterford and Paeonian Springs for both water and wastewater. Such items may include:

Advantages:

- Land Acquisition – Waste Water Treatment Plant (WWTP) site already owned by LW, so additional WWTP land not needed. Land would be needed for only one Water Treatment Plant (WTP).
- Permitting –Easier to modify existing wastewater permit, only one water permit required.
- Cost – Less expensive to expand an existing wastewater plant than to build a new one. Building one new water treatment plant is less expensive than building two.
- Engineering – Higher likelihood of finding high yielding wells with an expanded area.
- Cost sharing – Decrease in cost per user if not funded.

Impacts:

- Land Acquisition – No need for communal drain field area.
- Site Improvements – No duplication of improvements required.
- Infrastructure support – Auxiliary utilities already exist in Waterford.
- Concrete – Reduced amount in expansion of existing plant instead of new build.
- Life-cycle cost – Operational efficiencies with reduced number of plants.
- Public impact – Reduced impact to viewsheds, avoids impacts to historical designations.
- Environment – Single surface discharge, reduced risk of permit violations.

Table 4 provides options for interconnected communal systems between Waterford and Paeonian Springs for both water and wastewater.

Table 4: Option Matrix for Interconnected Communal Systems

Option	Paeonian Springs		Waterford		Total # of Plants
	Water Communal System	Wastewater Communal System	Water Communal System	Wastewater Communal System	
1	New Standalone	New Subsurface	New Standalone	Existing	4
2	New Standalone	New Surface Discharge	New Standalone	Existing	4
3	New Standalone	Interconnected Pump to Waterford	New Standalone	Interconnected Expand Existing	3
4	New Interconnected	New Subsurface	New Combined	Existing	3
5	New Interconnected	New Surface Discharge	New Combined	Existing	3
6	New Interconnected	Interconnected Pump to Waterford	New Interconnected	Interconnected Expand Existing	2

The proposed interconnections would involve design and construction of a wastewater collection system in Paeonian Springs that would serve the Village and dispose of waste via interconnection with the existing Waterford wastewater plant (approximately 3 miles). The existing plant is subject to pending improvements required to meet new Virginia Department of Environmental Quality ammonia standards, so timing for a connection discussion is adequate.

For water, a collection system in both villages would need to be constructed, as well as a location for a common water treatment plant and supply wells located between the villages. The co-location of the wells and treatment facility at a location between the two villages would eliminate two of the main concerns of the Village of Waterford by assuring that 1) the treatment facility would not prove detrimental to the NHL viewshed; and 2) placement of nearby high-capacity groundwater wells would adversely impact yields of existing wells in the Village.

Funding: The timing of consideration for the interconnected communal systems is advantageous since the Paeonian Springs community water/wastewater improvements have already been provided with $3.5 million in American Rescue Plan Act (ARPA) funding for the purpose of pre-construction activities, to include design and any land acquisition needed. Land acquisition for wells and a water treatment system could serve both communities.

If interconnected communal systems are pursued, staff is recommending that the Board approve appropriating up to $1.5 million from the Water & Wastewater Fund in the CIP to begin preliminary engineering work within the Village of Waterford so that both Village projects progress concurrently. This amount represents approximately 10% of the total estimated capital costs from the Feasibility Study, which is a typical estimation of Preliminary Engineering Study costs. Completed preliminary engineering work will also serve to support applications for state and federal grant funds.

Water and Wastewater Program Policies: All Water and Wastewater Program projects are dependent on project financing and funding. Funding for Program projects are outlined in the Water and Wastewater Projects Funding Policy (Policy). This Policy establishes the approach and procedures that the County will follow in providing financial support to communities that have been prioritized for water and/or wastewater projects. Financial support could include grants, state and federal loans, bonds, private donations, and local tax funding. To utilize the funds allocated to the Water & Wastewater Fund in the CIP, the process begins with a community income verification review as outlined in the Policy and is necessary to determine the percentage of low-to-moderate income households in a community. The low-to-moderate percentage determines if the water or wastewater project costs will be funded by the County through the Water and Wastewater Fund or financed by the community. Any deviations from the Policy requires Board direction.

Project Timeline: Several community members addressed timeline concerns with Loudoun Water and County staff regarding the projected six-year timeline to establish a communal water system (described in Section 5.4 of the Study). Infrastructure projects in existing communities, especially those with the historical designations like Waterford, are extremely complex and resource intensive and it is unlikely that a water project of this magnitude could be implemented in a significantly reduced timeframe. As addressed in the Feasibility Study, there are sequential steps that need to occur before design or construction can commence. Should the communal water system option be pursued by the County, to allow for a timely resolution of the water concerns in the community, staff believe a two-phased approach should be applied.

Phase 1: DGS staff, in coordination with LW, will conduct Preliminary Design Work for a communal water system in Waterford. Preliminary Design Work may include but is not limited to aerial and land surveys, deed and easement reviews, utility location, Phase 1 Archaeological Review, and an Environmental Site Assessment. Phase 1 will allow staff an opportunity to coordinate discussions with the community and regulatory agencies to address design challenges and concerns and pursue potential grant funding opportunities.

Phase 2: This phase would include land acquisition, design, and construction of the communal water system.

Additional Consideration: Unrelated to the Waterford or Paeonian Springs Feasibility Studies, at the July 19, 2022, Board Business Meeting, staff from the Department of Transportation and Capital Infrastructure (DTCI) presented to the Board with the Village of Waterford Preserving the Landmark Infrastructure Improvements Master Plan (Master Plan), which was an update to the Waterford 2003 *Bury the Wires and Tame the Traffic Study*.[4] The updated report was completed upon the request of the Waterford Citizens Association and Waterford Foundation Inc., and incorporates recommendations from recent studies. It also provides comprehensive recommendations and updated high-level cost estimates for a program of several infrastructure improvements, all in the context of the village's status as an NHL. The intent of the report was to address the ongoing challenges associated with a growing number of overhead wires and cables, aging stormwater pipes and culverts, growing traffic volumes, and high traffic speeds. Included with those recommendations was a communal water system, identified as Option #3 from the Study. Ultimately, on July 19, 2022 the Board endorsed all recommended improvements in the Master Plan for future planning and implementation, including a communal water system, and forwarded the funding request to the CIP FY 2024 budget process for consideration and prioritization (8-0-1, Vice Chair Saines absent for the vote). It is important to note that the actions described in the Master Plan identify an infrastructure project path for a communal water system that does not adhere to the Water and Wastewater Program guidelines. Consequently, the Waterford Water Feasibility Study is being presented to the Board for consideration in accordance with the program separately but in coordination with any actions the Board may take in the future regarding the Landmark Infrastructure Improvements Master Plan.

On January 3, 2023, the Board formally forwarded discussion of road and utility improvements related to the Village of Waterford to the FY 2024 CIP work sessions.[5] It is anticipated that at the CIP work sessions, staff will present an overview of the full program of improvements that could be implemented in this vicinity, triggered by the need for water/wastewater improvements. Efficiencies have been identified that could cause the Board to combine all infrastructure improvements into one project.

The work described in Phase 1 above is necessary regardless of approval of the other Village of Waterford Landmark Infrastructure Master Plan proposed projects. Should Phase 1 of the communal water system be advanced, staff will administer the work in accordance with County policies, procedures, and best practices, while considering the long-term goals and purpose of the project should it be approved. Any Phase II actions related to the larger infrastructure improvement plan cannot be projected pending FY 2024 budget approval.

FISCAL IMPACT: Staff's recommendation to allocate $1.5 million from the Water and Wastewater Fund does not require new funding, but directs the use of existing CIP funds. There is

[4] July 19, 2022, Board Business Meeting, Item 6: Village of Waterford Master Plan Study
[5] January 3, 2023, Board Business Meeting, Item 4b: FINANCE/GOVERNMENT OPERATIONS AND ECONOMIC DEVELOPMENT COMMITTEE REPORT: FY 2024 Budget Development – Final Budget Guidance

sufficient funding in the Water and Wastewater Fund to complete the preliminary design work of the proposed project.

The estimated current project costs for design and construction of a communal water system for the Village of Waterford is $10.5 million. This cost will be evaluated, per Board direction, along with other components of the Village of Waterford Preserving the Landmark Infrastructure Improvements Master Plan during the FY 2024 CIP budget work sessions.

ALTERNATIVES:

1. The FGOEDC may recommend that the Board endorse a Village of Waterford communal water system for future planning and implementation, by allocating $1.5 million from the CIP Water and Wastewater Fund to complete preliminary design work.
2. The FGOEDC may recommend that the Board endorse an alternative option for future planning and implementation of a Village of Waterford communal water system.
3. The FGOEDC may take no action at this time and direct staff how to proceed.

DRAFT MOTIONS:

I move that the Finance/Government Operations and Economic Development Committee recommend the Board of Supervisors endorse a communal water system in the Village of Waterford. and direct staff to continue evaluation of potential interconnected communal systems to address water and wastewater needs for the Villages of Waterford and Paeonian Springs.

I further move that the Finance/Government Operations and Economic Development Committee recommend the Board of Supervisors create a Village of Waterford Communal Water System capital project and direct staff to move funds in the amount of $1.5 million from the Capital Improvement Program Water and Wastewater Fund (C02091) to the new project in order to complete Preliminary Design Work for a Village of Waterford communal water system.

OR

1. I move an alternate motion.

ATTACHMENT(S):

1. Waterford Water Feasibility Study
2. Waterford Survey Results and Responses
3. Department of Planning and Zoning Memorandum regarding Interconnected Communal Systems in the Rural Policy Area.

Dewberry

ARCHITECTS ENGINEERS CONSULTANTS

Historic Waterford Water Feasibility Study

Loudoun County

Dewberry Project No.: 50079958

March 31, 2022

PREPARED BY:

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Attachment 1

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ABBREVIATIONS

AACE	American Association of Cost Engineering International
ADD	Average Daily Demand
CAPP	Certificate of Appropriateness
CLOMR	Conditional Letter of Map Revision
CMPT	Commission Permit
Dewberry	Dewberry Engineers, Inc.
DTW	Depth to water
EDM	Engineering Design Manual
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
GPD	Gallons per Day
GPM	Gallons per Minute
HDRC	The Historic District Review Committee
LC	Loudoun County
LCHD	Loudoun County Health Department
LOMR	Letter of Map Revision
LW	Loudoun Water
MSL	Mean Sea Level
NEPA	National Environmental Policy Act
NTP	Notice to Proceed
ODW	Office of Drinking Water
OPCC	Opinion of Probable Construction Cost

RPA	Rural Policy Area
SHPO	State Historic Preservation Office
SWPPP	Stormwater Pollution Prevention Plan
TOYR	Time of Year Restrictions
The Program	Community Water and Wastewater Program
US	United States
USACE	US Army Corps of Engineers
VA DEQ	Virginia Department of Environmental Quality
VDCR	Virginia Department of Conservation and Recreation
VDH	Virginia Department of Health
VDHR	Virginia Department of Historical Resources
VDOT	Virginia Department of Transportation
VDWR	Virginia Department of Wildlife Resources
VDOF	Virginia Department of Forestry
VMRC	Virginia Marine Resources Commission
VSMP	Virginia Stormwater Management Program
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The Village of Waterford is a community that is dedicated to preserving its 18th- and 19th-century architecture and landscape, located in a historic district in Loudoun County, Virginia. The village includes 154 lots that are completely within or partially within the study boundary, with 145 lots completely within the study boundary. Many of the community members of Waterford use individual wells as their primary source of water without issue. However, a number of members of the community have been experiencing issues with well yield, which led them to apply to the Water and Wastewater Program (The Program). This application was accepted, and as a result, Dewberry Engineers Inc. (Dewberry), under agreement with Loudoun Water (LW), was tasked with developing an engineering feasibility study.

The purpose of this feasibility study is to evaluate the concerns identified in the community of Waterford's application and to determine the technical feasibility of potential solutions to the community's drinking water issues. This feasibility study reviews the existing conditions of the community, presents the estimated existing and future water demands of the community, provides an analysis of the existing water supply systems and provides an evaluation of the following five (5) options to improve the water systems in Waterford:

1. Upgrade Existing On-Site Systems to Improve Yield on Individual Wells
2. Shared Private Wells
3. Community Water System Owned and Operated by Loudoun Water (Using New Community Wells)
4. Connection to a Nearby, Existing Community System
5. Wholesale Purchase of Water from, or Connection to, a Nearby Municipal System

Prior to analyzing the feasibility of solutions, an analysis of the overall community was performed to better understand the community characteristics such as topography, historical resources, planning and zoning. A technical memorandum was prepared that assessed potential permitting and regulatory conflicts within the Waterford study boundary in regard to the five (5) options, which is included as **Appendix A**. A summary of the potential permits needed for Waterford is provided in the permit register in **Table 2.1**. It should be noted that the exact permitting and regulatory requirements for a particular option will not be able to be fully evaluated until a plan for that option is completed, or advanced with sufficient detail, and submitted to regulatory agencies for review. Based on the historic nature of the community, the permitting and approval process may be involved, however, no limitations were identified that would deem construction of a water system infeasible at this stage of a study. Subsequent phases of this project may include further field investigations, which could drive permitting and approvals that ultimately become a critical path for the project, such as the need for archeological surveys or other detailed studies.

A flow analysis technical memorandum was developed, included as **Appendix B,** which describes the process used to estimate existing and future water demands within the Waterford community. Community demand and minimum yield requirements are dependent on which alternative is selected and is a function of existing community development and potential future community development. Individual systems have different requirements than community systems or municipal connections. As a result of the flow analysis, a community well system serving the existing development would require a well yield of 146 gpm with a potential future yield requirement of 173 gpm based on potential future buildout. Therefore, the recommended demand flow (for the study area) to be used for

sizing of a community water distribution piping and well/treatment systems (as needed) for the Waterford community is 173 gpm.

Online health department records, the results of a survey that was sent out to 117 residents regarding water yield, and the groundwater hydrology report prepared by Tetra Tech were studied to determine the existing conditions of the well systems throughout Waterford. The survey letter and summary of results are included in **Appendix C** and the groundwater hydrology report is included in **Appendix D**. This review confirmed that well yield is a concern within pockets of the Waterford community and identified contributing factors to low-yield wells. These problems were documented for approximately 17 to 22 lots out of approximately 145 lots completely within the study boundary (approximately 12% to 15% of the community). In general, groundwater elevations in Waterford wells rose or changed little between 2006 and 2021, and groundwater mining (i.e., withdrawal of water faster than recharge rate) does not appear to be occurring. Although, it should be noted that there is relatively less groundwater in Waterford than is typical within the greater Western Hills Watershed of western Loudoun County, as well as defined areas within the Waterford study boundary that have wells with low yield. In regard to water quality, the groundwater is generally acceptable for a potable water-supply, however; treatment will likely be required for iron and manganese.

Based on the location of the community, condition of the existing systems, and permitting/approval requirements, all five (5) options were evaluated to determine technical feasibility. The result of the evaluation determined that four (4) alternatives are technically feasible and one (1) alternative is not feasible. In summary:

1. Upgrade Existing On-Site Systems to Improve Yield on Individual Wells – Technically feasible alternative that may improve individual systems. Would require hydrofracking on individual wells to improve yield. Long term sustainability of this solution cannot be determined.

2. Shared Private wells – Technically feasible alternative that would require new wells and service connections that would serve up to four (4) residential homes. Challenges associated with maintenance agreements, easements, and building restrictions exist that will need to be addressed.

3. Community Water System Owned and Operated by Loudoun Water (Using New Community Wells) – Feasible alternative requiring new communal well system and treatment facility as well as water distribution system. Wells and treatment facility could be located in or around the existing Waterford community, pending further groundwater hydrology studies.

4. Connection to a Nearby, Existing Community System – The only existing nearby community water systems are Raspberry Falls/Selma Estates and Beacon Hill. However, a connection to Raspberry Falls/Selma Estates is not feasible due to the elevations of the mountain range that separates the community and Waterford .Beacon Hill has existing challenges with well yield. A technically feasible alternative would require expansion of the existing Beacon Hill well system and treatment system as well as installation of a long water transmission main that would convey water from Beacon Hill to Waterford. This solution may be a cost prohibitive alternative.

5. Wholesale Purchase of Water from, or Connection to, a Nearby Municipal System – No municipal systems exist within approximately five (5) miles of the community, making this alternative infeasible.

Therefore, Options 1, 2 and 3 are technically feasible, and Option 4 is only technically feasible for connection to the Beacon Hill community system. A criteria analysis was developed using six (6) criteria, used to score each option

on a scale from one (1) to five (5), with 5 being the more favorable scoring. As a result of this matrix, Option 2 or Option 3 are the preferred options for implementation to address Waterford's yield problems.

Option 2 includes a shared private system between residents. This option is limited to residential homes. Multiple shared well systems can exist within the community, as long as Loudoun County Health Department (LCHD) guidelines are followed. In order to remain under the jurisdiction of LCHD, the well must serve less than 15 connections or 25 people. If these numbers are exceeded or met, the well would become public waterworks, as defined by VDH ODW. Per discussions with the VDH ODW and LCHD, the limiting factor on number of connections is population, which is counted by 2 people per bedroom. Based on these discussions and an assumption of three (3) or four (4) bedrooms per home, the maximum number of connections that has been considered for this study is four (4) connections per shared well in order to ensure that the system does not exceed population restrictions as required by LCHD. Each new shared well system would require an existing or new well capable of providing an eight (8) gpm yield, easements, deeds and any additional legal covenants or agreements needed to ensure that the well does not meet the definition of a public waterworks and that responsibility for costs (e.g., well improvements) and violations are clearly defined between property owners.

Option 3 includes a new community system, owned and operated by Loudoun Water, with potentially six (6) community wells located along the periphery of the Waterford study boundary and associated treatment system and distribution piping to convey drinking water to Waterford residents, as shown in **Figure 4.5** and **Figure 4.6**. Attempts to locate and construct high-yield water wells would benefit from (and will require) conducting electrical resistivity survey work to select drilling locations on target parcels. High-yield wells are more likely to be developed in and to the north and east of the Waterford study boundary. The recommended demand flow to be used for sizing of water distribution piping and well/treatment systems (as needed) for the Waterford community is 173 gpm. Based on the information analyzed as a part of this study, a groundwater treatment system is assumed necessary due to iron and manganese levels within Loudoun County, therefore it is assumed that greensand filtration will be required. However, the type of treatment technology to be used, if needed, will need to be confirmed through quality testing once the community wells have been developed.

Class IV preliminary cost estimates, as defined by the American Association of Cost Engineering International's (AACE), were prepared for the recommended options (Options 2 and 3) using 2021 cost factors. Class IV cost estimates have an accuracy range of -20 to +30 percent of the estimated cost. The cost estimates represent a preliminary opinion of probable construction cost (OPCC) and are based on the assumptions outlined throughout this feasibility study. The approximate cost of the project will need to be inflated based on the anticipated implementation schedule.

The preliminary cost of implementing Option 2, which includes drilling a well and running 2-inch distribution piping to each property (4 properties), is estimated to be approximately $159,500 (with a low range of $127,600 and high range of $207,350).

The preliminary cost of implementing Option 3, which includes the design/permitting/surveying for the project, construction of the water distribution system and the water treatment system (assuming one greensand filtration treatment system), individual parcel improvements and road restoration/site work, is estimated to be approximately $10.5 million (with a low range of $8.4 million and high range of $13.6 million). Additional costs associated with Option 3 include O&M costs, to be borne by Loudoun Water, which are estimated to be approximately $108,000 annually (with a low range of $86,000 and high range of $140,000). Finally, a present worth analysis reveals the net present cost of Option 3 to be approximately $11.2 million.

1 PROJECT BACKGROUND

1.1 Waterford Overview

The Village of Waterford is located in a historic district in Loudoun County, Virginia, as shown in **Figure 1.1**. Waterford is a National Historic Landmark, meaning that it is recognized by the United States government for its historical significance, as the village is dedicated to preserving its 18th- and 19th-century architecture and landscape. All of the water provided to the community is through private wells (both shared and individual). Some members of the community have been experiencing issues with well yield, which led the community to apply to the Community Water and Wastewater Program (The Program). The community applied to The Program first in 2018 and then again in 2019 with additional information and a modified boundary, which is shown in **Figure 1.1**. This application was accepted due to the reported issues with well yields and the expanded study area.

Dewberry Engineers Inc. (Dewberry) is under agreement with Loudoun Water (LW) to develop an engineering feasibility study for The Program in order to evaluate the concerns identified in the community of Waterford's application and potential solutions to the community's drinking water issues. The following five (5) options are being evaluated to help improve water conditions within Waterford:

1. Upgrade Existing On-Site Systems to Improve Yield on Individual Wells
2. Shared Private wells
3. Community Water System Owned and Operated by Loudoun Water (Using New Community Wells)
4. Connection to a Nearby, Existing Community System
5. Wholesale Purchase of Water from, or Connection to, a Nearby Municipal System

1.2 Feasibility Study Purpose

The purpose of this study is to determine the technical feasibility of the five (5) potential solutions to Waterford's water issues. This feasibility study is divided into the following sections:

- Project Background
- Overall Community Evaluation
- Preliminary Existing System Analysis
- Current Estimated Water Demand & Potential Future Demand
- Water System Alternatives Evaluation
- Overall Costs
- Summary & Recommendations

It is ultimately the decision of the Waterford community as to which of the five (5) options shall be pursued. Should Options 3, 4 or 5 be chosen, the information in this study may be utilized by the community as a basis for planning and design.

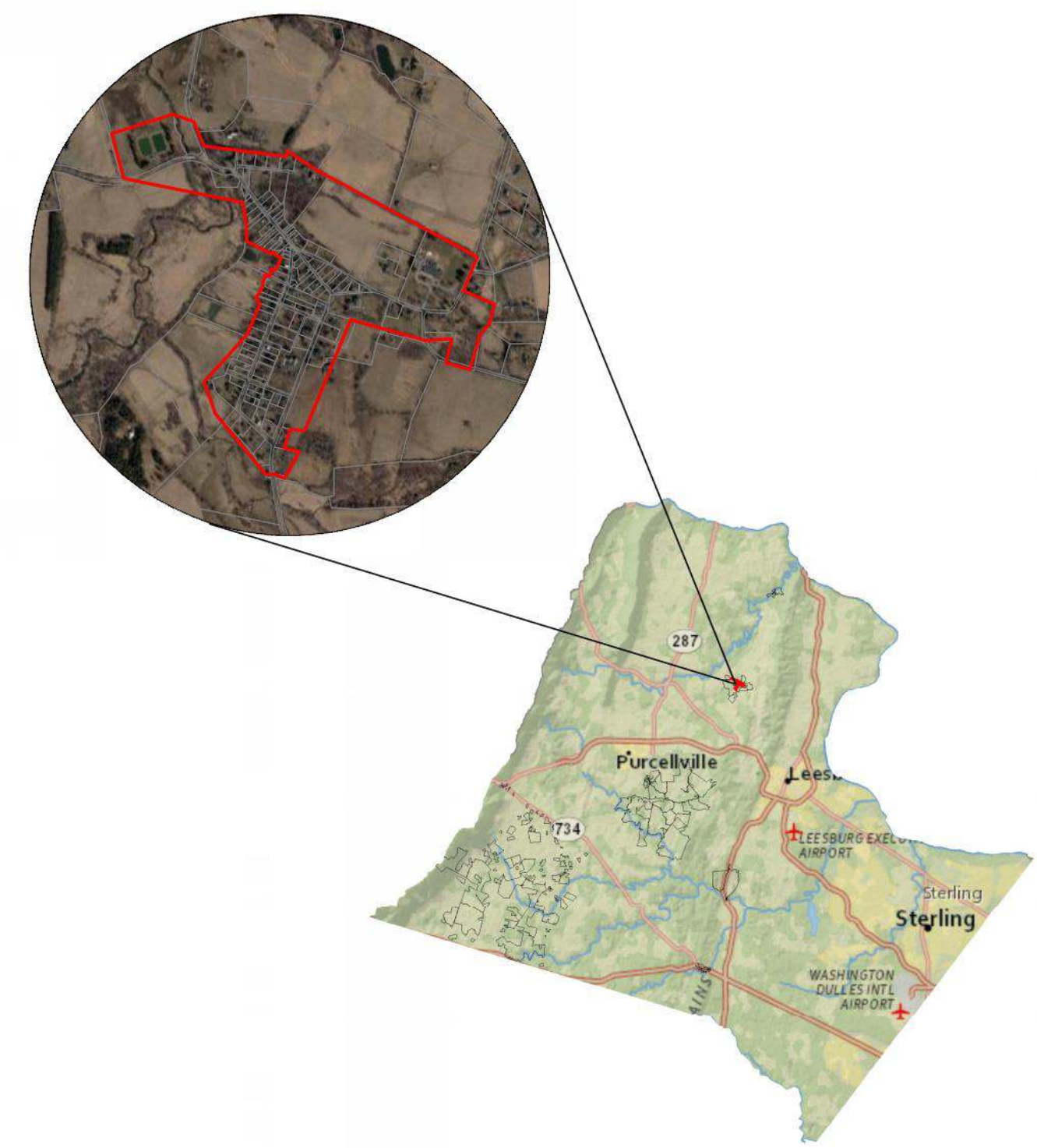

Figure 1.1 – Waterford Location Map and Study Boundary

2 OVERALL COMMUNITY EVALUATION

2.1 Existing Characteristics

Waterford is a small community with 154 lots that are either completely within or partially within the study boundary. The 145 lots that are completely within the study boundary range in size from approximately 0.02 acres to approximately 19 acres. A wastewater treatment plant (WWTP), owned and operated by Loudoun Water, is located at the Northwest corner of the study boundary, and most of the community is served by public sewer, which was installed in the mid- to late- 1970's. It should be noted that public sewer was installed to address a public health need, as wells showed bacterial contamination resulting from private on-site disposal systems. The sewer infrastructure is located under the roads of the community. Waterford is located by the South Fork of Catoctin Creek, as shown in **Figure 2.1**.

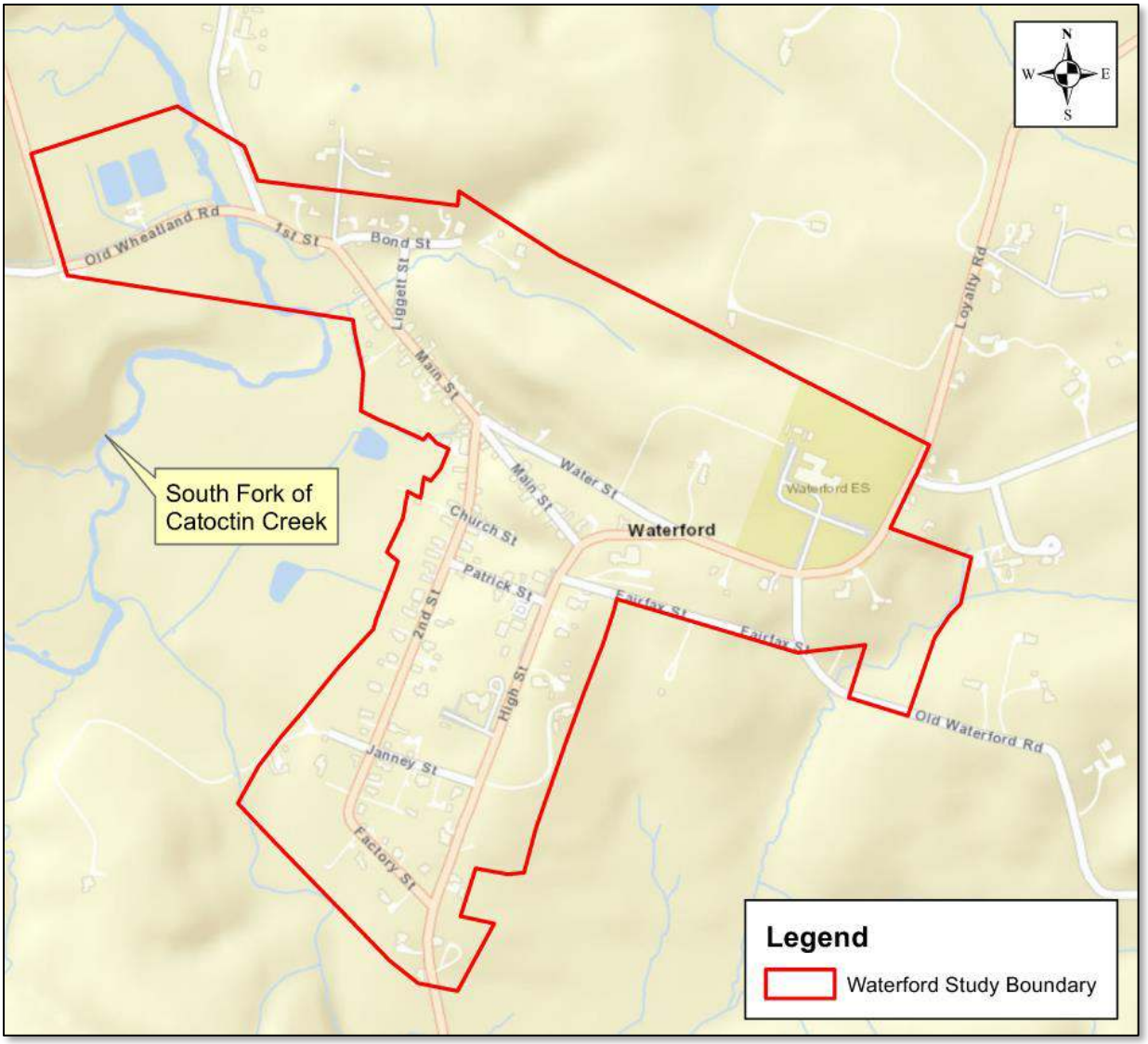

Figure 2.1 – Waterford Village by Catoctin Creek

2.2 General Topography

Waterford has a generally sloping topography throughout the community, with elevations generally decreasing from East to West as the land slopes towards the Catoctin Creek, as shown in **Figure 2.2**. The high point of the community is by the Waterford Elementary School at the Northeast corner of the Waterford study boundary and is approximately 472-feet above Mean Sea Level (MSL). The low point of the community is located to the Northwest of the study area boundary at the Catoctin Creek, which is approximately 340-feet above MSL. To the west of the Catoctin Creek and the WWTP (at the Northwest corner of the boundary), the elevation rises to approximately 360-feet above MSL.

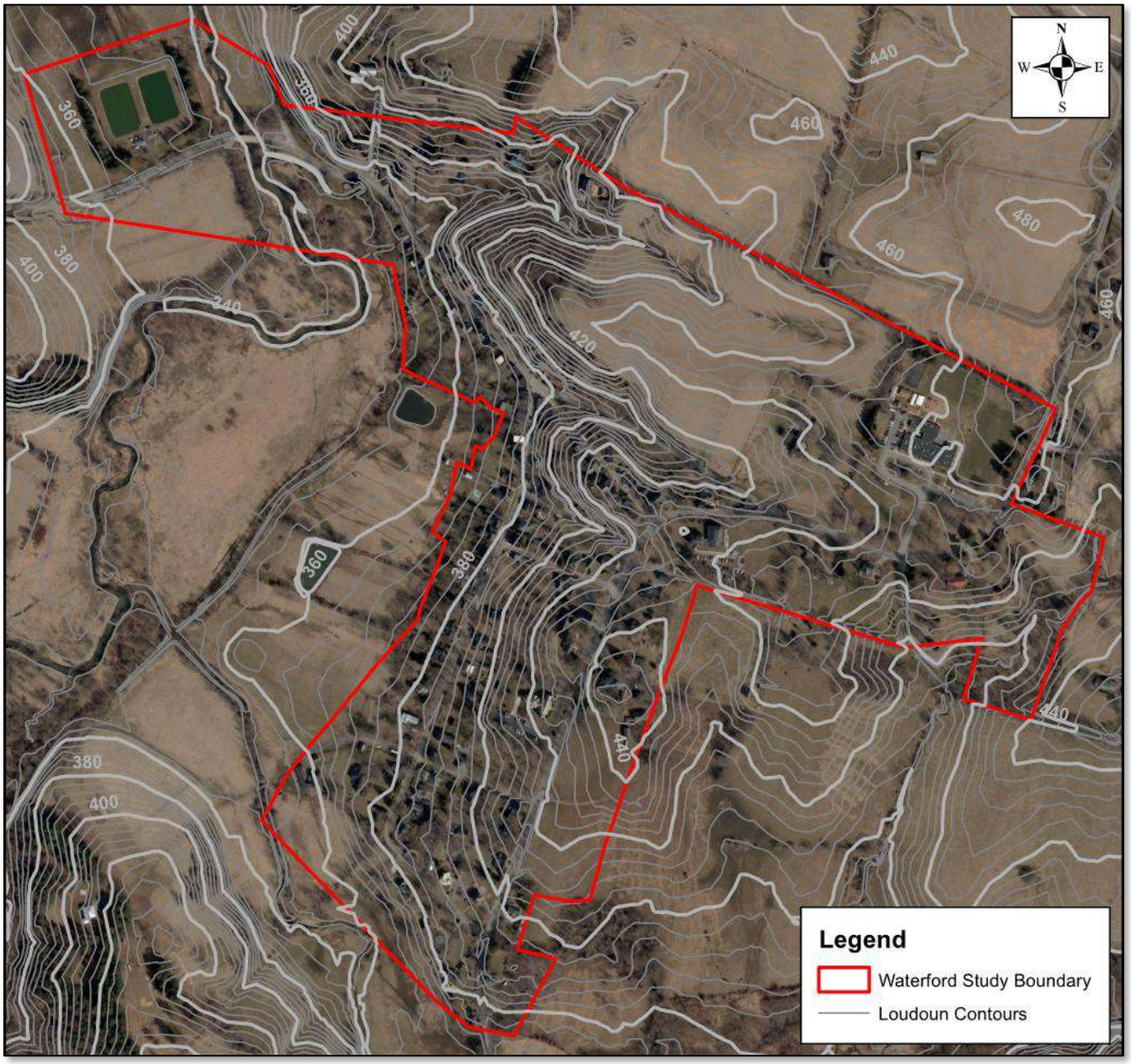

Figure 2.2 – Waterford Topography

2.3 Permitting/Policy Considerations, Regulatory Requirements & Right-of-Way Constraints

As previously described, the Village of Waterford has a rich historical background. The Village of Waterford with its well-preserved 18th and 19th century architecture and rural landscape is designated as a National Historic Landmark (ID#69000256), as well as a Loudoun County Historic and Cultural Conservation Site. Waterford is also included on the Virginia Historic Landmarks Register (ID#401-0123) and the National Register of Historic Places (ID#69000256). Furthermore, per the Loudoun County 2019 General Plan (2019 GP), Waterford is within the Rural Policy Area (RPA) in the Rural North Place Type and is designated as a Rural Historic Village. The 2019 GP policies for the RPA are aimed at protecting existing community characteristics and landscape, preserving heritage resources, developing agricultural and rural economy uses while limiting residential development. The 2019 GP policies also support the construction of community water systems in rural historic villages, as the document states, "public water and wastewater facilities are encouraged to provide services to the villages."

Due to the historic nature of the village, conflicts may arise with permitting considerations and regulatory requirements for each of the five (5) previously listed options to improve well yield problems in Waterford. This includes, but is not limited to, jurisdictional determinations, right-of-way (ROW) and easement constraints, policy considerations, and working in a National Historic Landmark.

A Technical Memorandum (TM) was prepared to assess potential permitting and regulatory conflicts within the Waterford study boundary in regard to the five (5) previously listed options, which is included as **Appendix A**. There are potential Federal, state and local permitting processes that need to be undertaken for all options. The permitting processes and regulatory requirements for each of the five (5) options were divided into four (4) different categories and are discussed in the following sections of the TM: Historical Permitting, Planning and Zoning Permitting, Health Department Permitting and Environmental Permitting. In each section, a description of relevant permit processes and regulatory requirements, as well as the options that they are applicable to, is provided.

The exact permitting and regulatory requirements for a particular option will not be able to be fully evaluated until a plan for that option is completed, or advanced with sufficient detail, and submitted to regulatory agencies for review. Should Options 3, 4 or 5 be chosen, the water main alignment will drive many of the permitting requirements, therefore; it should be noted that each permit needs to be considered as the alignment selection process is advanced.

A summary of the potential permits needed for Waterford is provided in the permit register in **Table 2.1**. The permit register was developed to consider all five (5) options. This list may not be all-inclusive and should be revisited and updated as appropriate (i.e., as the project scope and design proceeds and options are further assessed). All permits, regulatory requirements, and authorizations, such as Section 106 of the National Historic Preservation Act (NHPA), are further detailed in **Appendix A**.

Table 2.1 – Waterford Permit Register (August 2, 2021)

Permit/Authorization	Agency
Historical	
Section 106 authorizations, easement encroachments, and appropriate mitigation as necessary	VDHR SHPO
Section 106 / Landmarks Effect Determination	National Park Service (National Landmark Coordinator)
Certificate of Appropriateness (CAPP)	HDRC
Phase 1 archaeological survey approval	VDHR; Loudoun County Planning and Zoning
Planning and Zoning	
Commission Permit (CMPT)	Loudoun County
Special Exception (SPEX)/Minor Special Except (SPMI)	
Site Plan	
Grading Permit	
VDOT Utility Plan	VDOT
Detour/Traffic Management Plan	
VSMP/SWPPP	VA DEQ
Health Department	
Private Well Construction Permit (Single family or shared well not meeting the definition of a Public Waterworks)	LCHD
Chapter 1042.02 Application for Public Waterworks (15 connections or 25 people served, or greater)	
Abandonment Permits	
Construction and Operation Permits	VDH ODW
Construction Permit	LW
Connection Permit	
Environmental	
NEPA Document (if federally funded)	TBD; dependent on involvement of Federal agencies
Clean Water Act Section 404 Permit	USACE
Wetland Delineation Report and Jurisdictional Determination Request	
Clean Water Act Section 401 Virginia Water Protection Permit	VA DEQ
Virginia Stormwater Management Program Permit	
Hazardous Materials & Due Diligence Compliance	
Emergency Generator or Concrete Batch Plant Permit	VA DEQ
Permit to construct in Virginia Tidal Wetlands and Subaqueous bottoms.	Virginia Marine Resources Commission
Permit for timber sale	VA Department of Forestry
Virginia Scenic River Program Designation	Catoctin Creek Scenic River Advisory Committee
Preparation and submittal of a Conditional Letter of Map Revision (CLOMR)	Loudoun County/FEMA
Once constructed, prepare and submit a Letter of Map Revision (LOMR)	

3 CURRENT ESTIMATED WATER DEMAND & POTENTIAL FUTURE DEMAND

A Flow Analysis TM was prepared, which describes the process used to estimate existing and future water demands within the Waterford community and summarizes the results of this analysis. Community demand and minimum yield requirements are dependent on which alternative is selected and is a function of existing community development and potential future community development. Individual systems have different requirements than community systems or municipal connections. Analysis results were used to determine the recommended amount of flow, in gallons per minute (gpm), to be used for sizing of water distribution piping and well/treatment systems for the Waterford community, should they be necessary (i.e., if Option 3 was chosen). These estimates were developed to be as accurate as possible while adhering to Loudoun Water's Engineering Design Manual (EDM) and VDH ODW standards and requirements. Details can be found in the Flow Analysis TM, which is included as **Appendix B**.

For existing development demand estimates, the demands for residential homes, commercial buildings and schools were estimated using EDM standards. For commercial and industrial buildings, the number of employees for each business was determined either by contacting the businesses or by online research. Demands for churches and auditoriums were determined to best match the "theaters" category of the VDH ODW standards. These facilities were contacted to determine the number of persons expected at events. The total minimum required demand was also calculated per LW requirements, which require that a demand of 1.2 gpm be provided per connection to a community well (assumed 122 existing connections).

The potential future demand estimates were developed by assuming that all 154 parcels in the Waterford study boundary, except for ten (10) parcels that were excluded due to zoning restrictions or lack of anticipated water use, are occupied and require water service. The total minimum required demand was also calculated per Loudoun Water requirements, which require that a demand of 1.2 gpm be provided per connection to a community well (assumed 144 future connections).

Based on the analysis described above, a community well system serving the existing development would require a well yield of 146 gpm with a potential future yield requirement of 173 gpm based on potential future buildout. Therefore, the recommended demand flow (for the study area) to be used for sizing of a community water distribution piping and well/treatment systems (as needed) for the Waterford community is 173 gpm. It should be noted that requirements for fire protection is not included as part of this assessment. Loudoun County Facility Standards Manual regulations state that community water systems within the rural policy area do not require providing fire flow and pressures throughout the system. Fire protective devices, such as drafting hydrants, can be used to provide additional water storage for fire protection.

4 WATER SYSTEM EVALUATION

4.1 Review of Existing Data

Waterford is located in the Northeast portion of the Western Hills Watershed of western Loudoun County, which includes the North Fork Catoctin Creek and South Fork Catoctin Creek major watershed area. There have been approximately 190 individual private wells installed in the Waterford study boundary since the 1950's, including 147 individual wells (WWIN and WWTS types), 25 shallow dug wells (WWDU), 11 "dry hole" wells (WWDH), three (3) non-community water-supply wells (WWNC), three (3) heat pump wells (WWHP), three (3) springs and one (1) community well (WWCO), as shown in **Figure 4.1**. Approximately 131 wells are currently active, and most shallow dug wells have either been abandoned in accordance with LCHD regulations or are not pumped. Some residences rely on more than one (1) well to provide an adequate water supply. Some of these additional wells may be shallow dug wells.

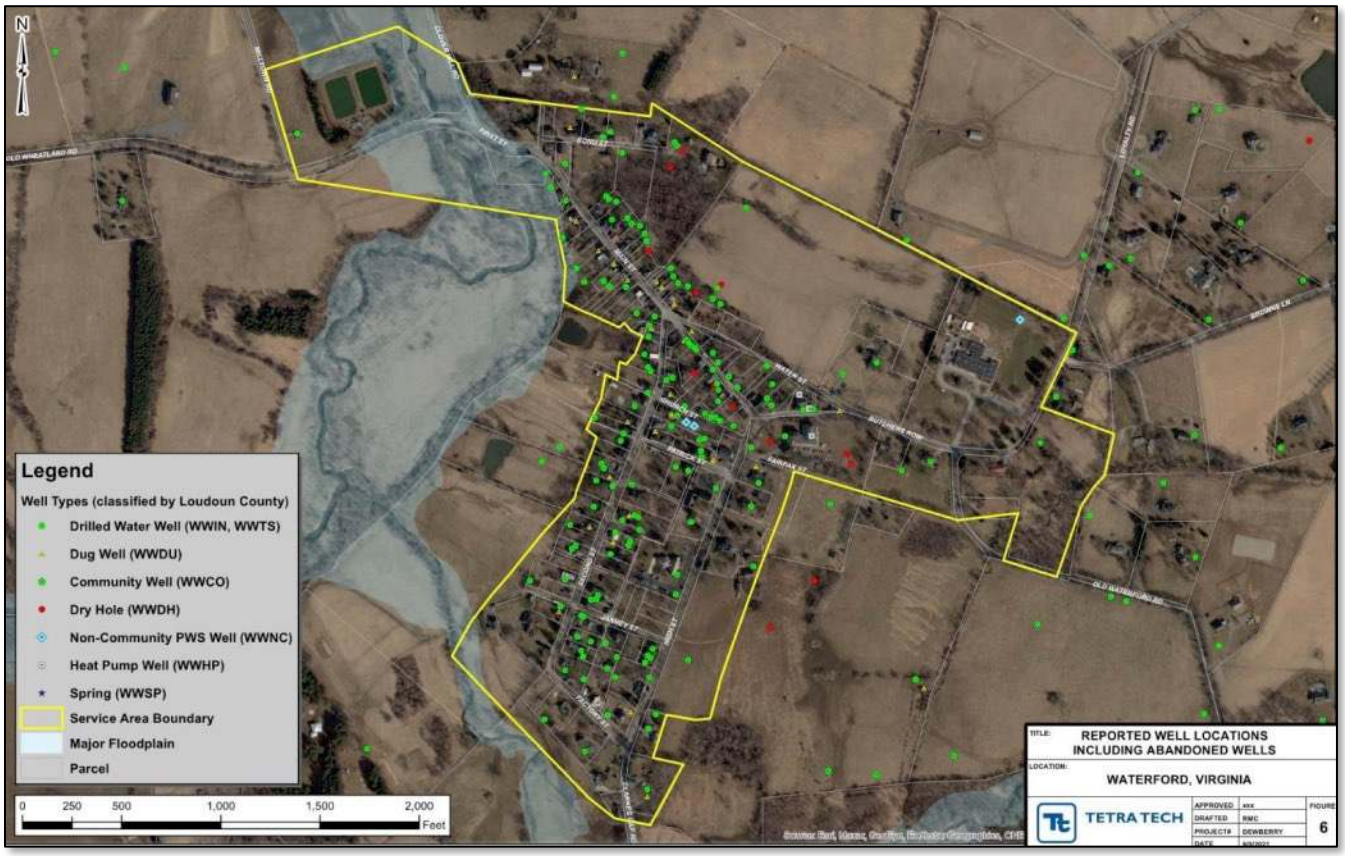

Figure 4.1 – Waterford Wells

This section reviews a 1966 feasibility study prepared by Dewberry, the Waterford application and existing well and groundwater data, which have been evaluated from health department records, survey results and a groundwater hydrology report prepared by Tetra Tech.

4.1.1 Previous Feasibility Study

Dewberry previously completed a feasibility study for water and sewerage facilities for the community of Waterford in August 1966. A survey conducted for this report found that more than 50% of the water supplies were not acceptable for domestic use. However, it was noted that the unsanitary health conditions were caused by the malfunctioning of a majority of the individual septic systems, which contaminated several of the well supply systems. The report recommended a centrally operated water and sewer distribution system. A sewer distribution system was installed in the late 1970's following this report and subsequent design.

The recommended water distribution system consisted of transmission mains, an elevated storage tank and source of supply from drilled underground wells. It was determined that well supply was the most economical and feasible method of obtaining water for a small community, as connection to a nearby municipality (Leesburg) was deemed economically infeasible and the costs (including land, construction operating and treatment costs) of obtaining a potable water supply from a stream (surface water) is much greater than that of a drilled well. The report noted that the required water demand of the community could be satisfied from drilled wells, and it was anticipated that the water would be of good chemical quality.

4.1.2 Waterford Application

The community of Waterford applied to The Program first in 2018 and then again in 2019 with a new study boundary. The 2019 Waterford application was accepted due to the reported issues with well yields and the expanded study area. It should be noted that "the majority of those who did not sign are worried about the possible cost and uncertainty about The Program and the threat of development should water be more readily available."

The application states that "18 homes are having serious quantity problems but can't afford to drill again and/or current technical options are limited on their small, marshy, or steep lots; others have periodic challenges, where the well goes 'dry' or the pressure drops so low, water can't be obtained." The application highlights thirteen (13) residential properties that have significant yield problems, which are described below:

- One (1) property is empty due to a lack of water
- Owners of one (1) property have to purchase 5,000 gallons of water every two (2) weeks to meet household needs
- One (1) property with three (3) wells that likely cannot drill more
- One (1) property owner that had a well go dry but fears digging a new well
- Five (5) properties "where residents must closely monitor and often forego showers, flushing toilets, running dish washer, etc."
- Four (4) properties that "have wells that run 'dry' periodically or measures have to be taken to prevent water shortages when guests arrive."

The application also notes that having water or improved water at several buildings could benefit business in the community.

4.1.3 Review of Health Department Records/Official Online Records

Existing health department records were reviewed through VDH ODW's open-information online database, Online Responsible Management Entity (RME). The database includes records of well and sewer system applications,

such as well permits and Water Well Completion Reports submitted by well drillers, as well as inspections and results. It should be noted that inspections are not routine and occur following complaints, prior to real-estate transfer and following connection to a newly constructed well. Due to the lack of routine inspection, some wells could have become non-compliant since last inspection. It should also be noted that records of some parcels are non-existent, as older wells do not have records. Furthermore, there are inconsistencies in records, such as lots being identified as “septic with gravity” despite records showing septic had been abandoned. Therefore, the information presented in this section is not comprehensive.

Records were available for 48 of the 145 parcels completely within the Waterford study boundary. Of these parcels, 15 (approximately 10%) contained documentation of yield problems and/or a dry well, and 16 (approximately 11%) contained documentation of an unsatisfactory well sample and/or a complaint regarding water quality. It should be noted that, due to the previously described lack of records, these numbers do not necessarily reflect the full extent of existing community well conditions.

Despite the lack of records and inconsistencies, there appeared to be strong evidence that well yield is a historical and continuing problem within the Waterford community. Several documents indicated that yield problems in Waterford are common knowledge. A letter dated 8/1/2010 states, “the water situation in Waterford makes it very unwise to abandon any well with a measurable return." Another letter dated 7/13/2000 states, "as you know, Waterford suffers from many instances of wells going dry.” A letter dated 5/1/2000 introduces Waterford as “a village with a long history of water problems." The online records also provided specific examples of problems encountered by Waterford residents. A letter dated 6/11/1994 states, “Our well runs dry approximately once a week despite our best efforts to be frugal with water use...Our current water supply is so scarce that we fear any decrease in well yield will effectively leave us with no water at all." Another letter dated 8/17/2010 states, "I was distressed to hear of your difficulty to find sufficient water to serve your home in Waterford." Overall, records as recent as 2010 detail yield problems within Waterford, with ten (10) lots containing documentation of yield problems and seven (7) lots containing records of dry wells, which date back to 1983. Therefore, the records indicate that well yield is a reoccurring and current problem in Waterford.

There was not strong evidence that water quality is a current issue in the community. However, there have been past instances where water quality was of concern. There was an underground storage tank release in the late 1980’s. The issue is described in a letter dated 1/13/1989, which states, "recently, this office was informed of petroleum contamination to a private drinking water well in the vicinity of a previously investigated pollution incident resulting from an underground storage tank release…this office requires the Waterford Foundation to conduct further investigation and complete corrective action requirements." The contamination affected the groundwater aquifer, which affected wells in two (2) neighboring lots. This issue was resolved, as the wells were tested and the results revealed that the measured contaminant levels were not considered a threat to health. This resolution is documented in a letter dated 6/29/1989, which states, "In response to your complaint, the Loudoun County Department of Health collected a water sample from your residence on November 15, 1988. In consideration of the maximum contaminant levels published for regulated chemicals listed in the Safe Water Drinking Act, concentration levels of 12 ppb naphthalene, and 11 ppb ethyltoluene identified in your well water, are not considered to be a threat to your health." All other instances of past water quality issues (e.g., sewage drainage into water from since abandoned drainfields, water quality issues from naturally occurring leachate, odor/taste complaints and unsatisfactory tests) also appeared to be resolved. Overall, the majority of records containing water quality issues occurred from the 1970’s to the early 1990’s. The lack of recent records may be due to the fact that testing and reporting are not required after the initial construction of a well, and a small number of wells have recently been constructed in Waterford. Furthermore, various water quality issues may have been resolved following the

implementation of a public sewer system in the late 1970's and subsequent abandonment of individual sewage systems over time as members of the community chose to connect to the public sewer system.

Additional, official documentation of well yield problems in Waterford can also be found online. Several reports developed by community members address these problems and potential solutions. The "2011 Community Water Supply For Waterford: What Would It Take Report" states, "an unusually high proportion of the wells in the Village have low or very low yields in comparison to other areas in western Loudoun County." Furthermore, the "Status of the Water Supply on Waterford Foundation Properties" (October 2011) report states, "The Waterford Foundation Board of Directors (BOD) established the Ad-Hoc Water Supply Committee in September 2010. The decision to create this committee was made after several wells in the village went dry during the previous summer."

4.1.4 Well Yield Survey Results Summary

A survey was sent out to 117 residents of the Waterford community in March 2021. The purpose of the survey was to obtain feedback from the community regarding any issues experienced with well yield. The survey asked seven (7) questions. Questions 1, 2, 3 and 5 were quantitative questions (with the option to provide additional comments), and questions 4 and 7 were qualitative questions. In order to identify if certain areas in Waterford experience more well yield problems than others, while maintaining anonymity, survey responders were asked (in question 6) to indicate which "zone," out of five (5) zones, that their residence is located in, based on a map provided with the survey. The survey letter and results, as well as the map showing the different zones, can be found in **Appendix C**. The survey questions can be found on the next page.

1. Do you encounter problems with the amount of water your well provides?

   If you answered 'Yes' please explain problems encountered below:

2. Do you encounter these quantity problems only at certain times of the year? Yes _____ No _____

   If you answered 'Yes' please place an X over every typical month(s) when quantity problems occur below:

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC

   Please provide additional explanation below, if needed:

3. For the well problems noted in question 2, if they occur on a regular frequency, please indicate the frequency below:

   Indicate the number of hours and times DAILY_____,

   Indicate the number of days WEEKLY_____,

   Or Indicate the number of weeks MONTHLY_____?

4. For the well problems noted in question 2, if they occur on an intermittent frequency, please describe below:

5. Have you observed a noticeable decrease in the amount of water provided by your well within the last five years (since 2016)? Yes _____ No _____

   If you answered 'Yes' please explain below:

6. Using the figure provided with this survey, please indicate the geographical area, by zone number, where your well is located. The purpose of this information is to provide general location information for well quality concerns without identifying a specific parcel or well's location:

   Zone ____

7. Please provide any additional information or comments:

A total of 82 responses to the survey were received as of May 20, 2021 (70% response rate). Quantitative responses are summarized in **Table 4.1**, which shows both the number of responses and the percentage of responses within each zone and overall.

Table 4.1 – Well Yield Survey Quantitative Results

Zone	#[1] / %[2]	Question 1		Question 2		Question 3				Question 5	
		Yes	No	Yes	No	Daily	Weekly	Monthly	N/A	Yes	No
1	#	1	10	0	11	1	0	1	10	0	11
	%	9%	91%	0%	100%	9%	0%	9%	91%	0%	100%
2	#	2	13	0	15	0	0	0	15	0	15
	%	13%	87%	0%	100%	0%	0%	0%	100%	0%	100%
3	#	8	17	1	24	0	0	0	25	4	21
	%	32%	68%	4%	96%	0%	0%	0%	100%	16%	84%
4	#	1	14	0	15	0	0	1	14	0	15
	%	7%	93%	0%	100%	0%	0%	7%	93%	0%	100%
5	#	5	10	1	14	0	0	0	15	2	13
	%	33%	67%	7%	93%	0%	0%	0%	100%	13%	87%
Overall	**#**	**17**	**65**	**2**	**80**	**1**	**0**	**2**	**80**	**6**	**76**
	%	**21%**	**79%**	**2%**	**98%**	**1%**	**0%**	**2%**	**98%**	**7%**	**93%**

[1]Number of responses

[2]Percentage of responses

Overall, 21% of survey responders indicated that they have problems with well yield (Question 1). The highest number of well yield problems was reported in Zone 3. It is inferred that the majority of well yield problems occur in the central area of the Waterford study boundary around Main Street. However, well yield problems appear to occur throughout the entire study area. Based on investigation by tetra tech, lowest yielding wells, which are those with flows less than or equal to 2 gpm, are prevalent throughout the community. It should also be noted that the number of responses that indicated well yield problems within each zone did not correspond to the number of wells with yields from 0-2 gpm in each zone, as shown in **Figure 4.2**.

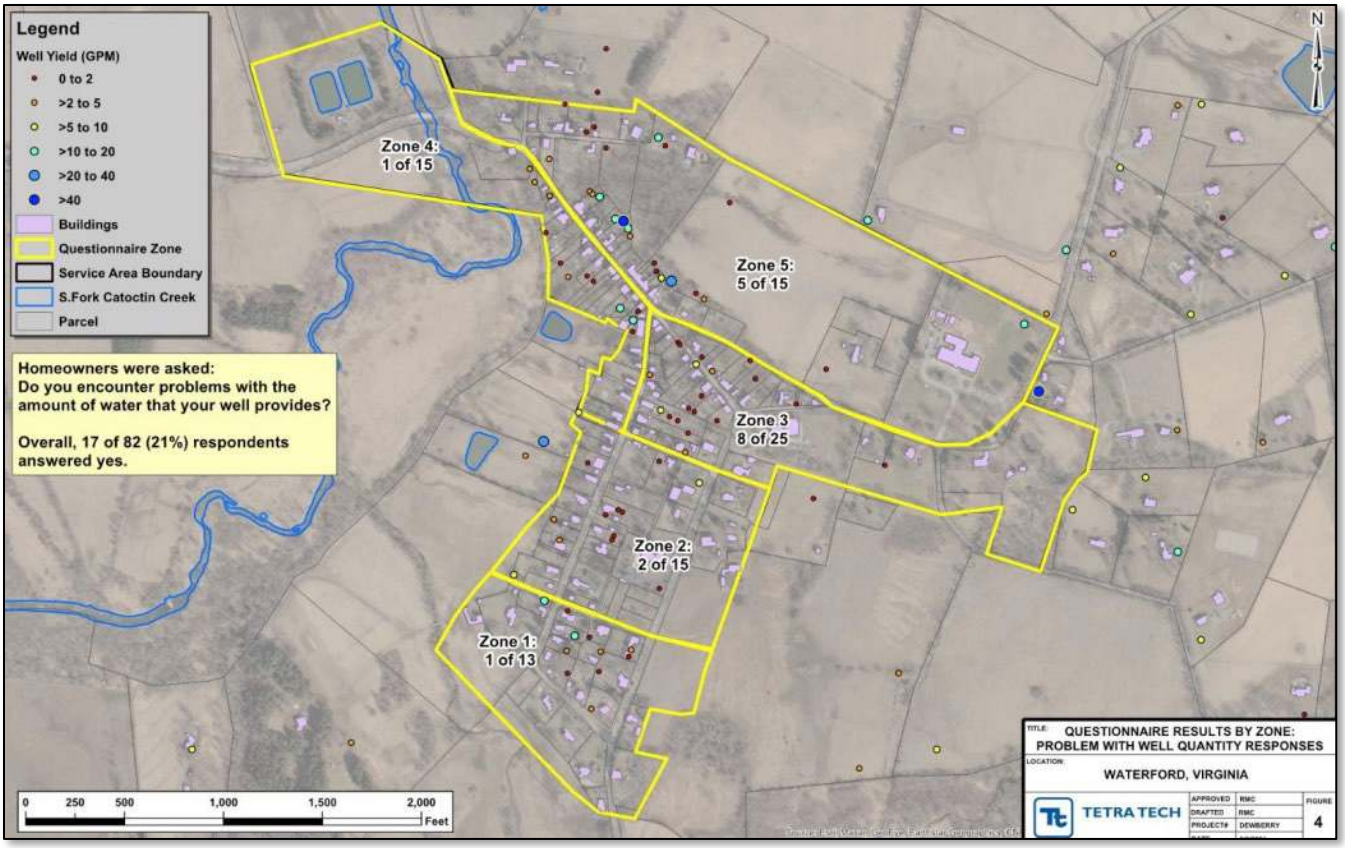

Figure 4.2 – Survey Responses (Question 1) versus Well Yields

Survey responders were also provided the chance to share thoughts in qualitative questions and space for comment on quantitative questions. Many responses noted that their well(s) ran dry if used for a prolonged period of time (e.g., watering grass, hosting large event, running laundry/dishwasher, washing car, etc.). Several responses noted that their well(s) ran dry during a drought or dry weather. Numerous responses indicated that well yield problems did not occur during a certain time of the year, but rather all year-round. Some comments acknowledged that they are not aware of the full extent of their well yield problems, as they currently practice several methods of conserving and storing water. A very concerned response wrote, “We have struggled with water for 20+ years in Waterford. In 2017, our second well went dry. Our new well only provides a pint of water every 45 minutes, about 6 gallons a day. The new well is >700-feet deep. We truck water in on our own truck and tank every 3-5 days from a local municipality. Our problems have been every month for 20+ years.” Another concerned response wrote, “I have to haul 5-gallons of bottled water to bathe. It's hard to lift bottles up 3 flights of stairs. It's been going on for 2 years now.” These comments confirm that members of the Waterford community are currently experiencing well yield issues and have historically experienced these issues.

It should also be noted that five (5) responses indicated concerns regarding water quality. Three (3) responses indicated the need to treat water for iron. Responses also noted black grit, sulfur and high acid content in water. A very concerned response wrote, “I’m also very unhappy with the water quality. I failed county water quality for coliform bacteria and had a UV water purification system installed. We only drink bottled water and notice skin problems in the warmer months.” These responses suggest that water quality is a current concern within pockets of the Waterford community.

Based on both the quantitative and qualitative responses, it is estimated that between 17 and 22 lots out of the 145 lots completely in the study boundary (approximately 12% to 15%) have challenges with their water systems, including approximately nine (9) lots (approximately 6%) facing critical challenges.

4.1.5 Groundwater Hydrology Report

Tetra Tech conducted a study that evaluated the groundwater conditions of the Waterford community and produced a report titled "Groundwater Resource Evaluation Waterford, Virginia," dated September 16, 2021, which is included as **Appendix D**.

As a part of the study, Tetra Tech solicited permission from property owners within the study boundary, as well as several property owners outside of the boundary, to measure depth to water (DTW) in wells on their properties. Tetra Tech also monitored hydraulic head changes in select private wells caused by residential pumping stresses. Furthermore, Tetra Tech reviewed available data and literature, such as aquifer test data and the results of a survey that was sent out regarding depth to water in wells. Tetra Tech used this information to determine DTW and groundwater elevation (hydraulic head) in wells in the Waterford area in May 2021, to compare measured water levels to those measured in Spring 2006, to estimate local formation transmissivity and to estimate groundwater flow directions. Long term well-monitoring results are included as part of this report. It should be noted that individual assessments of wells were excluded from this scope of work.

As a result of the study, Tetra Tech found that groundwater flow through bedrock in Waterford is primarily from east to west. Tetra Tech identified the median bedrock well yield in Waterford to be less than 2 gpm, which is significantly lower than the reported range of yield (8 gpm to 12 gpm) in the Western Hills Watershed. However, groundwater elevations in Waterford wells rose or changed little between 2006 and 2021. Furthermore, although variable drawdown has occurred since before well pumping began, groundwater mining (i.e., withdrawal of water faster than recharge rate) is not occurring.

The median well depth in Waterford is approximately 550-feet. There is a negative (weak) correlation between well yield and well depth because well drilling generally continues to greater depths until a satisfactory yield is achieved. Statistically in western Loudoun County, yield is increased by drilling wells deeper. However, it should be noted that the mean yield per depth interval drilled declines from 4.4 gpm between 300- and 400-feet to 1.0 gpm between 700- and 800-feet. DTW in wells on the west and east sides of the Waterford study boundary is much shallower (e.g., 15- to 50-feet deep) than in active pumping wells apparently completed in poorly transmissive rock in areas of greater well density (where DTW in wells exceeds 100-feet at 12 locations). Particularly in low-yield wells, DTW is sensitive to both well pumping rates, which vary with time and use, and formation transmissivity. Data collected by Loudoun County from 2005 to 2017 from a well just south of the Waterford study boundary showed a seasonal pattern of hydraulic head fluctuation, with lower DTW realized in the winter and higher DTW realized in the summer. High-yield wells are more likely to be found at the Northeast end of the Waterford study boundary.

Tetra Tech noted the following three (3) main factors that contribute to the low yield of wells in Waterford:

1. Relatively unfractured, poorly transmissive bedrock
2. High density and small separation between wells on small lots
3. Reduced recharge to groundwater after septic drainfields were replaced by public sewer, which was installed to resolve a public health issue

Figure 4.3 shows low yield areas and well yields within Waterford. The "red" zones, which have yields less than two (2) gpm, are considered to be low yield areas. 49 lots fall completely or partially within a low yield area. 37 lots fall completely within a low yield area and are completely or majority within the study boundary. Therefore, based on the hydrology study, approximately 26% of lots are within a low yield area. This is similar to the results of the resident survey, which indicated that 21% of the community experiences low well yield.

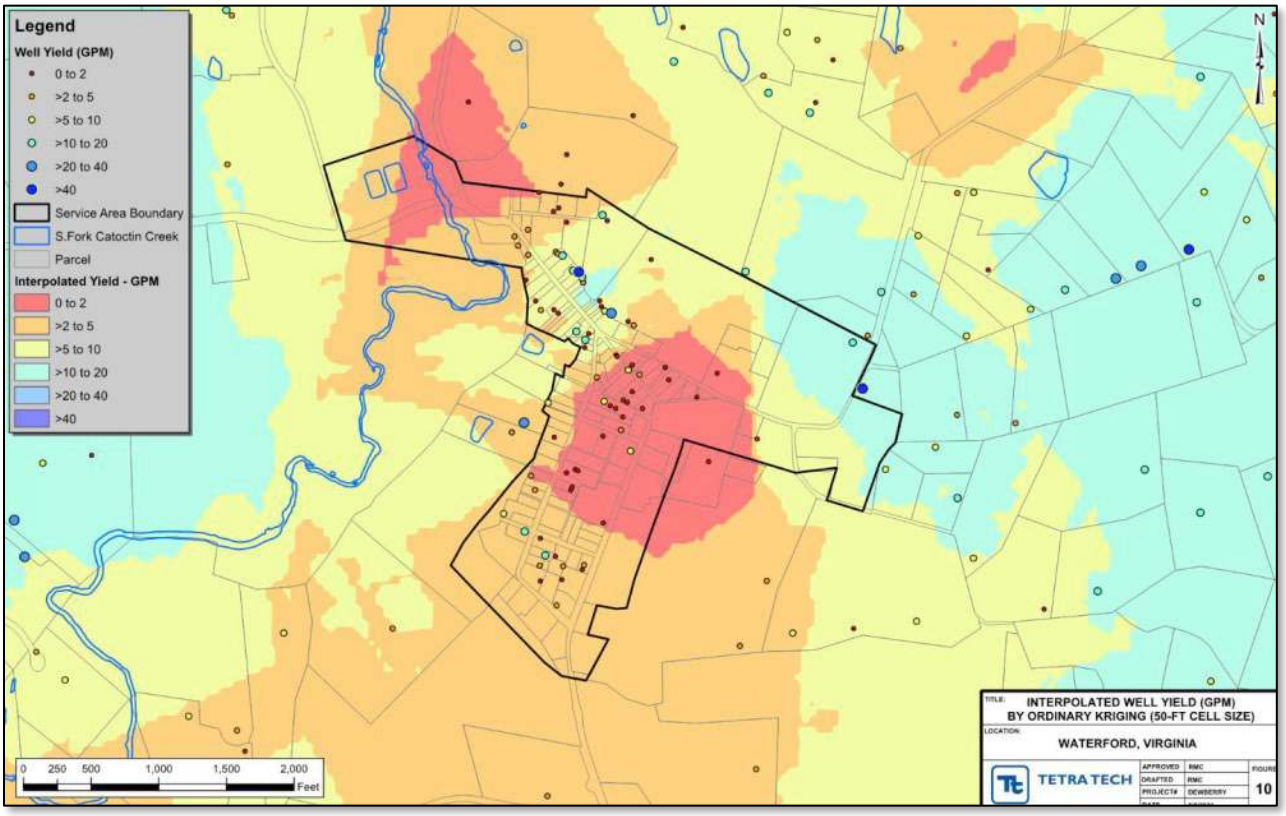

Figure 4.3 – Waterford Well Yields

Tetra Tech also evaluated groundwater quality. Groundwater samples were taken within and near Waterford and tested for chemical constituents. The results of the chemical analysis showed that the groundwater is generally acceptable for a potable water-supply. However, treatment will likely be required for iron and manganese since these metals are frequently detected in western Loudoun County groundwater above their Secondary Maximum Concentration Levels. Also, as previously noted, several survey responses noted issues with iron in their water supply.

4.2 Overview of Options

The technical feasibility of five (5) different options were evaluated to improve water systems in Waterford, which are listed and described below.

1. Option 1 – Upgrade Existing On-Site Systems to Improve Yield on Individual Wells

   Involves private property owners making individual improvements to their system by means such as hydraulic fracturing of rock (hydrofracking), construction of a new well or wells, or well deepening.

2. Option 2 – Shared Private wells

   Consists of connecting two or more homes to a private well, therefore implementing a shared well system. This option is limited to residential homes. Multiple shared well systems can exist within the community, as long as LCHD guidelines are followed. Each new shared well system would require an existing or new well capable of providing 8 gpm yield, easements, deeds, and maintenance agreements. Costs would be divided by four (4) homes.

3. Option 3 – Community Water System Owned and Operated by Loudoun Water (Using New Community Wells)

   Consists of the construction of a community well system and associated treatment system for the entire community. This option would require that a well or several wells be sited to meet the potential future demand of the community (173 gpm, or 1.2 gpm per connection).

4. Option 4 – Connection to a Nearby, Existing Community System

   Requires connecting to a nearby community system with sufficient capacity to serve its residents and the community of Waterford.

5. Option 5 – Wholesale Purchase of Water from, or Connection to, a Nearby Municipal System

   Involves connecting to a nearby municipal system with sufficient capacity to serve its residents and the community of Waterford.

The following sections expand upon considerations for each option in more detail.

4.2.1 Option 1 – Upgrade Existing On-Site Systems to Improve Yield on Individual Wells

Based on the review of existing information described above, there are approximately 17 to 22 lots that need well improvements in Waterford (with up to 37 lots potentially needing improvements, based on the map in **Figure 4.3**). Potential improvements to individual wells include hydraulic fracturing of rock (hydrofracking), drilling a new well, or well-deepening, which are further described below.

Hydrofracking involves injecting water under pressure to open or clean out existing rock fractures and thereby increase well yield, and typically takes one (1) day to complete. For hydrofracking, Loudoun County requires that potable water be used and LCHD recommends zone tracking. Hydrofracking cannot be performed in the top 120-feet of the well, and the upper packer, which acts as a seal between layers within a well, must be placed below the casing and grout zones. Loudoun County requires that the hydrofracking contractor be licensed by LCHD to install water supply systems. Although this is technically feasible, there has been limited documentation of success with hydrofracking in Loudoun County, and the feasibility of hydrofracking as a long-term solution (i.e., sustainability of yield increases) is still unknown. There is no guarantee that hydrofracking will be successful. For example, one response to the well yield survey noted, “We had our well "fracked," which increased flow, but after 3 to 4-years, problems returned.” Additionally, few contractors perform hydrofracking in Loudoun County. Details regarding hydrofracking procedures in Loudoun County are not well-documented. Hydrofracking also poses risks to nearby wells and the environment. Further explanation of hydrofracking can be found in the hydrology report in **Appendix C**.

Another solution to improve yield on a private property is to drill an additional well or wells. However, due to setback requirements and other permitting and regulatory requirements, this option may not be feasible. An additional challenge for individual properties may be lack of access for necessary drilling equipment due to small parcel size

and density of structures. The majority of lots in need of improvement are located in areas where it would be difficult to construct a new well based on either lot size and/or the surrounding characteristics (i.e., structures, old drainfields and other lots). For example, one response to the well yield survey noted, “Because of small lot size, old septic field, near sewer line or property line there is no place to drill a new well.” Furthermore, there is no guarantee that newly drilled wells will provide adequate yield.

Well deepening involves drilling in an existing well. There has been some success of well deepening within Waterford, as one (1) responder to the well yield survey wrote, “well was deepened 10 years ago, from 540' to 700' and flow went from 2 QT/min to 5.5 gal/min.” Although this improvement is technically feasible and has improved well yield in some instances, there is no guarantee that it will be successful, and the effectiveness of well deepening as a long-term solution (i.e., sustainability of yield increases) is uncertain.

Private property owners are entirely responsible for the costs of any improvements to existing wells or the construction of new wells.

4.2.2 Option 2 – Shared Private wells

If fifteen (15) connections (or more) are made to one well, or if 25 people (or more) are served by one well (for at least 60 days out of the year), the system meets the definition of a public “Waterworks” and would be required to meet VDH ODW public water supply system standards. Per discussions with VDH ODW, the limitation for a shared well is driven mainly by the number of connections, and the maximum number of connections (15) is rarely approved, as it is difficult to prove that the number of people connected will not exceed the definition of public water works. There are numerous ways to help guarantee the number of people connected to a shared well doesn't go over 25, such as looking at how many people occupy each home and the ages of occupants. However, should the results of a census reveal that the number of people connected to a shared well is over 25, VDH ODW would be notified. Based on discussions with the LCHD, the number of people in a house can be estimated by the number of bedrooms and accounting for two (2) people per bedroom. Therefore, based on an assumption of three (3) or four (4) bedrooms per home, approximately four (4) homes can be connected to an individual shared well system. A shared well with four (4) connections should have an approximate yield of eight (8) gpm.

Although Option 2 is technically feasible, it is a challenge and comes with restrictions that need to be considered during design/preliminary engineering. As previously described, one of the main challenges is ensuring that the shared system does not meet the definition of a public waterworks. In order to ensure this, legal covenants may be needed. For example, a legal covenant could prevent a newly built house from connecting to the shared well. Furthermore, legal determinations that limit the number of people allowed to live in each home could be developed.

Another challenge is the determination of responsibility for each owner connected to the shared well. Responsibility for costs (e.g., well improvements) and violations should be clearly defined between property owners that are connected to the well in an agreement, in order to avoid litigation. In addition, property sale and agreements may be required by mortgage companies associated with each home.

A third challenge is the uncertainty of the specific individual lots that are experiencing issues. Each new shared well system would require an existing well or new well capable of providing an eight (8) gpm yield.

Since the exact locations of all lots experiencing issues are unknown, Dewberry cannot explicitly determine if any of the following conditions exist in order to ensure adequate supply for a shared well system:

- Nearby existing wells with yield > 8 gpm
- Nearby existing wells with yield that could potentially provide > 8 gpm with improvements (such as hydrofracking)
- Ability to construct a new well that could potentially provide > 8 gpm

As previously noted, it is expected that the majority of well-yield problems can be found in the central area of the Waterford study boundary around Main Street. Implementing shared well systems in this area may be difficult due to the density of residential homes (i.e., difficulty meeting setback requirements for the construction of new wells) and the well yields currently realized within the area (i.e., the majority of well yields in this area are less than 2 gpm).

Although there is flexibility with piping and layout, it is assumed that a new well will be drilled for each shared well system. New wells do not have to be drilled on site and may be drilled outside of the Waterford study boundary. Distribution piping may run under road for necessary distances in the community. However, since yield problems were noted throughout the community boundary, implementation of this option would need to be phased to target different areas of the community.

It should be noted that high-yield wells are sometimes drilled by chance, and actual sustainable groundwater extraction rates can only be determined by well drilling and testing. Attempts to locate and construct high-yield water wells would benefit from electrical resistivity survey work to select drilling locations on target parcels. Furthermore, there has been some success of shared wells within Waterford, according to multiple responses to the well yield survey. One (1) response wrote, “we share a well with our neighbor since this property does not have a well. Never had a problem 26 years,” and another response wrote, “I share a well with the neighbors…and so far I have not encountered problems.”

Based on existing information, it is estimated that at least six (6) total shared well systems are needed in Waterford, in the four (4) general areas shown in **Figure 4.4**. However, several factors, such as property and well locations, may change the number of shared well systems needed. Note that the shared wells may not be placed in these areas and may be placed elsewhere (such as outside the study boundary) as needed to obtain the required yield. The areas circled indicate approximately where service from a shared well would be needed.

Overall, each new shared well system would require an existing or new well capable of providing 8 gpm yield, easements, deeds, mortgages and costs to drill and connect to a new well, which would be divided by private property owners of the four (4) homes.

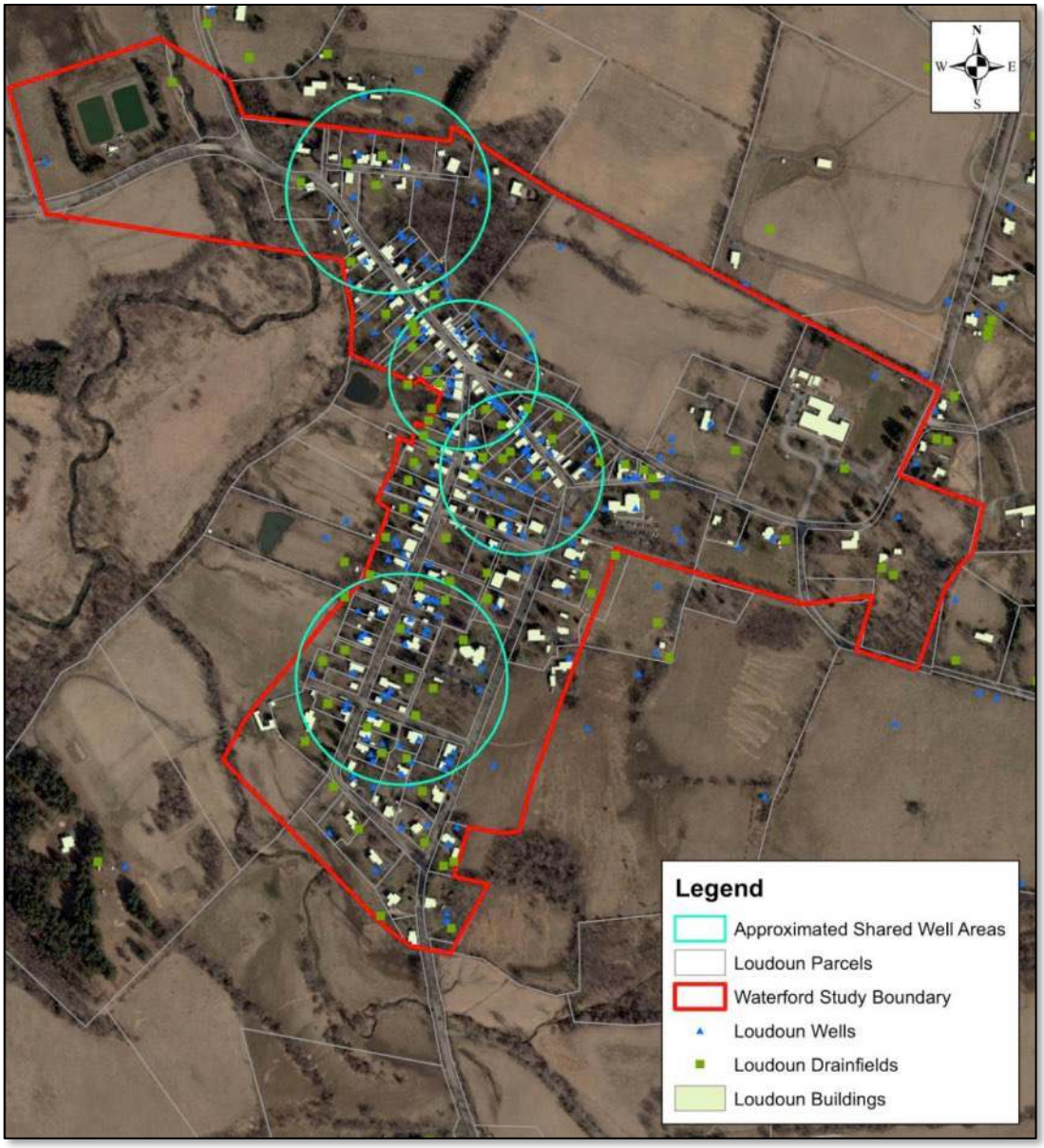

Figure 4.4 – Potential Shared Well Areas

4.2.3 Option 3 – Community Water System Owned and Operated by Loudoun Water (Using New Community Wells)

For a community system, a well system will need to be designed and constructed to convey the minimum required flow of 146 gpm for the existing condition and 173 gpm for the future condition. Furthermore, LW requires that systems having more than 50 connections shall provide either:

1. Three (3) wells with required easements, including two (2) wells in service and one (1) backup well, producing at least 0.6 gpm per connection (which is equal to 73.2 gpm per well for 122 connections and 86.4 gpm per well for 144 connections), or

2. Four (4) or more wells with required easements, including a backup well that has undergone initial hydro geological testing, the two (2) smallest of which shall combined produce at least 0.6 gpm per connection with the smallest producing at least 0.12 gpm per connection.

It should be noted that there are no reported wells in the Waterford study boundary with a yield greater than 50 gpm. The closest well to Waterford (not including wells associated with public water-supply systems) having a yield of at least 100 gpm is approximately 2.5 miles away. However, new wells do not have to be drilled on site and may be drilled outside of the Waterford study boundary. Tetra Tech determined the best potential community well sites, which are shown in **Figure 4.5.** According to Tetra Tech, it may be possible to sustain production of 86,000 to 212,000 gallons per day (gpd) (60 to 147 gpm) from six (6) wells located along the periphery of the Waterford study boundary, and high-yield wells are more likely to be developed in and to the north and east of the boundary.

The potential to achieve this goal is uncertain, as actual sustainable groundwater extraction rates to support a community water supply system in Waterford can only be determined by well drilling and testing. It should be noted that due to the complex, heterogenous distribution of water-bearing fractures in the metamorphic rocks of western Loudoun County, dry holes may be drilled in areas with statistically high yields, and vice versa. Extreme high-yield wells are sometimes drilled by chance. Attempts to locate and construct high-yield water wells would benefit from (and will require) conduct of electrical resistivity survey work to select drilling locations on target parcels.

Community wells would be owned and operated by LW and would pump groundwater to a treatment facility, as needed. The facility would be designed to treat the raw groundwater to required standards prior to distribution. This option would also require that a conveyance system be installed to distribute water from the treatment facility to individual homes. A preliminary layout of the conveyance system is shown in **Figure 4.6**. A baseline assumption for the size of the distribution piping is 6-inches to 10-inches in diameter. Per the LW EDM, raw water lines 4-inch and larger for a community system shall be ductile iron pipe AWWA C151, Class 52 or better, with AWWA C153 MJ fittings.

A small treatment facility may be necessary prior to the distribution system to convey treated water. Prior to deciding the final treatment requirements, well development and testing would be completed to determine water quality. These systems could range from simple disinfection to membrane treatment for contaminants. Based on experience in the area and similar facilities in the region, the most common water quality issue that requires treatment is heavy metals, such as iron. The most cost-effective approach to treat wells with heavy metal is the use of a manganese greensand filtration system. For the purpose of this report, the facility is shown on the Elementary School parcel and a manganese greensand filtration system has been assumed. However, the location of the treatment facility could be located anywhere near the distribution system. Should the treatment facility be moved further away from the community or distribution system, the cost of the project will increase to accommodate additional piping.

It is anticipated that any kind of water storage tank or similar facility required for this project will need to meet the requirements of Chapter 3 of the Waterford Loudoun County Historic District Guidelines. The most relevant requirements of this chapter, which addresses the addition of Site Elements to the community, will be those guidelines for Landforms and Features (Part B), Siting (Part C) and Accessory Structures and Breezeways (Part F). Designs for water storage facilities and appurtenances will be designed in accordance with the District Guidelines to preserve the community landforms, vegetation, viewsheds and structure siting patterns to the greatest extent practicable. A viewshed analysis for any proposed structure(s) is anticipated to be necessary to evaluate the potential of the project to impact historic viewsheds for the community. Part I, which deals with Mechanical and

Utility Screenings, will be utilized as appropriate if screenings might be useful in mitigating the potential for any proposed water facility to impact the character of the historic district. Part E, addressing archaeological sites, is expected to be addressed through agency permitting reviews.

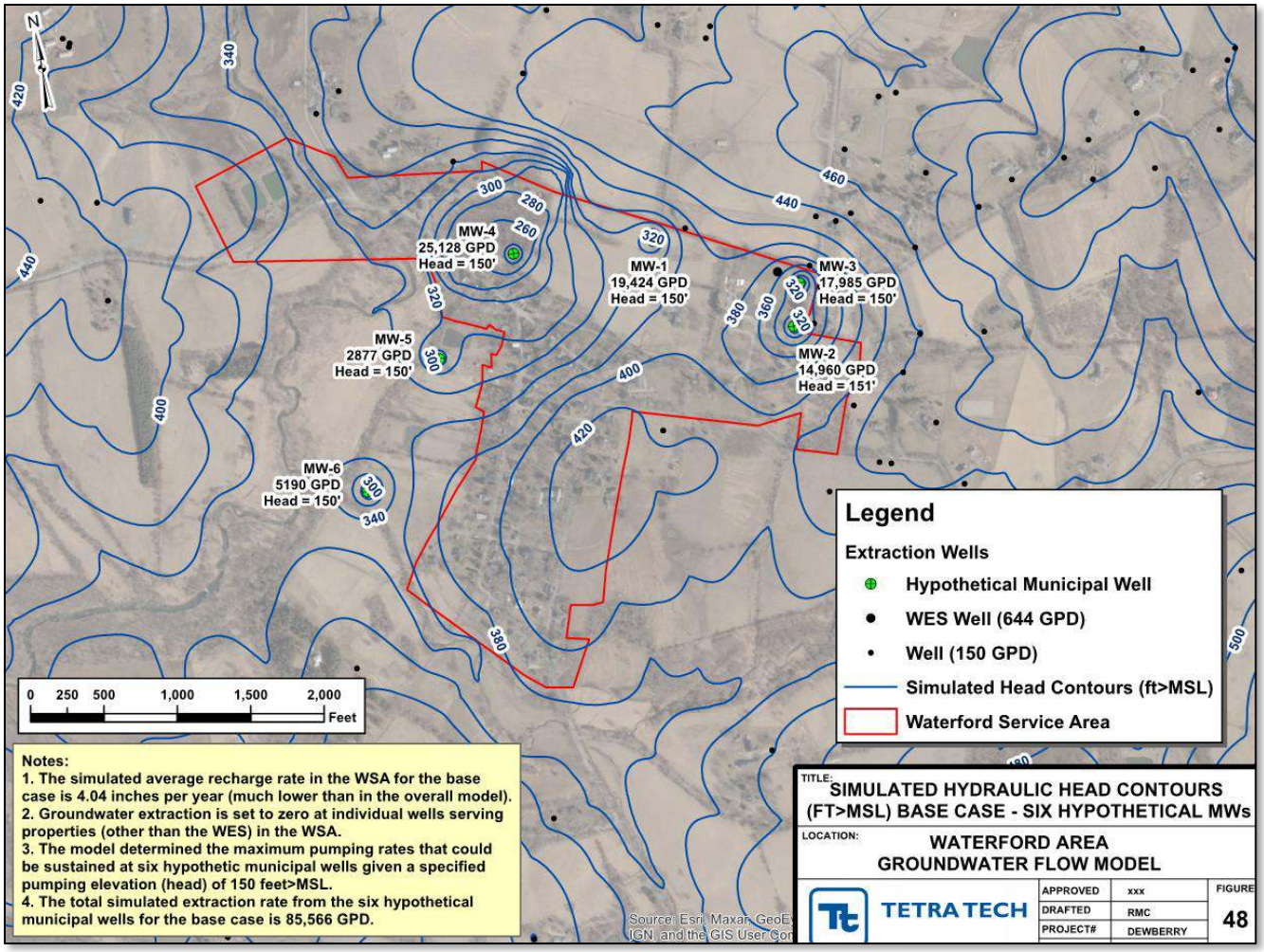

Figure 4.5 – Potential Community Well Sites

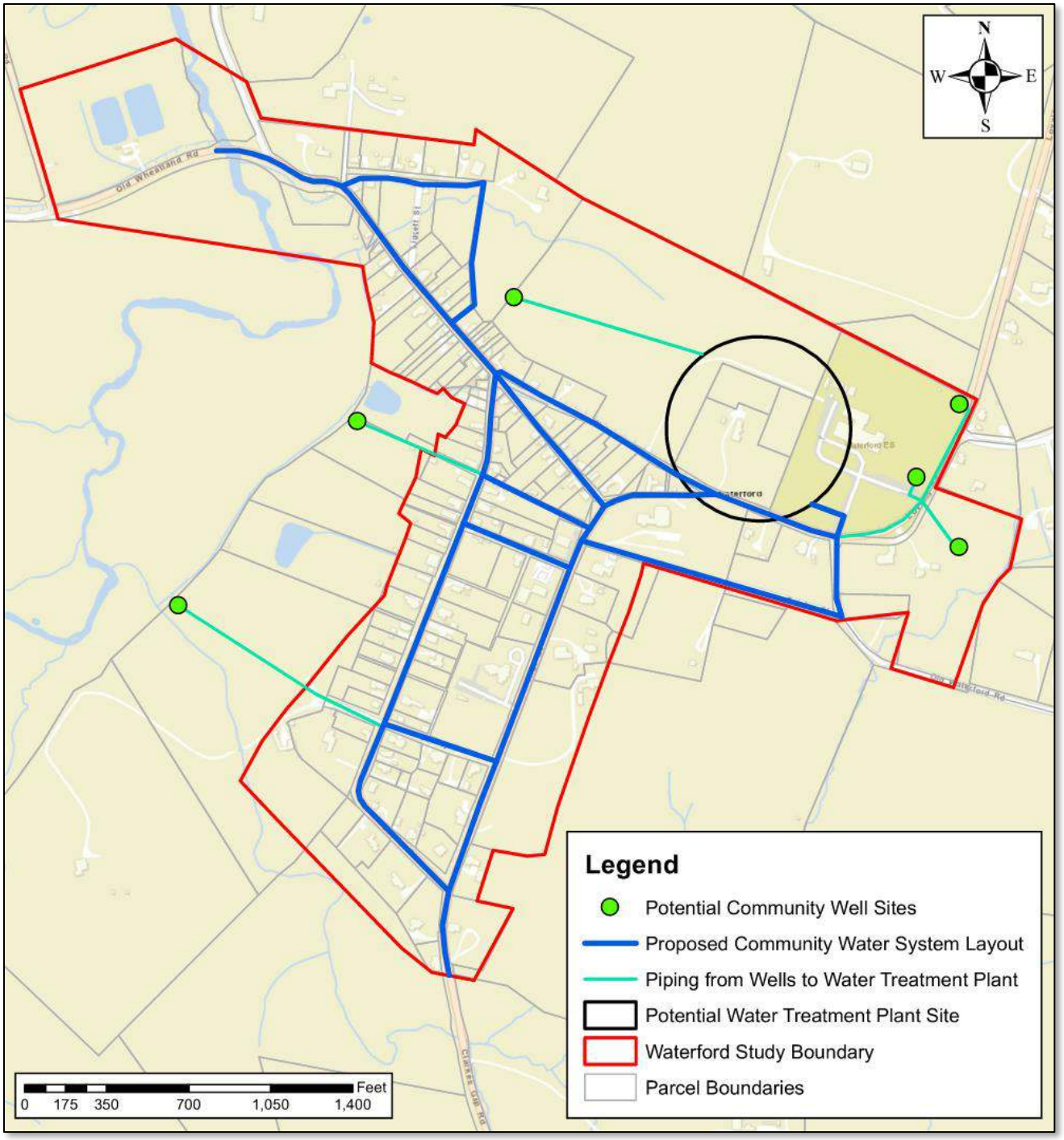

Figure 4.6 – Preliminary Water Main Layout

Each community well will need to be tested and monitored per the Virginia Waterworks Regulations (12-VAC-590). The water treatment technology will depend of the water quality of the well drilled. **Table 4.2** shows the primary and secondary Maximum Contaminant Levels (MCL) for several water quality measurements from the VDH ODW. Primary standards are legally enforceable, and secondary standards are non-mandatory but are recommended for aesthetic purposes. A full list of standards can be found in **Appendix E**.

Table 4.2 – Primary and Secondary MCLs for Water Quality

Primary	
Substance	**MCL (mg/L) VDH ODW**
Total Coliforms (including fecal coliform and E. Coli)	Positive repeat sample
Arsenic	0.010
Copper	1.3
Lead	0.015
Nitrate (measured as Nitrogen)	10
Secondary	
Substance	**MCL (mg/L) VDH ODW**
Chloride	250.0
Iron	0.3
Manganese	0.05
pH	6.5-8.5
Sulfate	250.0
Total Dissolved Solids (TDS)	500

During well drilling and testing, water samples will be taken and tested for water quality parameters. Based on the results of the water quality tests, water treatment may be required.

Water may be treated by conventional or direct filtration, slow sand filters, diatomaceous earth (DE) filters, or alternative filtration technology. Applying granular filtration removes turbidity and suspended solids. It will not remove any harmful bacteria. Alternative filtration, such as membrane filters, is capable of removing harmful bacteria in the water. Several additional common water treatment technologies which may be required are described below:

- Microfiltration Membranes: Microfiltration uses semi-permeable membranes with small pores to filter and remove bacteria, Giardia, and Cryptosporidium. This treatment technology reduces the amount of chlorine dosage needed for disinfection but is not effective in removing dissolved contaminates.
- Greensand Filtration: Greensand filtration uses filters made from glauconite greensand with a special coating of manganese oxide in order to oxidize iron and manganese. As the water flows through the greensand filter, these elements form solids that are filtered out of the water. The filters are capable of removing dissolved solids but are unable to remove bacteria.
- Activated Carbon Filters: Activated carbon filters are typically made of coconut shells, wood, or coal and are capable of removing organic contaminates, as they are effective for removing heavy metals such as copper, lead and mercury since these chemicals adsorb to the carbon. These filters are not able to remove dissolved solids, coliform, bacteria and arsenic.

It is assumed that greensand filtration will be needed since iron and manganese are frequently detected in western Loudoun County groundwater above their Secondary Maximum Concentration Levels and since three (3) well yield survey responses indicated the need to treat water for iron. However, the type of treatment technology to be used, if needed, will need to be confirmed through water quality testing once the community wells have been developed.

For the purposes of this feasibility study, it is also assumed that there will be one (1) treatment system for all wells. Similar to the potential well locations, the treatment system may also be located outside of the study boundary.

Another alternative for supplying water to the community is a surface water withdrawal from a nearby waterway. Surface water withdrawal permits are managed by VDEQ and the State Water Control Board. In addition, the Virginia Marine Resources Commission (VMRC) will be coordinated through the permit process to confirm no adverse impact from a new withdrawal structure. Permit applications for new withdrawals on streams are managed through the joint permit application (JPA) process. Surface withdrawal regulations are outlined in Chapter 210 of the Virginia Administrative Code (9VAC25-210). An extensive public outreach process is required as part of any new surface water withdrawal application for any proposed withdrawal above 10,000 gallons per day (GPD). In addition, new surface withdrawal systems need to be coordinated with local and regional water supply planning as outlined in Virginia Administrative Code (9VAC25-780) and may result in the development of a new Water Supply Program for the region.

Surface withdrawal permit applications require evaluations of numerous criteria of the proposed stream withdrawal including the availability of any alternatives considered, interconnectivity of water supply systems, environmental reviews of state and federally listed threatened and endangered species, water quality monitoring and proximity to point source discharges. Several challenges exist for installing a new surface water withdrawal system near the Waterford Boundary, including:

- The Waterford WWTP has a discharge in the creek within close proximity to the community. This point source discharge may require any new withdrawal be placed a significant distance up or downstream. Detailed water quality modeling is required to confirm feasible locations for a new withdrawal structure.
- Portions of the Catoctin Creek and its forks are 'impaired'. Depending on the results of water quality sampling, withdrawals may not be feasible.
- The feasibility of withdrawal locations depends on normal stream flow as well as drought creek flows and elevations. Seasonal fluctuations in flow and stream levels for Catoctin Creek and its tributaries make standard withdrawals challenging. In areas where stream flow is insufficient, impoundments (i.e. dams or other structures) can be installed to store water for withdrawal. However, due to the topography of the area, sensitivity of the watershed and existing flows, an impoundment may not be practical.

Based on a desktop review of streams around the community, a new surface withdrawal will be challenging but may be technically feasible. The JPA process through the state requires that, prior to proposing a surface withdrawal for water, the applicant has determined that other alternatives for providing the necessary water demand have been thoroughly studied and deemed infeasible. Based on the hydrology report prepared as part of this study, a communal well system may be able to meet the demand requirements. Therefore, a phase 2 groundwater study, including test wells, drawdown testing and yield testing, will be required prior to requesting a surface withdrawal facility.

Once it has been determined that no groundwater source is available to the community, a petition to the state through the JPA can be initiated. Siting and locating a new withdrawal will require further analysis of waterways in the area, including sampling, water quality modeling and environmental reviews. At a minimum, coordination and/or developing a Local Water Supply Plan and a more robust treatment system (i.e. Membrane) would be required, in addition, an intake structure would need to be included and an impoundment created. The new raw water intake and treatment system would still distribute water into the same water distribution piping proposed with a communal well system. Due to the complexity of getting a new surface water intake approved and permitted, there will be

significant schedule impacts should this be required. The permitting process for a new surface withdrawal could extend the project schedule by two to three years. In addition to schedule, the cost of the project will be significantly impacted. Depending on the location of the withdrawal, the cost for a surface facility could be as much as 80% - 100% higher than a communal groundwater well system. Lastly, long term O&M costs for a surface water treatment facility will be significantly higher, increasing overall lifecycle cost of the solution.

In summary, a surface withdrawal system should only be considered should the groundwater alternatives be deemed infeasible after well testing has been completed.

4.2.4 Option 4 – Connection to a Nearby, Existing Community System

Several potential connections points to be considered include:

- Beacon Hill
- Raspberry Falls/Selma Estates

The locations of these service areas relative to Waterford are shown in **Figure 4.7**.

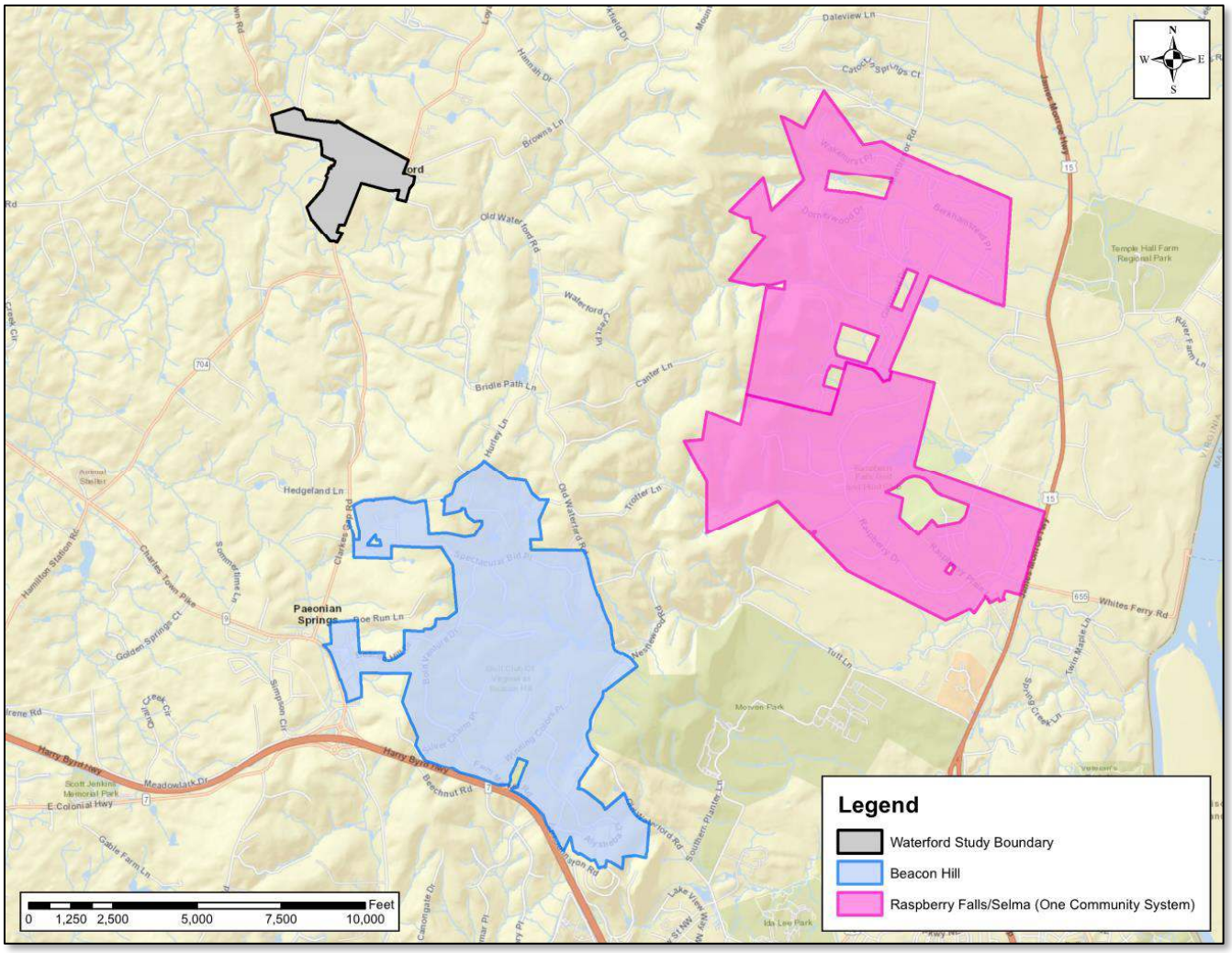

Figure 4.7 – Potential Neighboring Community Water System Connections

Connection to these systems would require sufficient well and treatment capacity to serve Waterford. Additionally, a water main would need to be installed to convey potable water from the existing systems to the community.

Installation of a water main from Raspberry Falls/Selma Estates to Waterford is not technically feasible due to elevation, as there is a mountain range between the two communities. **Figure 4.8** shows potential paths for installation between the two communities (with green lines indicating where the path lacks roadway), however; all potential paths cross the mountain range and have elevation changes similar to that shown in the elevation profile in **Figure 4.9** for the shortest path. For this path, the starting elevation at Raspberry Falls/Selma Estates is approximately 280-feet and the end elevation at Waterford is approximately 470-feet, and the path covers a distance of approximately 3.89 miles. Since the elevation at Waterford is higher than the starting elevation at Raspberry Falls/Selma Estates, there is an overall negative slope between the communities, meaning that pumping will be required for the majority of the conveyance system. Furthermore, the mountain range in the middle of the distance between the communities' peaks at an elevation of approximately 700-feet. Slopes along the mountain side reach up to 11%, which is not acceptable for conveying flow. This option is also not practicable, as there are constructability challenges with the installation of approximately 3.89 miles of water main, and there is concern with the age of the water once it reaches Waterford (due to the time it takes to travel the length of the water main). Furthermore, based on preliminary discussions with LW, Raspberry Falls/Selma does not have spare capacity (well or treatment) to serve the Waterford community.

However, it is technically feasible to install a water main from Beacon Hill to Waterford based on location and elevation. As shown in **Figure 4.10**, the elevation from Beacon Hill to Waterford slopes downhill about 0.38%, from approximately 537-feet at Beacon Hill to approximately 470-feet at Waterford over approximately 3.33 miles. At the low point elevation between the communities, which is at an elevation of 400-feet at a distance of 2.49 miles from Beacon Hill and 0.84 miles from Waterford, the downward slope from Beacon Hill to the low point is approximately 1.0% and the upward slope from the low point to the high point at Waterford is approximately 1.6%. Since the majority of the path follows a downward slope and the slope percentages are relatively low, it is technically feasible to install piping between the communities in order to convey water from Beacon Hill to Waterford. The cost of implementing this option is significantly higher than other options. Furthermore, based on preliminary discussions with LW, Beacon Hill does not have spare capacity (well or treatment) to serve the Waterford community. It should also be noted that since this community is located in the RPA, approvals through the Board of Supervisors would be required for connection.

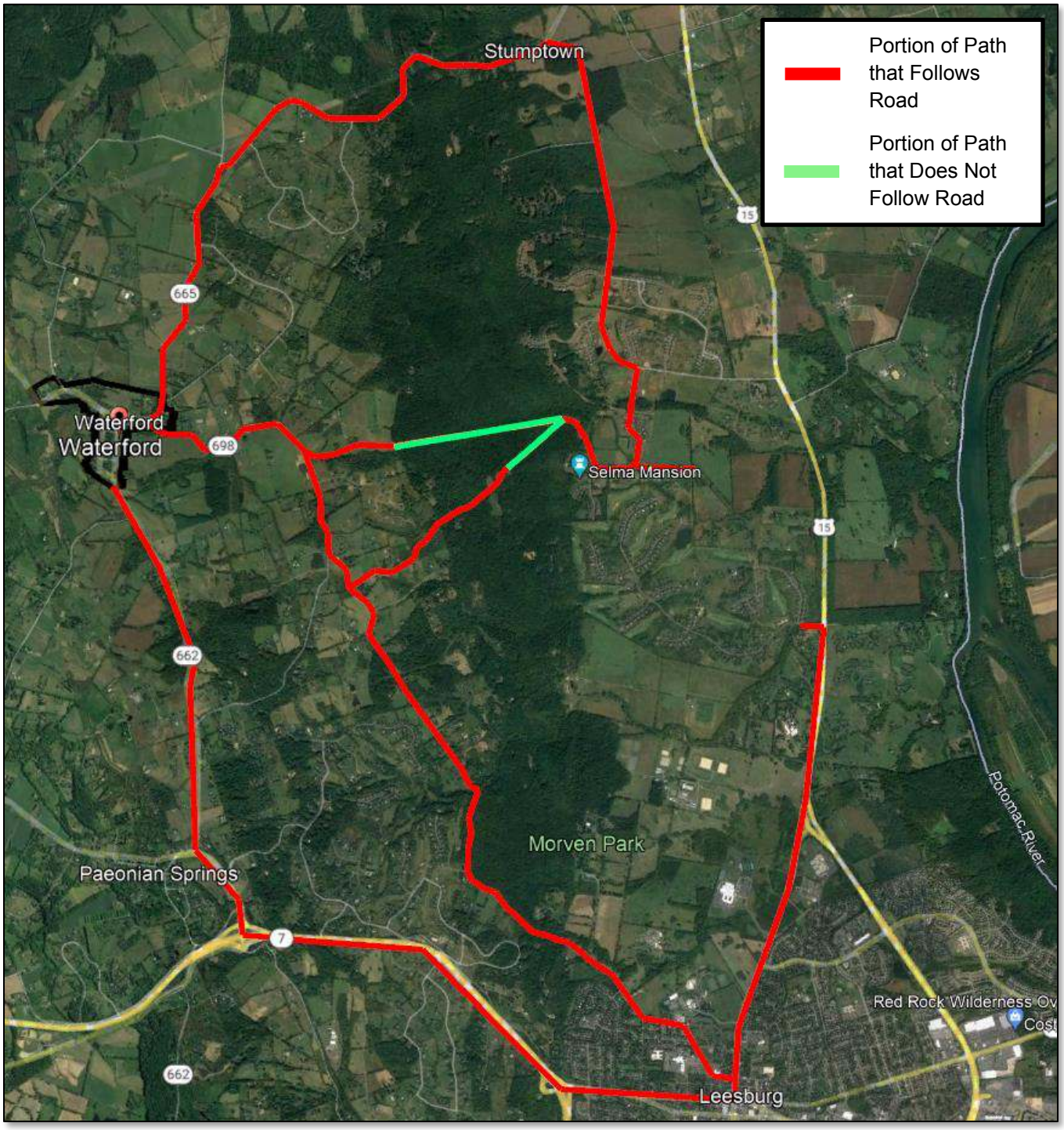

Figure 4.8 – Potential paths from Waterford (Left) to Raspberry Falls/Selma Estates (Right), Photo Courtesy of Google Earth

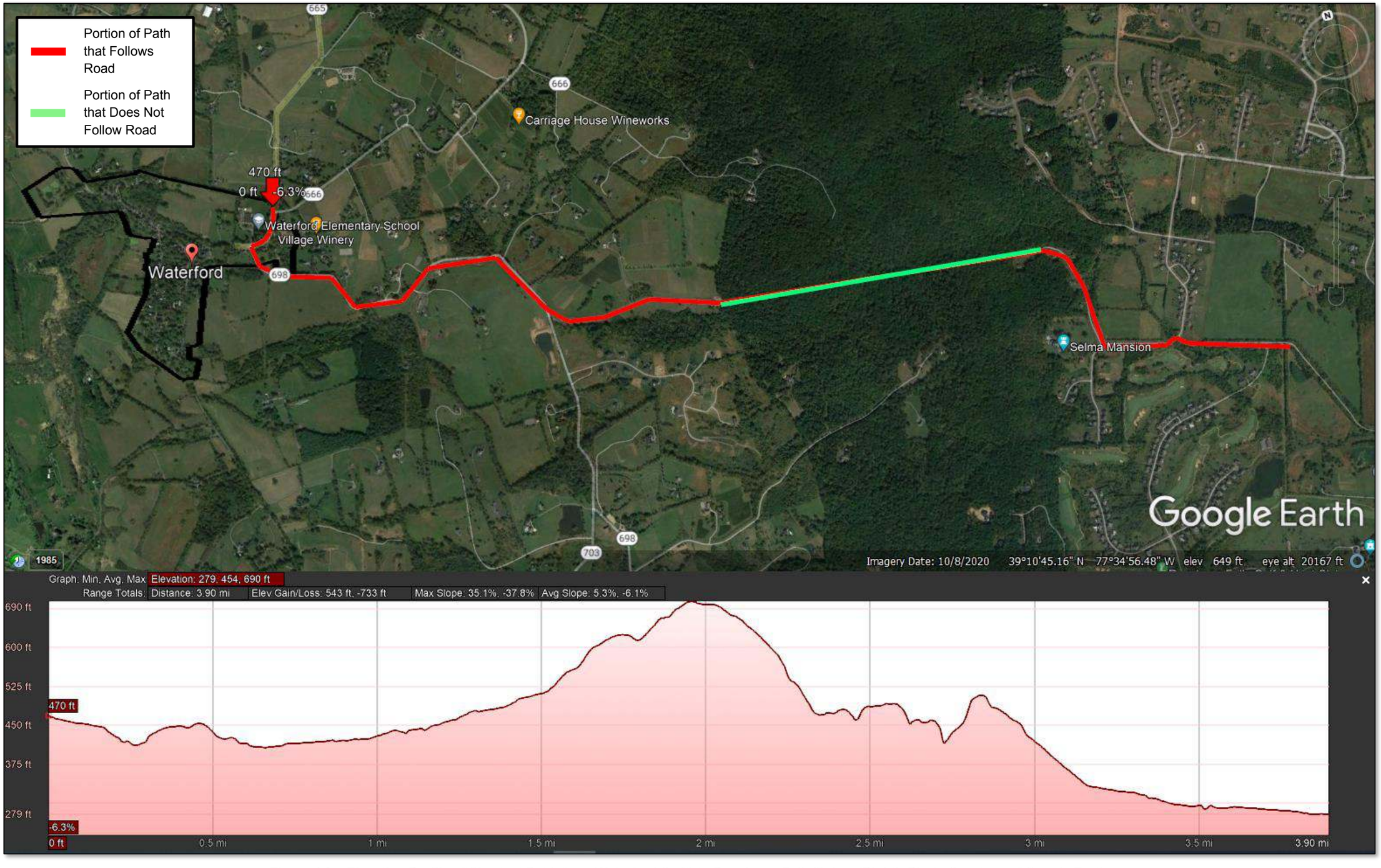

Figure 4.9 – Elevation Profile of Shortest Pat h from Waterford (Left) to Raspberry Falls/Selma (Right), Photo Courtesy of Google Earth

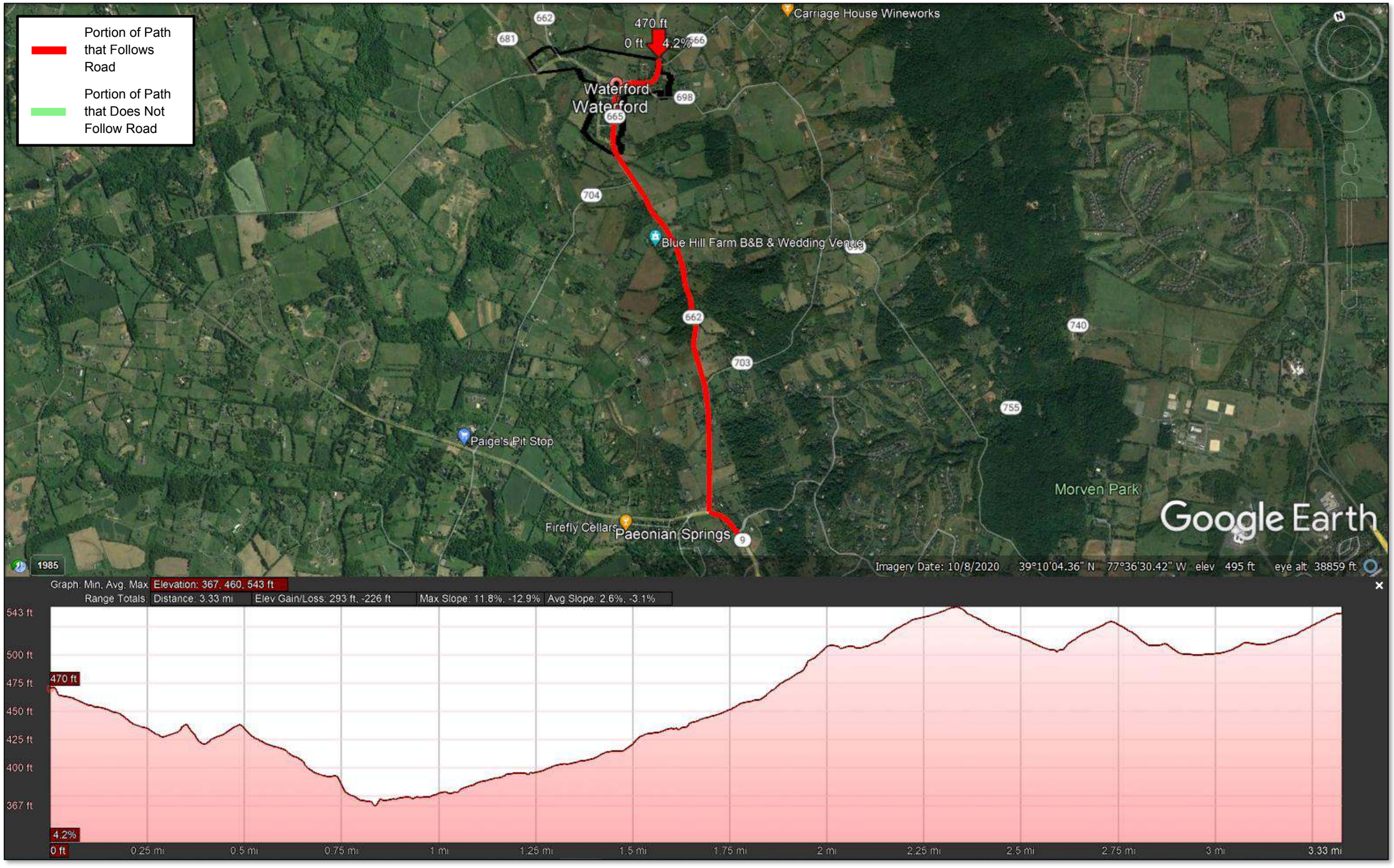

Figure 4.10 – Elevation Profile from Waterford (North) to Beacon Hill (South), Photo Courtesy of Google Earth

4.2.5 Option 5 – Wholesale Purchase of Water from, or Connection to, a Nearby Municipal System

Several potential connections points to be considered include:

- Purcellville
- Hamilton
- Town of Leesburg

The locations of these service areas relative to Waterford are shown in **Figure 4.11**.

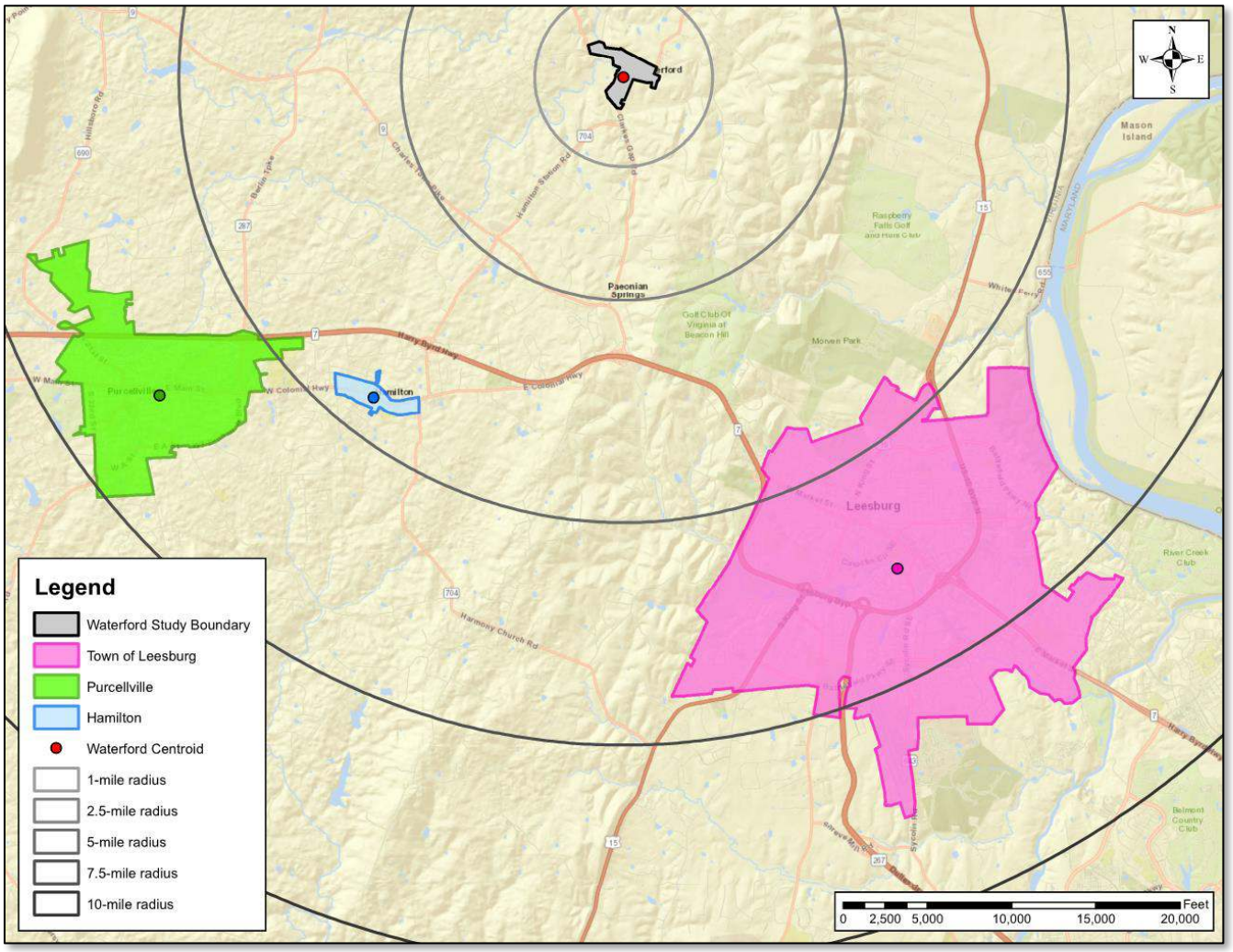

Figure 4.11 – Potential Neighboring Municipal Water System Connections

Connection to these systems would require sufficient well and treatment capacity to serve Waterford. Additionally, a water main would need to be installed to convey potable water to the community. The distance from the centroid of the community to the centroids of the nearby municipal systems ranges from approximately 4.5 miles (Hamilton) to approximately 6.3 miles (Leesburg and Purcellville). However, since water mains generally follow roadways, the length of the water main from Waterford to the Town of Leesburg would be approximately 6.3 miles (from Route

662 to Route 9 to Route 7), to Hamilton approximately 5.4 miles (from Route 662 to Route 704 to Route 7) and to Purcellville approximately 8.5 miles (from Route 662 to Route 704 to Route 7). While technically feasible, connection to any of these municipalities would not be practical, as this would require an extensive water main and supplemental support appurtenances, such as a booster pump. Construction of the water main would be challenging since it would run through existing developments and a major thoroughfare, Harry Byrd Hwy (Route 7). Therefore, this option is associated with the highest cost. Furthermore, there is concern with the age of the water once it reaches Waterford due to the time it takes for water to travel the length of the main. It should also be noted that since this community is located in the RPA, approvals through the Board of Supervisors would be required for connection.

4.3 Options Matrix

A simple options matrix was developed to analyze the five (5) potential options relative to recommendation criteria. The purpose of the matrix is to better present and compare the options, in order to recommend a water system. The options were considered based on six (6) criteria, which are listed below:

- Constructability
- Public Impacts
- Costs
- Approval/Acceptance
- Environmental Impacts
- Operations & Maintenance

The criteria for each option was then rated on a scale from one (1) to five (5), with the larger number being more favorable, as shown in **Table 4.3**.

Table 4.3 – Scoring Breakdown

Rating Score	
5	Very Good
4	Good
3	Fair
2	Poor
1	Very Poor

The full matrix is included as **Table 4.4**. As a result of the analysis, two (2) options are most practical for further analysis to address the water yield concerns within the Waterford community:

- Option 2 (Shared Private Wells), or
- Option 3 (Community Water System Owned and Operated by Loudoun Water)

For Option 2, it is estimated that approximately six (6) shared well systems are needed in Waterford. It is recommended that a new well be drilled for each shared well system, and 2-inch piping be used to distribute the water to the connected properties. The well sites, piping and treatment system (if necessary) may be located outside of the Waterford study boundary. Easements, deeds, mortgages, permits and costs to drill and connect to a new well would be divided by private property owners of the four (4) homes for each new shared well system. Not all

systems will be the same cost. Agreements should be developed between property owners regarding responsibility for any necessary maintenance or future well improvements.

Option 3 includes the implementation of a water distribution and treatment system. Six (6) potential well sites, as shown in **Figure 4.5**, have been identified that may provide adequate yield to convey the estimated future demand of 173 gpm to Waterford. It should be noted that no discussions took place with property owners regarding potential well sites. The well sites are shown conceptually for the purpose of this feasibility study and to show potential water infrastructure alignments. Per the preliminary layout shown in **Figure 4.6**, approximately 13,350 LF of 6-inch ductile iron pipe (DIP) is recommended to convey the water. Greensand filtration is the recommended treatment system due to the presumed presence of iron and manganese in the water. For the purposes of this feasibility study, it is also assumed that there will be one (1) treatment system for all wells. All well sites, piping and treatment system locations are shown preliminarily for conceptual purposes and some infrastructure may ultimately be located outside of the Waterford study boundary.

Table 4.4 – Waterford Options Matrix

Waterford Options Matrix							
Alternative Number	**Constructability**	**Public Impacts**	**Costs**	**Approval/Acceptance**	**Environmental Impacts**	**Operations & Maintenance**	**Average Score**
Option 1 Upgrade Existing On-Site Systems to Improve Yield on Individual Wells	Community may have issues with new well construction based on parcel sizes and setback requirements.	Upgrade of existing systems not guaranteed to address issues with poor yield. Long-term effectiveness of hydrofracking unknown.	Upgrade of existing systems would have lower initial capital costs. Long term O&M costs would be the responsibility of the property owner.	Existing wells may need to be repaired or replaced. No need for additional land acquisition. Minor permitting approvals.	Water usage, potential contamination and potential impacts to nearby wells from hydrofracking (if used).	Continued homeowner O&M. Yearly inspections and upkeep.	**2.5**
Raw Score	**2**	**1**	**4**	**3**	**3**	**2**	
Option 2 Shared Private Wells	Locating new wells with sufficient yield may be challenging based on hydrology study. Access to lots may be challenging.	Shared wells will require extensive agreements between homeowners for proper access and maintenance. May impact long term ownership and sale/transfers.	Should sufficient yield be discovered for shared wells, costs will be reasonable and distribution system will be limited. Costs would be the responsibility of the property owners.	Shared well system do not need to meet public water work regulations. Approvals from several property owners will be required. Limitations on number of connections and residents for each system.	Limited environmental impacts. New wells may remove older non-yielding well systems.	Continued homeowner O&M. Yearly inspections and upkeep. Shared wells expense is divided amongst several owners.	**2.8**
Raw Score	**1**	**2**	**4**	**3**	**3**	**4**	
Option 3 Community Water System Owned and Operated by Loudoun Water (Using New Community Wells)	Requires new community well system and treatment facility. Extensive road restoration and community impacts for long construction durations.	Elimination of existing wells will provide more sustainable community solution. Public impacts during construction of distribution systems with road works and extended impacts.	High initial capital costs and connection fees.	Easements and land acquisitions necessary for well/treatment facility and distribution system. Extensive permitting due to historic nature of community.	Communal well would eliminate numerous old wells from community. Historic nature requires permitting, however, minimum environmental concerns.	New community system that will need O&M in accordance with VDH ODW requirements. Ongoing water fees.	**3.0**
Raw Score	**3**	**4**	**2**	**1**	**4**	**4**	
Option 4 Connection to a Nearby, Existing Community System	Requires road work and restoration. Consideration for crossing Catoctin Creek. Significant impacts due to extended water main in rural policy area and distance from Waterford to nearest community system.	Public impacts during construction. Elimination of existing wells will provide more sustainable community solution.	Highest initial capital costs and connection fees due to extensive piping required and work within major thorough fares and required coordination/ negotiation with nearby communities	Board of Supervisors approval required. Easement and land acquisitions most likely necessary. Need to prove existing community system has capacity to provide additional water to Waterford.	Potential tributary impacts with seasonal streams for distribution piping. Larger land disruption.	No additional treatment facility for maintenance. Ongoing water fees for residents.	**2.0**
Raw Score	**1**	**4**	**1**	**1**	**1**	**4**	
Option 5 Wholesale Purchase of Water from, or Connection to, a Nearby Municipal System	Requires road work and restoration. Consideration for crossing Catoctin Creek. Significant impacts due to extended water main on busy roads and distance from Waterford to nearest community system.	Public impacts during construction. Greatly reduce risk of ongoing public health impacts due to connection to nearby system.	Highest initial capital costs and connection fees due to extensive piping required and work within major thorough fares and required coordination/ negotiation with nearby communities	Board of Supervisors approval required. Easement and land acquisitions most likely necessary. Need to prove existing municipal system has capacity to provide additional water to Waterford.	Potential tributary impacts with seasonal streams for distribution piping. Larger land disruption.	No additional treatment facility for maintenance. Ongoing water fees for residents.	**2.0**
Raw Score	**1**	**4**	**1**	**1**	**1**	**4**	

5 OVERALL COSTS & SCHEDULE

A Class IV preliminary cost estimate for the recommended options (Options 2 and 3) to solve yield problems in Waterford has been prepared using 2021 cost factors. A Class IV preliminary cost estimate is defined by the Cost Estimate Classification System of the American Association of Cost Engineering International (AACE) and has an accuracy range of -20 to +30 percent of the estimated cost. The cost estimates represent a preliminary opinion of probable construction cost (OPCC) and are based on the assumptions outlined throughout this feasibility study. The approximate cost of the project will need to be inflated based on the anticipated implementation schedule.

A schedule was prepared for Option 3, as this would be a capital project. A schedule is not provided for Option 2 since work for this option would be at the discretion of the property owners.

5.1 Option 2 – Shared Well Systems

Assuming that one (1) well is drilled per shared well system and that approximately 1,000 LF of piping is needed per shared well system, the total cost for each shared well system is approximately $159,500 with a low range estimate (-20%) of approximately $127,600 and a high range estimate of approximately $207,350. Divided by four (4) properties, the cost per property (i.e., per connection) is approximately $40,000. Costs for operations and maintenance as necessary shall be agreed upon between property owners.

Table 5.1 – Shared Well Costs

Shared Well Costs				
Item	**Units**	**Quantity**	**Unit Price**	**Total**
Drill Well	EA	1	$ 35,000	$ 35,000
2” Piping	LF	1,000	$ 85	$ 85,000
Road Restoration (5' Sawcut and Full Road Overlay)	SF	2,500	$ 11.00	$ 27,500
County Well and Site Plan Approvals	EA	1	$ 12,000	$ 12,000
			Total	**$ 159,500**
			Low Range Estimate (-20%)	**$ 127,600**
			High Range Estimate (+30%)	**$ 207,350**

5.2 Option 3 – New Community Water System

5.2.1 Water Conveyance and Treatment Capital Costs

As described above, the community water system will require distribution piping and a treatment system. For the purpose of the cost estimate, it is assumed that all community wells will pump to one (1) treatment system and that a greensand filtration system will be used. It is also assumed that one (1) greensand filtration system is sufficient for treatment. However, upon drilling the wells, it may be determined that a treatment system is not necessary. This system does not take into consideration fire or irrigation flows. The preliminary capital cost estimate is summarized in **Table 5.2**. The total preliminary capital cost for the water system is approximately $9.1 million, with a low range of $7.3 million and high range of $11.8 million.

Table 5.2 – Water System Capital Costs

Water System Capital Costs				
Item	**Units**	**Quantity**	**Unit Price**	**Total**
Furnish and Install 6" DIP Water Main	LF	13,350	$ 300.00	$4,005,000.00
Water Meter and Service Installation	EA	122.00	$ 3,250.00	$ 396,500.00
Blow Off Valve	EA	5.00	$ 2,750.00	$ 13,800.00
Air Release Valve	EA	5.00	$ 2,750.00	$ 13,800.00
Road Restoration (5' Sawcut and Full Road Overlay)	SF	66,750	$ 22.50	$1,501,900.00
Groundwater Well (Six 8-inch Wells and Casing)	EA	6.00	$ 49,500.00	$ 297,000.00
Water Treatment System (greensand filtration, disinfection, pressurization, SCADA, etc…)	EA	1.00	$2,750,000.00	$2,750,000.00
Land Acquisition for Well and Treatment Facility	ACRES	3.00	$ 40,000.00	$ 120,000.00
			Total	**$ 9,100,000**
			Low Range Estimate (-20%)	**$ 7,300,000**
			High Range Estimate (+30%)	**$ 11,800,000**

[1]This cost includes drilling, water quality report, logging for test wells and conversion to production wells after completion

The scope of this project will include service lines from the water main to a new water meter that will be installed for each connection. Homeowners will be responsible for making the connection to the new water meter. This work may include installation of new service line piping, well abandonment, internal piping modifications and site restoration. The cost for this work is not included as part of this cost estimate. It should be noted that Loudoun Water review fees are calculated as 2.5% of the construction bond estimate and are paid at the first plan submission and then reassessed at plan approval. It should also be noted that individual wells shall be abandoned per VDH ODW requirements, which requires an abandonment permit by LCHD, unless the well is converted to an irrigation well. The cost of this permit is $300; however, this fee is refunded upon request when replacing existing wells or springs, or when replacing a new well drilled dry. Furthermore, this fee is waived if the well is located on the owner's primary residence.

The capital costs outlined reflect current 2022 market conditions. Year of year price escalations due to inflation, market demand and other factors will increase the cost of the project through future years. Historically, a 3-5% yearly increase has been realized for similar projects. However, over the past 12-24 months, influence from COVID and other supply chain issues have caused significant increases in construction costs. For the purpose of estimating future costs of the project, a 6% yearly escalation can be used for budgeting purposes. **Table 5.3** below shows approximate costs over time with a 6% escalation. It should be noted that current market volatility significantly impacts future costs, and these estimates should be confirmed during preliminary design.

Table 5.3 – Water System Capital Costs Over Time

Water System Capital Costs Inflation			
Year	**Total**	**Low Range Estimate (-20%)**	**High Range Estimate (+30%)**
2022	$ 9,100,000.00	$7,300,000.00	$11,800,000.00
2023	$ 9,646,000.00	$7,716,800.00	$12,539,800.00
2024	$10,224,760.00	$8,179,808.00	$13,292,188.00
2025	$10,838,245.60	$8,670,596.48	$14,089,719.28
2026	$11,488,540.34	$9,190,832.27	$14,935,102.44
2027	$12,177,852.76	$9,742,282.20	$15,831,208.58

Taking into consideration the design, permitting and surveying required prior to construction, as well as necessary improvements to individual parcels (e.g., service lateral and meter), the overall preliminary costs for implementing a community system were determined and are summarized in **Table 5.4**. The total preliminary cost of the water system is approximately $10.5 million, with a low range of $8.4 million and high range of $13.6 million.

Table 5.4 – Water System Summary

Water System Summary	
Item	**Total**
Design, Permitting, & Surveying	$ 1,364,700.00
Water Distribution System	$ 4,429,100.00
Water Treatment System	$ 3,047,000.00
Road Restoration & Site Work	$ 1,501,900.00
Land Acquisition for Well and Treatment Facility	$ 120,000.00
Total Capital Costs	**$10,463,000.00**
Low Range Estimate (-20%)	**$ 8,370,000**
High Range Estimate (+30%)	**$ 13,602,000**

5.2.2 Loudoun Water Operation and Maintenance Cost

Following construction completion, there is additional effort for the operation and maintenance (O&M) of the facilities, as there are costs associated with upkeep of the treatment system. These costs are summarized in **Table 5.5**. The total preliminary estimated yearly cost for O&M is approximately $108,000, with a low range of $86,000 and high range of $140,000. The operation and maintenance costs would be the responsibility of Loudoun Water and would be included as part of the quarterly usage fees assessed for each property.

Table 5.5 – Operation and Maintenance Costs

Estimated Maintenance Costs		
Item	**Unit**	**Cost**
Maintenance Parts (consumables/repair)	$/year	$ 2,750
General Equipment Maintenance[1]	$/year	$ 9,100
Facility Maintenance[2]	$/year	$ 2,150
Estimated Operational Costs		
Item	**Unit**	**Cost**
Standard Operating Personnel[3]	$/year	$ 67,018
Routine Maintenance[4]	$/year	$ 10,400
Power Cost[5]	$/year	$ 9,500
Chemicals	$/year	$ 7,000
Total		**$ 108,000**
Low Range Estimate (-20%)		**$ 86,000**
High Range Estimate (+30%)		**$ 140,000**

[1]Includes costs associated with monthly, annual and semi-annual maintenance of equipment

[2]Includes maintenance costs associated with the well area including leaf removal, grass trimming, etc…

[3]The cost of 1 operator for three (3) four (4) hour visits per week at $107.40 per hour

[4]Time spent in addition to standard maintenance to maintain technology specific equipment. Assumes 2 hour per week at $107.40 per hour

[5]Assumes 200 kWh/day at $0.13/kWh

5.2.3 Present Worth Analysis

A present worth analysis was also performed for the water system, which is summarized in **Table 5.6**. The total net present cost of implementing a community system in Waterford is approximately $11.2 million.

Table 5.6 – Present Worth Analysis

Present Worth Analysis	
Disposal Method	**Cost**
Initial Capital Cost	$ 9,100,000.00
Yearly O&M Costs	$ 108,000.00
Lifecycle (years)	30
Interest Rate	3%
Net Present Cost	**$ 11,200,000**

5.3 Cost Summary

The overall costs of Options 2 and 3 are summarized in **Table 5.7**.

Table 5.7 – Costs of Feasible Options

Option	Cost	Low Range Estimate (-20%)	High Range Estimate (+30%)
2 (Shared Wells)	$ 159,500 [1]	$ 127,600 [1]	$ 207,350 [1]
3 (New Community Water System)	$ 10,463,000.00 [2]	$ 8,370,000 [2]	$ 13,602,000 [2]

[1]Per shared well system, to be divided by four (4) homes

[2]Includes design/permitting/survey, water distribution and treatment system and road/site work

When divided by four (4) homes, the cost of Option 2 to each property owner, and therefore the cost of connection, is approximately $40,000. There are also O&M costs associated with Option 3, which are approximately $108,000 (with a low range of $86,000 and high range of $140,000). Finally, a present worth analysis reveals the net present cost of Option 3 to be approximately $11.2 million.

5.4 Schedule

A schedule was not developed for Option 2 since work for this option would be at the discretion of the decisions between property owners. The following sequence of actions are anticipated for this option:

- Develop agreement between shared well users
- Develop easements and land agreements as necessary
- Obtain contractor
- Contractor to submit shared well plan to health department
- Install shared well and service piping
- Perform well testing and obtain certification from health department

The approximate schedule for implementing Option 3 is shown in **Figure 5.1**.

The legislative approval process covers the special exception and commission permit (CMPT) process, which includes extensive public comment periods and board approvals.

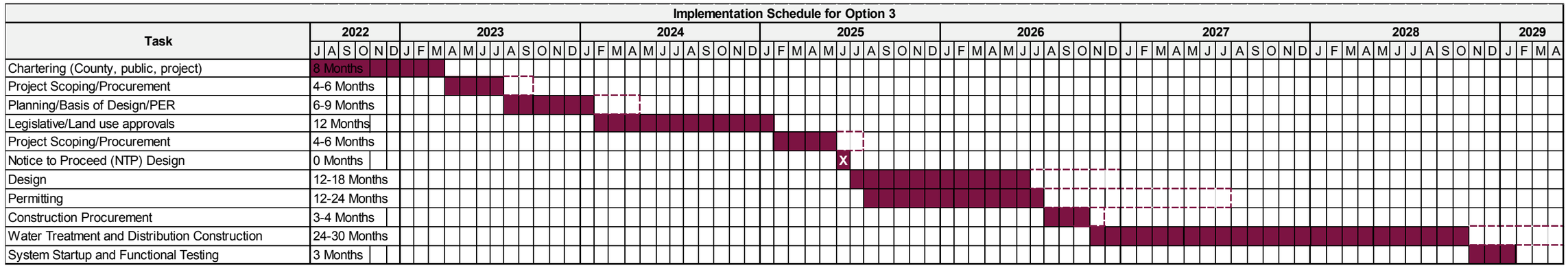

Figure 5.1 – Implementation Schedule for Option 3 (New Community Water System)

6 SUMMARY & RECOMMENDATIONS

6.1 Summary

This feasibility study evaluated the concerns identified by the community of Waterford and the technical feasibility of potential solutions to the community's drinking water issues. This feasibility study reviewed the existing conditions of the community, estimated the existing and future demands of the community, analyzed the existing systems and evaluated a total of five (5) options.

Prior to analyzing the feasibility of solutions, an analysis of the overall community was performed to better understand the community characteristics such as topography, historical resources, planning and zoning. A technical memorandum was prepared that assessed potential permitting and regulatory conflicts within the Waterford study boundary in regard to the five (5) options. Based on the historic nature of the community, the permitting and approval process may be challenging, however, there were no limitations that were identified that would deem construction of a new water system infeasible at this stage of a study. Subsequent phases of this project may include further field investigations that could drive permitting and approvals and ultimately become critical path for the project, such as the need for archeological surveys or other detailed studies.

A flow analysis technical memorandum was developed, which describes the process used to estimate existing and future water demands within the Waterford community. As a result of the flow analysis, a community well system serving the existing development would require a well yield of 146 gpm with a potential future yield requirement of 173 gpm based on potential future buildout. Therefore, the recommended demand flow (for the study area) to be used for sizing of a community water distribution piping and well/treatment systems (as needed) for the Waterford community is 173 gpm.

A review of online health department records, the results of a survey that was sent out to 117 residents regarding water yield and the groundwater hydrology report prepared by Tetra Tech were studied to determine the existing conditions of the well systems throughout Waterford. This review confirmed that well yield is a concern within pockets of the Waterford community and identified contributing factors to low-yield wells. These problems were documented for approximately 17 to 22 lots out of approximately 145 lots completely within the study boundary (approximately 12% to 15% of the community). In general, groundwater elevations in Waterford wells rose or changed little between 2006 and 2021, and groundwater mining (i.e., withdrawal of water faster than recharge rate) is not occurring. Although, it should be noted that there is relatively less groundwater in Waterford than in the Western Hills Watershed of western Loudoun County, as well as defined areas within the Waterford study boundary that have wells with low yield. In regard to water quality, the groundwater is generally acceptable for a potable water-supply, however; treatment will likely be required for iron and manganese.

Based on the location of the community, condition of the existing systems, and permitting/approval requirements, all five (5) options were evaluated to determine technical feasibility. The result of the evaluation determined that four (4) alternatives are technically feasible and one (1) alternative is not feasible. In summary:

1. Upgrade Existing On-Site Systems to Improve Yield on Individual Wells – Technically feasible alternative that may improve individual systems. Would require hydrofracking on individual wells to improve yield. Long term sustainability of this solution cannot be determined.

2. Shared Private wells – Technically feasible alternative that would require new wells and service connections that would serve up to four (4) parcels. Challenges associated with maintenance agreements, easements, and building restrictions exist that will need to be addressed.

3. Community Water System Owned and Operated by Loudoun Water (Using New Community Wells) – Feasible alternative requiring new communal well system and treatment facility as well as water distribution system. Wells and treatment facility would be located in or around the existing Waterford community, pending further groundwater hydrology studies.

4. Connection to a Nearby, Existing Community System – The only existing nearby community water system is Beacon Hill. However, Beacon Hill has existing challenges with well yield. A technically feasible alternative would require expansion of the existing Beacon Hill well system and treatment system as well as installation of a long water transmission main that would convey water from Beacon Hill to Waterford. This solution may be a cost prohibitive alternative.

5. Wholesale Purchase of Water from, or Connection to, a Nearby Municipal System – No municipal systems exist within approximately five (5) miles of the community, making this alternative infeasible.

Therefore, Options 1, 2 and 3 are technically feasible, and Option 4 is only technically feasible for connection to the Beacon Hill community system. A weighted criteria analysis was developed using six (6) criteria, used to score each option on a scale from one (1) to five (5), with 5 being the more favorable scoring. As a result of this matrix, Option 2 or Option 3 are the preferred options for implementation to address Waterford's yield problems.

6.2 Recommendations

Based on the evaluation presented in this feasibility study and summarized above, Option 2 and Option 3 were determined to be the preferred options to address Waterford's yield problems.

Option 2 includes a shared private system between residents. This option is limited to residential homes. Multiple shared well systems can exist within the community, as long as Loudoun County Health Department (LCHD) guidelines are followed. In order to remain under the jurisdiction of LCHD, the well must serve less than 15 connections or 25 people. If these numbers are exceeded or met, the well would become public waterworks, as defined by VDH ODW. Based on discussions with the VDH ODW and LCHD and an assumption of three (3) or four (4) bedrooms per home, the maximum number of connections that has been considered for this study is four (4) connections per shared well in order to ensure that the system does not exceed population restrictions as required by LCHD. Based on these discussions, the maximum number of connections that has been considered for this study is four (4) connections per shared well in order to ensure that the system does not exceed population restrictions. Each new shared well system would require an existing or new well capable of providing an eight (8) gpm yield, easements, deeds and any additional legal covenants or agreements needed to ensure that the well does not meet the definition of a public waterworks and that responsibility for costs (e.g., well improvements) and violations are clearly defined between property owners. The preliminary cost of this option, which includes drilling a well and running 2-inch distribution piping to each property, is approximately $159,500 (with a low range of $127,600 and high range of $207,350) and would be divided by four (4) properties to be approximately $40,000 per property.

For Option 3, which involves a new community system owned and operated by Loudoun Water, six (6) community wells located along the periphery of the Waterford study boundary and associated treatment system(s) and distribution piping to convey drinking water to Waterford residents is recommended, as shown in **Figure 4.5** and **Figure 4.6**. Attempts to locate and construct high-yield water wells would benefit from (and will require) conduct of electrical resistivity survey work to select drilling locations on target parcels. High-yield wells are more likely to be developed in and to the north and east of the Waterford study boundary. The recommended demand flow to be used for sizing of water distribution piping and well/treatment systems (as needed) for the Waterford community is 173 gpm. Based on the information analyzed as a part of this study, a groundwater treatment system is assumed necessary due to iron and manganese levels within Loudoun County, therefore it is assumed that greensand filtration will be required. However, the type of treatment technology to be used, if needed, will need to be confirmed through quality testing once the community wells have been developed. The preliminary cost of this option, which includes the design/permitting/surveying for the project, construction of the water distribution system and the water treatment system (assuming one greensand filtration treatment system), individual parcel improvements and road restoration/site work, is approximately $10.5 million (with a low range of $8.4 million and high range of $13.6 million). Additional costs associated with Option 3 include O&M costs, which are approximately $108,000 (with a low range of $86,000 and high range of $140,000). Finally, a present worth analysis reveals the net present cost of Option 3 to be approximately $11.2 million.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/7/2022 10:36	Yes	Support the water project.	No	For all of the challenges listed: agreements and easements.	Yes	Provides comprehensive solution for the entire community.	Yes	Location of treatment facility and community wells.				No	
11/7/2022 10:41	Yes	We support the project	No	Short term solution to a long term issue	Yes	As a commercial business, to expand we need reliable and safe water	Yes	Limiting future development in village and cost.			Loudoun Mutual Insurance Company	Yes	Quantity - we have on occasion
11/7/2022 10:49	Yes	I support it.	No	Concerned about viability of the existing wells to sufficiently service all homes during periods of drought and/or wells running dry. Possible confrontation between neighbors is not optimal.	Yes	Best suits the long-term needs of the Village.	I'm not sure	No visible complex to service the water needs. Would like it to be situated where it is non in the viewshed. Other than that, making sure it is done in a manner that will not preclude further improvements to the village such as buried utilities, lowering the road, improved sidewalks, etc.		Water is clearly essential. The fact that some homes do not have access is absurd in Loudoun county in 2022. Further, having water in the Foundation owned properties would allow those to be used to further the mission of the Foundation and help prolong the life of those structures.	No	No	
11/7/2022 10:51	Yes	maybe, I should have marked, but no choice	Yes		No	Loudoun Water is a county (big growth) facility	I'm not sure	A am uncertain at moment			no	No	
11/7/2022 10:59	Yes	N/A	No		Yes		Yes	sufficient water supply				No	
11/7/2022 11:01	Yes	N/A	Yes		No	I support a community system, however, the study that was conducted was full of issues with no clear solution including using private or conservation land for water treatment and pumping facilities. Everything in the project specifications is TBD and therefore if no real answers to how the system could be put in place without impacting conservation land, real estate	No	The locations of equipment and impact on properties				Yes	Low yield

ATTACHMENT 2

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/7/2022 11:06	Yes	.	Yes	I prefer to own my own water and not have it owned and treated by Loudoun Water	No	I do not support an outside company owning our water.	No	Maintaining autonomy over our water and ensuring everyone has equal access to water.				No	
11/7/2022 11:18	Yes	I support it	No	Seems like a logistical challenge with agreements and determining whoâ€™s property will provide the well. Will have to worry about the water consumption of neighbors possibly affecting your own supply.	Yes	This would be the most productive option as far as supply and water quality improvement without having to enter into agreements with neighbors.	Yes	N/a				Yes	We experience both water quality and quantity issues. We have to coordinate showers, laundry, and lawn care due to limited water supply
11/7/2022 11:49	No	We would like water mitigation efforts confined to those properties where water is a problem so that the supply and operation of current adequate wells are not jeopardized.	Yes	There is no way to respond I Don't Know Enough About It which would be my answer. IFshared private wells will enable properties with inadequate water to get it, then I'm for option 2.	No	There are many wells in 'Waterford, including ours, that have functioned without problems for decades. I see no point in jeopardizing their operation. Fix the ones that have problems. A community-wide system is unnecessary overkill.	No	Preservation of all wells that are currently producing adequate water. Only properties without adequate water need to have alternative measures taken.		Our well has been working without problems for more than 50 years. Taking measures that will jeopardize the existing adequately producing wells in Waterford would be counterproductive rather than helpful.		No	

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/7/2022 11:51	Yes	N/A	Yes	If people want to join together to pay for a shared well system, I don't see an issue with that.	No	I don't know the cost to residents so I can't support Option 3 at this time. What is an estimated cost to install water lines to the meter, fill and cap the existing 700' well, demo existing well tank, pump, and treatment system, and connect to existing in-house system? What is an estimate for the usage fee per gallon? Will the meter be at the property line? Will there be tap fees?	No	Location of meters in relation to sanitary sewer so residents can have the least expensive method for maintaining proper separation.		Cost estimate for owners, both initial construction and estimated usage rate.	No	No	
11/7/2022 11:55	Yes	N A	No	Doesnâ€™t solve the problem but only defers a solution (reliable community water supply for which costs are shared)	Yes	It is the most efficient solution.	Yes	Efficiency and long-term reliability.				No	
11/7/2022 11:56	Yes	"If not, please provide details": My answer was "yes." The form seems to be mis-coded, requiring a response here when it should not.	Yes	This arrangement already exists in Waterford, managed via easement. We are a rural area best served by well water; IF IT WOULD BE that the currently water-less homes could be served by a neighboring well, that sounds simple. If neighboring wells are not currently >8pgm, that would require new, unknown wells to be drilled at serious expense. Or if neighboring owners are not willing to enter into that easement, that also makes this option not very good! But, all this could be known.	No	Wells work fine except for the several houses where they don't; see Option 2. Option 3 is a giant development and construction project, changing the character of the town both in the infrastructure construction and its connection to the grid.	No	The facility should not be visible from roads.			No	No	

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11/7/2022 12:19	No	No to community water	Yes	County should help those who need it, protect preservation values with project to scale of issue, preclude further residential and commercial development in historic district, do not place burdens on those with perfectly good well water, protect the aquifer	No	Increases potential for residential and commercial development with no safeguards for protecting preservation values in historic landmark , county should support the minority who need water not put additional burdens on those who do not, puts pressure on aquifer, conservation easements preclude utilities	No	Get creative with a water solution for those who need it				No	
11/7/2022 12:29	Yes	We support Option 3. A community water system operated by Loudoun Water.	No	The community has been trying this method for 56 years, since the 1966 Water study came out and said Waterford has water issues and needs a water system. The concentration of businesses, churches and homes with water scarcity is too complex for an adhoc home owner driven plan. The Virginia Office of Drinking Water stated to me this is a not a project they would recommend the individuals in Waterford attempt.	Yes	Only viable solution to solve our acute water issues.	Yes	Starting an engineering phase quickly. How can we get started?		We would like to assist in any way to help accelerate this important Community Water Solution. How soon can we start design phase?	parcel owner 15520 Second Street	Yes	Our wells are dry. We buy and haul water from the town of Lovettesville.
11/7/2022 14:01	Yes	I support a water project	No	I already have a well	Yes	It will solve the longstanding water problem	Yes	design/cost				Yes	Highly sulferous and cloudy water from well

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11/7/2022 15:53	Yes	yes	No	noâ€”this will be a cause of problems between neighbors	Yes	Demand is equally spread.	Yes	gallons per minute				Yes	volume, taste, clarity
11/7/2022 19:06	Yes	I Do support it!! There is a flaw in this survey. I could not submit my form unless I filled in this box.	No	Completely infeasible. Also it is inadequate to meet even current needs, much less future water needs.	Yes	I would support this provided it would NOT require any household to give up its current well.	I'm not sure	No homeowner should be required to give up their current well.				No	
11/7/2022 19:10	No	I don't feel that it is needed. A water project will encourage wasteful water usage such a car washing and lawn watering.	Yes	Cheapest and won't impact people with good wells.	No	Not needed. A big waste of money.	No	Just don't impact my three properties.				No	
11/7/2022 19:32	Yes	I support the community water option 3 plan	No	Not successful in the past; short-term solution	Yes	Common sense.	Yes	appropriate design for the community well system so that it blends with the historic environment		Let's get going on this project. My property value is at stake.		No	

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11/7/2022 21:01	Yes	N/A	No	Not sure itâ€™s necessary and could see that leading to problems between neighbors.	Yes	Sounds like a more practical community option, but would hopefully be voluntary.	I'm not sure	Cost, impact to any historical structures, and people having a choice in what to do				Yes	I think I may have gotten bacteria or something from drinking my well water a couple times, so I only drink water brought in from outside now.
11/7/2022 21:57	Yes	I DO support a water project in Waterford and am not sure why my "Yes" reply is not registering in your survey. If you'd like to confirm that I DO support a water project, please call me 703.244.3347.	No	This Option has already failed. I shared my well with neighbors across the street. When the well failed, they did not have funds to contribute towards the new drilling(s) ~ i had to drill at least twice before hitting water ~ and I paid for all costs. Although not contractually required, I continued to provide water to the neighbors. As noted above, maintenance agreements and expired contracts make it nearly impossible to sustain shared wells.	Yes	This is the only viable solution to ensure the residents within the Village of Waterford have potable water, a basic human right.	Yes	Restrict the right to connect to this system, to the existing Village lots/buildings		THANK YOU!!		Yes	Quantity is the issue. The well has gone dry several times and we are extremely parsimonious.

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11/8/2022 5:23	Yes	I support yes. This survey is forcing me to type something in this field.	Yes	A "second choice" to Option 3 if Option 3 is not feasible.	Yes	Better guarantee of consistent water.	I'm not sure	As we have a good well I would support it for the sake of the town and if the cost was within reason.				No	
11/8/2022 8:07	Yes	I support the water project.	No	This option just does not appear to be a solution considering the lack of water in certain areas of Waterford that are currently experiencing water shortage and/or limited water availability. Maintaining a multi property agreement could also present a problem in the future if properties are sold to new owners.	Yes	This option appears to be most feasible and should provide a long term solution to the lack of water in the village.	Yes	Coordination with other projects in the village such as traffic calming measures and burying utility lines.			No	Yes	Our current well does go dry on occasion if we have guests. The well will recharge after a couple of days.
11/8/2022 8:56	Yes	We support a community water system.	No	The 1966 study found that we needed a community water system. We have tried to make indiviual and shared wells work for 56 years, and it has not.	Yes	On our property, we have no water and no prospects for water.	Yes	How fast can we start? Can we accelerate the design and engineering phase?				Yes	We have no water.
11/8/2022 12:50	Yes	I'm for public water.	No	It's not sustainable across the village.	Yes	It's best to share resources, and have water for all.	Yes	I would like to be on public water, but still have well water and cistern for the yard. Happy to pay for and maintain both. But we totally need the infrastructure for public water.				No	

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11/8/2022 13:29	Yes	NA	No	Should only be two(2) homes.Four homes make this option unacceptable.I believe this was done for that reason	Yes	In best interest of Waterford future	I'm not sure	Bury the wires must be done in conjunction with project				No	
11/8/2022 16:58	Yes	N/A			Yes	This will cover all households in case the water fails in other houses over time.	No	None				No	
11/8/2022 21:52	Yes	Na	No		Yes		Yes	None				Yes	
11/8/2022 21:57	Yes	N/a	No	Too political attempting to share between neighbors. Sets up for future relationship issues.	Yes		I'm not sure	How/if costs is passed to residents				No	
11/8/2022 23:18	No	many of the proposed solutions appear to exceed the extent of the problem. In addition, the process was tainted from the very beginning because the original applicant (who no longer lives in Waterford) gerrymandered the Village to	Yes	Whenever possible, private well water yield issues should be solved via private and targeted solutions.	No	In our opinion, this proposed solution exceeds the extent of the problem.	No	We don't believe Option 3 is a reasonable solution to solve private well water yield issues. Thus, in our opinion, there are no major design issues that need to be considered.		Focus on solving private well water yield issues via private and targeted solutions. In other words, don't use a sledgehammer to kill a fly. My 2 cents.	N/A	No	

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11/9/2022 7:22	Yes	None. We support the water project.	No	For reasons/challenges mentioned above.	Yes	Best long term solution to current challenges.	Yes	Location of wells and treatment facility		We recently completed drilling a well at this address with an approx. 3 gallon/minute yield, however we have not yet installed a pump or connected to the residence	40135 Main LLC	No	
11/9/2022 7:52	Yes	I said yes	No	Each home should have there own well	Yes	Itâ€™s best for the community.	Yes	Making sure there is sufficient water and water filtration			N/A	No	
11/9/2022 9:20	Yes	Strong support for Option 3!!	No	Prefer option 3	Yes	A more sustainable alternative to future proof the village against changes in climate affecting the water table and an option that provides better water access across the entire village.	Yes	Ease of connection and minimum disruption to gardens and structures.		Very excited to see this moving forward. Keep up the good work!	No	No	
11/9/2022 9:44	No	I think the project was initiated without adequate community wide conversation. Since then there was been community input but late in the game. late in the game for	Yes	It is the lowest impact, most community based solution.	No	I have NO CONFIDENCE in Loudoun Water. I lived here when the sewer was built. It was grossly overbuilt "for potential future demand" that was precluded by the historic naturre, covenants, etc of the historic village. It was grossly under subscribed, so all residences were forced to hook up. History will repeat itself with this project.	No	"Don't let the perfect be the enemy of the good." I can just see this project becoming too big, too extensive too coercive- but I'm afraid Pandora opened the box.		take a step back try to allow this problem, which I know is real, with a lighter, less intrusive less bureaucratic touch.	No	No	

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11/9/2022 9:54	Yes	need Water for the home owners in distress	No	does not solve the broad water need in the village	Yes	Economical and serves the community best	Yes	where the wells are located		We are in dire need of Water in Waterford - this is long overdue.		Yes	dry well and the well we use is non compliant in our house in the basement- so we can not sell our house if we needed to.
11/9/2022 10:17	Yes	Yes, we support option 3	No	Wells and shared private well has been the water model for the past 50+ years. This approach does not resolve access to water for many neighbors and Waterford properties do to underground geology, narrow or very small lots, etc. We prefer option 3.	Yes	Option 3 provides access to water for neighbors with limited water today and a more sustainable future for the village.	Yes	Ease of connection with minimal disruption to houses and gardens.		We own the adjacent tax parcel (both lots support option). Thank you for all of your efforts in moving this initiative forward! Keep going!		Yes	Our house is very water efficient (appliances and etc). There are seasons though where the well will need an overnight to replenish water sufficiently to keep the pump from shutting down.
11/9/2022 10:37	No	Again only minimal properties have little or no water flow	Yes	Only a few properties are experiencing low water.	No	Not enough properties have water problems	No	Only the few properties that need assistance so they could be accomodatex		My water supply is very good. NO water issues experienced in c 22 years.	N/a1 a	No	

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11/9/2022 13:35	Yes	Yes			Yes		Yes	Cost, Waterford is unincorporated with no mayoral representation, easement to prevent future development to connect to a central water system			40135 Main LLC, Member/Manager	No	
11/9/2022 16:25	Yes	I support a water project in Waterford	No	We've tried this for decades and it has failed to provide sufficient water.	Yes	This is the only viable solution to ensure Waterford,	Yes	Limit usage to existing lots within the Village only.		I am very grateful for your partnership!		Yes	Quality
11/10/2022 8:28	Yes	N/A	No	will not address water challenges in a comprehensive manner. will not address future water challenges in the Village.	Yes	will provide long term resolution to the Village's ongoing water challenges	Yes	Inclusion of bury the wires during the installation of the water system, if the water lines will run under the roads. Ensure the water system is only available to properties within the Village, so as not to increase development in the area.		Flow rate on my well is below 2 gpm		No	not potable per Loudoun Dept of Health. have UV light installed.
11/10/2022 16:22	Yes	i support a water system in waterford	No		Yes		Yes	i dont have any issues with supporting the water system				No	
11/12/2022 21:02	Yes	I support a water project	Yes	Private residents should have the option to solve their water concerns.	Yes	To ensure water safety and availability.	Yes	Accelerated design and implementation plan to more quickly address those residents without a safe and dependable water supply				Yes	Low yield well requires an undergrou nd storage tank to safeguard supply

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11/14/2022 13:13	Yes	I support a carefully-managed water project where collected property owners have actionable input on major decisions such as placement and design of the proposed treatment facility	No	Shared wells have worked in some isolated cases, but have also failed miserably in others. The homes in need donâ€™t appear close enough to other, better wells for this to be a viable solution.	Yes	I support as part of the overall 2033 effort. Main Street needs to be dug up and re-graded to fix major drainage and erosion issues. Water installation is an opportunity for multiple improvements, including burying power/data lines and fixing grading/drainage issues.	I'm not sure	Placement, design, and visibility of the treatment facility is a major concern. It needs to be architecturally appropriate and invisible. It should be located on or near Waterford Elementary. Water Street Meadow should not be touched and existing protection easements should remain unaltered.		Keep the treatment facility out of the Meadow. Drop it near the school where it will not impact existing view-sheds. Proposed location is definitely a problem. Also need to coordinate with other entities to ensure wires are buried and drainage issues are addressed during the construction process.		No	
11/14/2022 21:38	Yes	N/A			Yes	Waterford needs a water system and this is the optimal way to go!	Yes	Timeliness getting the project approved and started.		Timeliness getting the project approved and started.	Catoctin Presbyterian Church, Chair, Operations Committee	No	

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11/15/2022 9:27	Yes	I suppport the Water Project !!	No	some people would use more water, and deplete water supply for their neighbor	Yes	I trust Loudoun Water to give the infrastructure to have water to our homes, future demand is important to consider	Yes	the structures of Waterford that are historic and fragile, construction that would take the houses into consideration.		please help us get more water!!	N/A	Yes	low yield, no water upstairs, have to buy water in 5 gallon jugs and carry them up 3 flights of stairs to shower, i have to to the laundry mat to wash clothes, due to lack of water at house

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11/15/2022 11:36	Yes	We support a water project in general.	No	I foresee disputes or lack of agreement among neighbors which could ultimately stall the projects. In addition, this would be a piecemeal approach.	Yes	I would support this provided new wells do not adversely impact the flow of existing wells and the location is mutually agreed upon by property owners.	I'm not sure	This would be dependent on pricing (both up front costs and ongoing maintenance costs). It would also be dependent on the degree of disruption to bring inside the house. (ie. right now, our well is situated towards the back of the house and the water is piped into the house from the rear.		There is clearly a need for consistent clean and available water to be supplied to each building in the village. The key is to make it affordable and simple in order to minimize push-back.		No	currently share a well with our neighbor. Our original well ran dry. Our well is placed on a 3rd party's property. We are light users of water as both houses are single occupant homes. It is unknown if both houses had more occupants,
11/16/2022 12:05	Yes	we support a water project in Waterford	No	very complicated and will create more problems. We need a community system.	Yes	Our community needs a water system run be professionals.	Yes	Find ways to speed up the process. Some of us are really struggling with water scarcity.		we are grateful for the help to get our water problems resolved.		Yes	wells are very low yielding. my neighbors water use impacts my use as well.
11/17/2022 14:40	Yes	N/A	No	Waterford needs a long term solution to the water problem that we have been experiencing for many decades.	Yes	Waterford needs a reliable and safe source of water for drinking and cooking.	Yes	Finding wells that provide an optimum amount of water for the community.		Timeliness getting the project approved and started.	Catoctin Presbyterian Church, Chair, Operations Committee	No	

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11/17/2022 16:56	No	one is needed based on current status, which is - as I understand it - that few residences have a significant water problem. Concerned that the cost of a water project would result in significant increases in property-based	Yes	This would more likely limit the costs to the residences that actually have a shortage of water.	No	Too expensive. Unless the cost of construction is borne by a charity or the government.	I'm not sure	Again - is it needed?, how much will it cost, and who paya for it?			N/A	Yes	Minor issues with iron in the well that jave been resolved by a filtration system.
11/18/2022 16:53	Yes	I support a water project.	No	I do not think this is practicable or sufficient.	Yes	Many homes in Waterford do not have stable and sufficient water. Option 3 would provide relief and a modern standard of supply and quality.	Yes	I would like the system to be able to provide water during power outages for at least 24 hours.				No	
11/18/2022 16:57	No	Until the need is defined as necessary, I will not support a water system in Waterford.	No	It's not comprehensive, more piecemeal like.	Yes	Only if the need was clearly define and was suefficient to warrent the investment	I'm not sure	That if implemented, it should be seemless. And undetectable that anything was ever done to the village and its enviroment.		I believe most far minded residents would approve a water project if the need can be defined and shown to be suefficient to warrent the costs.		No	

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11/18/2022 20:02		Unsure, depending on cost and timing and other factors	No	costs and uncertainty of cooperation and likely negative impact on property value		possibly, depending on costs and disruption	I'm not sure	ease and costs of connection			no	No	
11/21/2022 12:01	Yes	N/A	No	Not a good long term solution as it depends on individual agreements which may not last over the long term. Also no consistent guidelines to ensure consistent water quality as individuals may only implement minimal filtration configurations.	Yes	This option would create a reliable water source for the entire community that meets appropriate drinking quality standards. This option is also scaled appropriately for the Village to use needed water at Foundation properties facilitating their long term preservation and adaptive reuse.	Yes	That wells and water processing site are appropriately placed in the Village				Yes	Quality suffers from regular coliform contamination and high manganese and iron content
11/21/2022 13:14	No	We feel that it is not needed.	Yes	Least expensive, less impact, people will continue to conserve	No	Too expensive, encourages wasteful water use	No	Not impact my property or water supply				No	
11/21/2022 13:18	Yes	Absolutely support!!	No	Complicated and can create additional oversight issues that ultimately does not resolve water shortages. Legal expenses could arise as well.	Yes	Allows us to have confidence in water quality and quantity. My home has lead pipes and I worry about my water quality.	Yes	Easily accessible, appropriate location within the Village, not overly expensive to connect to.		New owner and I have two lots, one of which I would like to build on.		Yes	Low pressure

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11/21/2022 13:36	No	scam. Loudoun County did not follow its own rules for project submission. The village of Waterefor d NEVER voted to submit an application. A small subset of residents submitted the application without Village consent. Loudoun County	No	My well is working. I do not need to share a well to solve a problem I do not have.	No	My well is working. I do not need to share a well to solve a problem I do not have.	No	There is no option for leaving residents who do not have well problems out of the design and billing for costs of the project.		A SMALL number of residents in Waterford have a problem with their wells. I will not pay tens of thousands of dollars to fix someone else's problem, let alone paying to fix well problems for non-Waterford residents. They can drill new wells. I do not support a study conducted in secret.		No	

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/21/2022 17:15		Unclear until I better understand the approximate cost for quarterly payments per residence.	No	Like the person that put forward question 6 in the Presentation Questions, I do not believe this option is practical for the reason stated in the question.		I cannot select yes or no to the question at this time. The primary concern is the quarterly bill. In the presentation it showed an example of a quarterly bill of $80. I believe this is very misleading if my calculations are correct. Instead, the number would well over $1000. If correct, I suspect that would be beyond many people's ability to afford. If I am wrong, please provide step by step calculations for an estimated debt payoff plus operating cost leading to a quarterly bill.	I'm not sure	Clarification of cost of option 3			NA	Yes	i have a great deal of cast off of stone particles from the side of the well. I also have iron which was visible at the time the well was drilled. I installed a filter system to address both problems.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 10:35	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	No current water supply, which limits use of the barn.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 10:40	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	No	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	Non-residential properties on small lots and/or environmentally compromised lots do not have access to private water supplies, and the lack of water limits their opportunities for preservation through adaptive reuse.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	This property currently has no water supply, and the ability to drill a well on the property is impaired due to the parcel size and past environmental contamination.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 10:42	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	Non-residential properties on small lots and/or environmentally compromised lots do not have access to private water supplies, and the lack of water limits their opportunities for preservation through adaptive reuse.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	Currently served by a shared well on a neighboring property. Limited supply limits commercial use of the building, and our access to the water is controlled by a third party.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 10:44	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	Non-residential properties on small lots and/or environmentally compromised lots do not have access to private water supplies, and the lack of water limits their opportunities for preservation through adaptive reuse.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	This property currently has no water supply, and the ability to drill a well impaired by the small lot size and proximity to neighbors and the street.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 10:47	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	I'm not sure	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	No	

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 13:28	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	The current water supply for this property is not potable.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 13:29	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	No	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	No	

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 13:32	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	existing well has failed water quality tests intended to establish the supply as a regulated water source. The use of this building is limited because the water supply is not regulated. The Old School could better serve the

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 13:34	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	No	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	No	
11/22/2022 14:14	No	We have lived here over 40 years. With holding tanks in the basement, plus the water held in the 18" diameter well, 600+ feet in depth, provides enough water.	No	Option 2 is better than 3, but we do not support either. They are unnecessary, expensive, and will increase development pressures. As long as no one	No		No	County has sole authority to expand the district and that would mean more development and endanger Waterford's National Historic Landmark status.		Ensure that project does allow present landowners to create secondary residences on their property nor water their lawns.	no	No	

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 16:20	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	Non-residential properties on small lots and/or environmentally compromised lots do not have access to private water supplies, and the lack of water limits their opportunities for preservation through adaptive reuse.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	n/a	Yes	This property currently has no water supply and the ability to drill a well is impaired by the size of the parcel and proximity to neighbors. Use of the building for almost any purpose is limited because of the lack of water.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 16:22	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	No current water supply, which limits use of the property.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 16:24	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	Yes	Non-residential properties on small lots and/or environmentally compromised lots do not have access to private water supplies, and the lack of water limits their opportunities for preservation through adaptive reuse.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	Yes	No current water supply and restroom facilities are needed for the school field trip program.

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/22/2022 16:26	Yes	n/a	No	Option 2 is limited to residential homes, and our properties are not residential.	Yes	This is the only studied solution that could supply water to non-residential properties. In addition, a reliable and secure water supply is critical to the long-term viability of Waterford as a living village.	No	All community water solutions must fit within the character of the National Historic Landmark and respect existing conservation easements, with proper approvals from easement holders. Water quantity/quality is a major limiting factor in the use of our historic properties for public benefit.		We would like to assist the County to start this project as soon as possible. How can we accelerate the timeline for option 3 completion? Is it possible to use funds in the DGS Water & Wastewater Program to start on design and engineering this winter? We appreciate your assistance to date and look forward to seeing option 3 as an official funded project with Loudoun County.	Waterford Foundation, Inc.	No	
11/22/2022 19:01	Yes	I said yes	Yes	This allows those in need of water to have it, and those who have no issues with water to maintain their existing water system.	No	No outside company should own our water.	No	serving those who need water and allowing those who don't need it to keep their existing systems.				No	
11/22/2022 22:55	Yes	n/a	Yes	Seems to be the least invasive	No	Donâ€™t want to see any of our beautiful open spaces taken up by a water treatment plant	I'm not sure	Location. The integrity of the Landmark depends on preserving the viewshed and our open spaces.			n/a	No	

Submission Date	Do you support a water project in Waterford?	If no, please provide details.	Do you support Option 2?	Why or why not?	Do you support Option 3?	Why or why not?	If a community system were offered under Option 3, would you connect?	What are the major issues you would like to be considered in the design of this project?	Are you experiencing issues with your water?	Please provide the project team with any additional information that you feel will improve the project.	Are you representing an organization, business or faith community? If so, please indicate the name of the organization and your title:	Are you experiencing any issues with water quality or quantity?	If "Yes," please describe the issue(s):
11/23/2022 8:45	No	Again only minimal properties have little or no water flow	Yes	I have abundant water and have problems with supply. Most properties in the village do not have issues with water. It's should individual properties have do have issues should be targeted by Option 2. The cost and disruption of a general public water system will only bring development and more houses within the village and outside the immediate village boundaries. It will destroy the inherent character of the village that residents and the have worked for 50 years to attain and preserve .	No		No	Only the few properties that truly need assistance so they could be accomodated		The property owners who have moved into the village in the last tens years were used to unlimited water which wells can not provide. They are trying to force through a costly and disruptive plan at the expense of residents who abide by the restrictions of well usage. Option 3 will destroy Waterford and its historic designation. These new property owners just want to make their homes more valuable.	N/a1 a	No	
11/23/2022 12:00	Yes	n/a	Yes	more targeted to problematic areas	No		No	impact to existing wells, if any.				No	
12/5/2022 17:07	No	See document uploaded below	Yes	A qualified yes because Option 2 is a viable solution based on known yields of selected private wells that are strong producers. However, Option 2 may not be possible under Loudoun Water.	No	See uploaded document below.	No	No structures on eased properties, no destruction of streetscape or impact on the historic village.			no	No	

LOUDOUN COUNTY VIRGINIA | Planning and Zoning

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MEMORANDUM

To: Ernie Brown, Director
Department of General Services

From: Daniel Galindo, Director
Department of Planning and Zoning

CC: Tim Hemstreet, County Administrator
Charles Yudd, Deputy County Administrator
Joe Kroboth, Assistant County Administrator
Erin McLellan, Assistant County Administrator

Date: January 26, 2023

Re: Paeonian Springs/Waterford Water & Wastewater Interconnection

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NOTE: This memorandum revises and replaces the November 28, 2022 memorandum on this topic.

As requested, the Department of Planning & Zoning (DPZ) has conducted an analysis of any conflicts within the *Loudoun County 2019 General Plan* (2019 GP) and the Revised 1993 Loudoun County Zoning Ordinance that may exist with respect to developing a water and wastewater connection between the Village of Waterford and Village of Paeonian Springs. The following summarizes the findings. This memo is not an official determination from DPZ but a summary of research. If your work necessitates a formal determination, please advise and we will convert the information to the appropriate document.

Comprehensive Plan Analysis: DPZ has reviewed the documents provided by the Department of General Services (DGS) pertaining to the proposal to connect future community water and wastewater facilities for the Village of Paeonian Springs with the existing and proposed facilities for the Village of Waterford. The policies of the 2019 GP encourage public water and wastewater facilities to provide services to the existing Rural Historic Villages, including Paeonian Springs (Ref: 2019 GP, Chapter 2, Rural Historic Villages, Design Guidelines, text). Specifically, the policies of the 2019 GP support construction of community systems for existing rural communities, such as Paeonian Springs, facing a potential public health risk (Ref: 2019 GP, Chapter 6, Rural Policy Area-On site and Community Systems, Action 4.6.C.). A Commission Permit is required to establish a defined service area, prior to the construction of any community water or wastewater system (Ref: 2019 GP, Chapter 6, Rural Policy Area-On site and Community Systems, Action 4.6.E.). Connections to water distribution and wastewater collection systems are prohibited outside the defined service area, ensuring that those properties located within the Rural Policy Area (RPA) that will be

crossed by sewer and water infrastructure between the two villages will be unable to tap into the systems (Ref: 2019 GP, Chapter 6, Sewer and Water, Countywide Strategies, Action 4.2.B.). Those properties outside the defined service area in the RPA that are crossed by sewer and water infrastructure would be required to have restrictive easements placed on the property that would prohibit connections to the community water and wastewater system.

DPZ Staff has also had ongoing discussions with DGS Staff and supports the Final Overall Paeonian Springs Service Boundary which captures the core of the historic Village of Paeonian Springs, and all the properties identified with failing or older septic systems. The details of the study are outlined in the Technical Memorandum provided by DGS and attached to this memorandum.

Zoning Analysis: Article 8 of the Revised 1993 Loudoun County Zoning Ordinance (Zoning Ordinance) defines communal sewer and water systems as follows:

> *Sewer, Public**:** A central, communal or municipal wastewater treatment system serving more than two (2) lots owned or operated by a municipality, the Loudoun County Sanitation Authority (LCSA), or a public sewer (wastewater) utility as defined in Chapter 10.1 or 10.2 of Title 56 of the Code of Virginia, for the collection, treatment and disposal of sewage.*
>
> > *Sewer System, Central**:** The sewage treatment system for Eastern Loudoun County owned and operated by the LCSA that is served by the Blue Plains and/or Broad Run treatment plants, and/or capacity supplied by the Upper Occoquan Sanitary Authority.*
> >
> > *Sewer System, Communal or Communal Wastewater System**:** A sewage treatment system for the collection, treatment and/or disposal of sewage operated and or owned by LCSA, or operated by a public sewer (wastewater) utility as defined by Chapter 10.1 or 10.2 of Title 56 of the Code of Virginia that is designed to serve small scale development, including clusters, where permitted by this Ordinance. Such system may serve only one lot, where a communal system is required by this Ordinance for a specific use.*
> >
> > *Sewer System, Municipal: A sewage treatment system that is owned or operated by one or the incorporated towns within Loudoun County.*
>
> *Water, public**:** A central communal or municipal water supply system serving more than two (2) lots owned or operated by a municipality or the Loudoun County Sanitation Authority (LCSA) or a public water utility as defined in Chapter 10.1 or 10.2 of Title 56 of the Code of Virginia for the purpose of furnishing potable water.*
>
> > *Water Supply System, Central**:** The water supply system for Eastern Loudoun County owned and operated by the LCSA for which the source*

of water is purchased from the City of Fairfax and County of Fairfax water supply system.

*Water Supply System, Communal**:** A water supply system owned or operated by the LCSA or a public water utility as defined in Chapter 10.1 or 10.2 of Title 56 of the Code of Virginia that is designed to serve small-scale development, including clusters, where permitted by this Ordinance. Such system may serve only one lot, where a communal system is required by this Ordinance for a specific use.*

*Water Supply System, Municipal**:** A water supply system that is owned or operated by one of the incorporated towns within Loudoun County.*

The Zoning Ordinance currently permits the use of communal water and wastewater systems in the following circumstances:

- As part of a cluster subdivision option in the AR-1 and AR-2 zoning districts;
- As part of a Rural Hamlet Development in the A-3 and A-10 zoning districts (Section 5-702(I));
- For Town or County public uses in the JLMA zoning districts;
- In the Transition Residential (TR) zoning districts, pursuant to the additional regulations in Section 5-621;
- In the Planned Development-Rural Village (PD-RV) zoning district;
- As a requirement in the Limestone Overlay District (LOD) for subdivisions containing 15 or more lots;
- For the "Rural Retreats and Resort" use (Section 5-601(D)(5)); and
- For the "Country Club" use (Section 5-660(G)).

Except as expressly allowed, the Zoning Ordinance currently prohibits the use of communal water and wastewater systems in the following circumstances:

- The A-10 zoning district (Section 2-307(B) and (C))
- The A-3 zoning district (Section 2-406(B) and (C))

The Paeonian Springs Village Conservation Overlay District currently contains the following underlying zoning districts: A-3, CR-1, CR-2, and RC.

- As noted above, the use of communal systems in the A-3 zoning district is prohibited. However, the Final Overall Paeonian Springs Service Boundary does not include any property in the A-3 zoning district.
- The CR-1 and CR-2 zoning districts require the use of public sewer for developments using the cluster and compact development cluster options. This would be in the form of a communal system if central or municipal systems are not available at the site.
- The Paeonian Springs area did not develop using the cluster or compact cluster option, as it was developed before these zoning districts were established in 1993.
- The Zoning Ordinance does not envision using communal sewer systems for non-cluster development options in the CR-1 and CR-2 zoning districts. However, CR-1 and CR-2 district regulations indicate the districts were for areas zoned R-1 under the 1972 Loudoun County Zoning Ordinance that were

not served by communal or municipal systems. New development in CR-1 and CR-2 is actually encouraged to utilize public (communal) systems in these areas to preserve open space. Therefore, it would be permissible to allow a communal system to serve existing development that predated the current regulations, such as Paeonian Springs.

- The RC zoning district is silent on utility requirements and would follow the policies of the 2019 GP.

Based on the above analysis, the Zoning Ordinance Rewrite project proposes to amend zoning district regulations for districts within the RPA to allow the use of communal systems to address public health issues. Until such time, the Zoning Administrator can consider an interpretation of the current Zoning Ordinance to permit the limited use of communal systems to address a public health risk.

Specific to the questions raised in your September 27, 2022 email to Joe Kroboth, I offer the following:

1. Would a Comprehensive Plan Amendment (CPAM) be required?

   No. DPZ finds the proposal to connect future community water and wastewater facilities for the Village of Paeonian Springs with the existing and proposed facilities for the Village of Waterford is supported by the policies of the 2019 GP. The proposal will not require any amendments or revision to the existing policies of the 2019 GP that would require a CPAM.

2. Could a Commission Permit (CMPT) be established for the full connection route, and in turn prevent service connections along the route?

   As part of the CMPT application, the County should define a proposed service area boundary in accordance with applicable 2019 GP policy. Through its review of the CMPT application, the Planning Commission will determine whether the proposed service area is consistent with the 2019 GP. Since a CMPT approval cannot include conditions of approval established by the Planning Commission, the CMPT plat should specify that connections outside the service area would not be permitted. However, restrictive easements should also be placed on any properties outside the approved service area that are crossed by sewer and water infrastructure to prohibit connections to the community water and wastewater system.

Attachments:

1. Paeonian Springs Water & Wastewater Boundary and Treatment Alternatives Technical Memorandum, April 2022