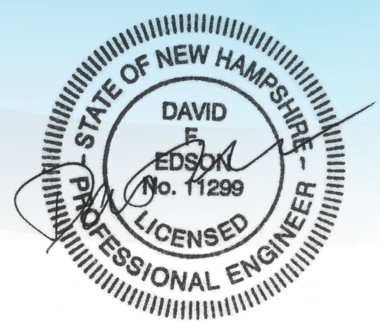

# Water System Feasibility Assessment Final Report Hollis, New Hampshire

Project No. 22.143901.00

**November 2022**

Prepared for:
Town of Hollis, New Hampshire




HOYLE TANNER

Trusted Experts | Innovative Results

# Table of Contents

Executive Summary ii
1. Background 1
1.1. Purpose and Scope of the Feasibility Assessment 1
1.2. Water System History 1
2. Current System Description 4
2.1. Facilities Currently Served 4
2.2. Source of Supply 6
2.3. Distribution Piping 7
2.4. Distribution Storage, Booster Pumps and Fire Protection 10
2.5. Estimated Water Demand 10
3. Alternatives Assessment 12
3.1. Alternative A: New Town Water System Utilizing Shallow, Overburden Wells 12
3.1.1. Shallow Groundwater Availability 13
3.1.2. System Concept 15
3.2. Alternative B: New Town Water System Utilizing Deep Drilled, Bedrock Wells 17
3.2.1. Bedrock Groundwater Availability 18
3.2.2. System Concept 19
3.3. Alternative C: Continued Use of School System with Recommended Improvements 22
3.3.1. Source of Supply 23
3.3.2. Distribution Piping 23
3.3.3. Water Storage 24
3.3.4. Summary 24
3.4. Alternative D: Individual Deep Drilled, Bedrock Wells 25
4. Comparison of Alternatives & Recommendations 27
4.1. Comparison of Alternatives 27
4.2. Recommendations 29
APPENDIX A: Regulatory Requirements for a New NTNC Water System 30
APPENDIX B: Opinions of Capital Cost 33

# Executive Summary

The Hollis School District owns and operates a public water system (PWS #1175030) that serves three school buildings, four town-owned buildings and three private residences. The Town of Hollis ("Town") retained Hoyle, Tanner to assess alternatives for future water service to the non-school properties. The alternatives considered included:

- A: A New Town Water System Utilizing Shallow, Overburden Wells
- B: A New Town Water System Utilizing Deep Drilled, Bedrock Wells
- C: Continued Use of School System with Recommended Upgrades
- D: Individual Bedrock Wells for the non-school Buildings

The least expensive alternative appears to be D, however, risk factors could significantly increase its cost or even render the alternative infeasible depending on the results of the well drilling. Alternatives A and B involving a new town water system are most expensive in terms of capital cost plus the recurring annual costs for administering, operating, and maintaining a new public water system.

Based on the evaluation performed and presented in this report, Alternative C offers the best value for the Town considering cost, operating and risk factors. The current school system has been in service for about 50 years, is fully operational and permitted, appears to be well managed and is in compliance with New Hampshire public water system regulations and requirements. Additionally, the Town is served by the system with no direct costs assessed by the school department.

The recommended upgrades to improve current system reliability and sustainability can be implemented in two steps:

<u>Step A</u> which includes the addition of a second well and emergency backup power at the Rocky Pond well site; operational upgrades at the well pumping station; and replacement of unreliable distribution piping serving the non-school buildings from the Middle School through the town center to the Lawrence Barn.

<u>Step B</u> would include adding a 24,000-gallon water storage tank and pumping/control facility to be tentatively located at the Lawrence Barn town property.

The opinions of capital cost are $796,000 for Step A and $497,000 for Step B. Potential cost savings could be achieved if both steps are done simultaneously. Each step would likely take 16 to 24 months to complete. All costs presented are in current dollars.

# 1. Background

## 1.1. Purpose and Scope of the Feasibility Assessment

The Hollis School District owns and operates a public water system (PWS #1175030) that serves three school buildings, four town-owned buildings and three private residences. According to New Hampshire Department of Environmental Services (NHDES) records, the system is a non-transient, non-community (NTNC) water system meaning it serves 25 or more of the same people at least 60 days of the year but less than 15 service connections serving year-round residents or at least and 25 year-round residents.

This study was performed as requested by the Town to assess the feasibility of a new Town water system separate from the school system including a new well supply. Alternatives evaluated included:

- A: New Town Water System Utilizing Shallow, Overburden Wells
- B: New Town Water System Utilizing Deep Drilled, Bedrock Wells
- C: Continued Use of School System with Recommended Upgrades
- D: Individual Bedrock Wells for the non-school Buildings

## 1.2. Water System History

It is believed that the water system dates to 1973 comprised of the dug well and pump house at its current location piped to buildings identified at the time as the Junior High School (now the location of the Primary School), the Elementary School, the High School (now the location of the Middle School), the High School White Building, the Police Station (now the location of the Old Fire Station), the Town Hall and Nichols Field House.

In 1987, an agreement (the "Water Use Agreement") was executed between the School District and the Town to define water service to additional town buildings and two residences. The non-school users named in the agreement included the Police Station, Town Hall, Nichols Field House, and private residences at 20 Main Street (the Wheeler House), 24 Main Street (the Block) and 27 Main Street (the Coniaris residence and one apartment).

The following is a chronological listing of developments and events from documentation provided by the Town and school system to provide historical perspective and understanding.

4/16/87 – Water Use Agreement was signed for the Hollis School District to share water from a well on its property with the Coniaris residence, "The Block", The Wheeler House, the Police Station, Town Hall, and Nichols Field House (also known as the Lawrence Barn).

9/17/91 – A report from Superintendent Arthur LeBlanc to the Hollis Board of Selectmen proposed two detailed options for the Nichols Field water supply and irrigation system.

2/16/94 – Active Maintenance Contract Inspection from Skillings & Sons reported the following service points as functioning properly: the pump house on Rocky Pond Road, tank chamber at Hollis Junior High School, pump and tank chambers at Hollis Elementary School, and tank chamber at Hollis High School.

9/30/94 – Draft report by unknown author presented three pressing issues the Town would have needed to address (in the near future): new regulations on water quality standards from the EPA for lead and copper, the age and inadequacy of the current water system, and the desire for a broader area of service to the Town. The report also presented four options to deal with the concerns: do nothing, continue Town ownership of the system and perform
upgrades to improve reliability/ meet regulatory requirements and provide for expanded service, hire a company to operate and maintain the system under a contract, or convey the water system to a utility company.

7/14/03 – Lab results of water tested from Nichols Field showed a health risk parameter, total coliform, present and exceeding the limit recommended by the EPA and/or NHDES.

9/21/05 – Skillings and Sons responded to a request from SAU 41 to improve water pressure at the middle school and proposed the solution of installing an atmospheric storage tank and a set of duplex centrifugal pumps to remove the stored water from the holding tank and pressurize it to 70 psi +/- to feed the school.

8/06 – 2" CTS plastic pipe water line was installed at the rec field next to Lawrence Barn.

8/15/06 - Lab results of water tested from Nichols Field showed both aesthetic and health related problems associated with the sample, including magnesium and pH outside of the acceptable levels.

7/31/08 – An emergency repair was made to the water line under the sidewalk near 16 Depot Road.

12/24/08 – A repair was made to the water line near the Town Hall. The valve in the manhole at the rec field was removed because it was leaking.

9/16/10 – A memo from SAU 41 reported Rocky Pond pump house was not able to supply enough water. The least expensive remedy, with the quickest turnaround time was implemented. The pumps were replaced and changed from 10hp motors to 3hp motors. The 3hp motors are shorter in overall pump height and when they both run at the same time, they continued to produce the same amount of PSI in the system as one 10hp motor. As the 10hp motors were drawing in air, the 3hp motors (because they are shorter) gave 11" (inches) of additional water height to work with as a short-term solution. Two new flow meters were installed, and one was repaired. Water conservation measures were taken while monitoring water recovery in the wells. A minor leak was discovered on the town side of the water distribution system near the old fire station and was repaired. The water supply issue was still of extreme concern and the report did not include a final solution.

11/5/10 – Report from Provencher Engineering described in detail the state of the distribution system as it existed in 2010 and proposed the following future and immediate recommendations for the system: develop a leak detection program, develop a water loss assessment program, assess Rocky Pond Well Source, separate out irrigation water from the system/develop separate irrigation source, replace and upgrade portions of the distribution system, provide more atmospheric storage and pumping redundancy in the system, evaluate Interconnecting the North and South Distribution Systems, provide emergency backup generator power at Rocky Pond Pump Station, investigate a fee-based system for residential and municipal connections, develop a Water Supply Capital Improvement Fund.

8/23/11 – A repair with brass fittings was made to the water line near 20 Depot Road.

9/27/11 – Lab results of water from a new irrigation well (640’ deep, 8” casing) at Lawrence Field showed no parameter results over the maximum contaminate level.

9/28/11 – Skillings and Sons conducted a water test on the new well at Lawrence Field for a possible new water system. Well produced 6 gallons per minute. Water reportedly could be heard coming in at about 20’ – 21’ (bottom of casing).

10/7/2011 – Rocky Pond pump station experienced several coliform and two E.coli bacteria hits at HBMS in the kitchen sink and nurse’s office sink. Resampling on 10/8/11 resulted in negative E. coli. HPS and HUES kitchen were positive for total coliform. Sampling at well showed a clean source. A chlorinator was installed at the well head. Led to Boil Water Order.

10/10/2011 – System was shocked with 10ppm CL solution in distribution piping due to the testing results of 10/7/11. Chlorination was adjusted to continuous dosing of 1-2 ppm on 10/11/11. Temporary CL injection was stopped 10/12/11.

10/17/2011 – Retesting revealed counts of coliform at HBMS and HUES.

11/18/2011 and 11/16/2011 – Two consecutive tests were clean of coliform; Boil Water Order was lifted conditionally.

12/2/2011 – Water pressure test revealed 1.5 GPM leak somewhere between Rocky Pond pump station and Proctor Hill Rd.

12/5/11 – Hollis Water Update presentation by SAU41 outlined sampling hits of coliform and E. coli within the schools, and the corrective actions taken.

12/15/20 – A repair was made to the water line near 16 Depot Road. The sidewalk and road were scheduled to be fixed in the spring.

# 2. Current System Description

This section addresses the facilities currently served, source of supply, distribution piping; distribution storage, booster pumps and fire protection; and estimated water demand.

## 2.1. Facilities Currently Served

The school system currently serves 10 buildings as summarized in Table 2-1 and shown in Figure 2-1. The Rocky Pond Well is the water source for the current system. There is an abandoned well for which there is no available information other than it was accessed via an underground vault. At Nichols Field there is either one or two wells that serve the “Snack Shack” and field irrigation system. The number and location of the well(s) were not confirmed during the assessment. The High School Wells serve the high school, which is a separate non-transient, non-community system and is not connected to the subject water system. The High School wells are discussed further in a section pertaining to bedrock groundwater availability.

**Table 2-1.** Facilities Served by the Water System

| | Facility Served | Comments |
|---|---|---|
| 1 | Primary School | Served by booster pump station with buried gravity and pressure tanks, both 7’ diameter, 6,000 gallons. Has fire suppression system. Has approximately 439 staff and students during the school year, and 10 staff during the summer. |
| 2 | Upper Elementary School | Includes underground vault with pressure tank. Has fire suppression system. Has approximately 425 staff and students during the school year, and 8 staff during the summer. |
| 3 | Middle School | Has fire suppression system |
| 4 | Farley Building | Town-owned |
| 5 | Town Hall | Town-owned |
| 6 | Lawrence Barn | Town-owned |
| 7 | The “Block” | 24 Main St, privately owned by John Plummer, Inc. |
| 8 | The Wheeler house | 20 Main St, privately owned by the non-profit Hollis Historical Society |
| 9 | The Old Fire House | Town-owned, managed by Hollis Historical Society |
| 10 | Private Residence | 27 Main St |

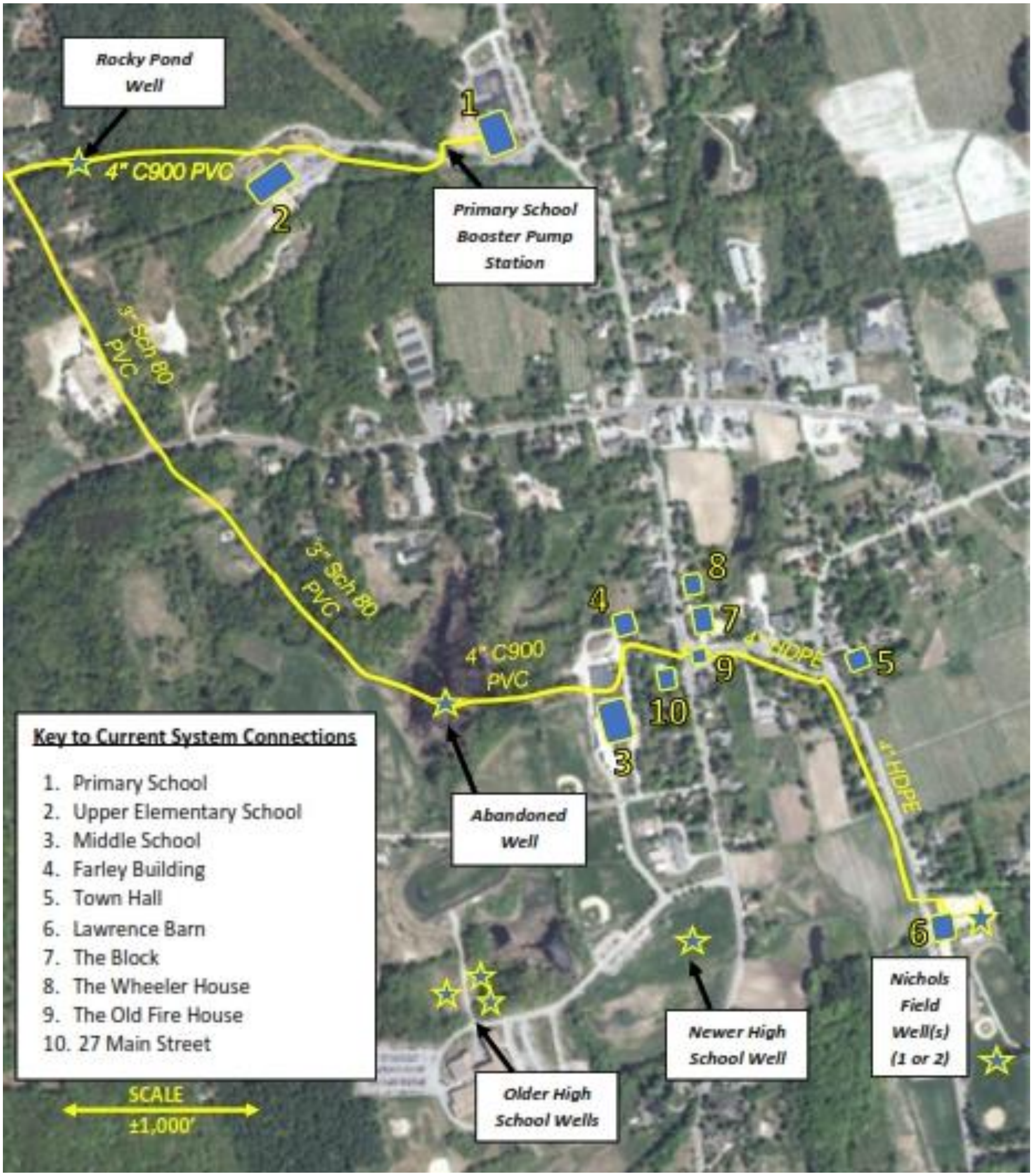



**Figure 2-1.** Water System Location Map

*(Note: The pipe sizes and materials information shown is from a 2010 report by Provencher Engineering and may not be entirely accurate according to other information reviewed for this report.)*

## 2.2. Source of Supply

The source of supply to the system is a shallow, dug well (the Rocky Pond Well) located east of Rocky Pond Road between Deacon Lane and Willoughby Lane. According to a 2010 engineering report[1], the well structure is a 52” diameter concrete caisson set below the floor of the pump station. An earlier evaluation report[2] indicated the well to be about 10 feet deep. A floor plan layout from the 2010 Provencher report is reproduced as Figure 2-2.

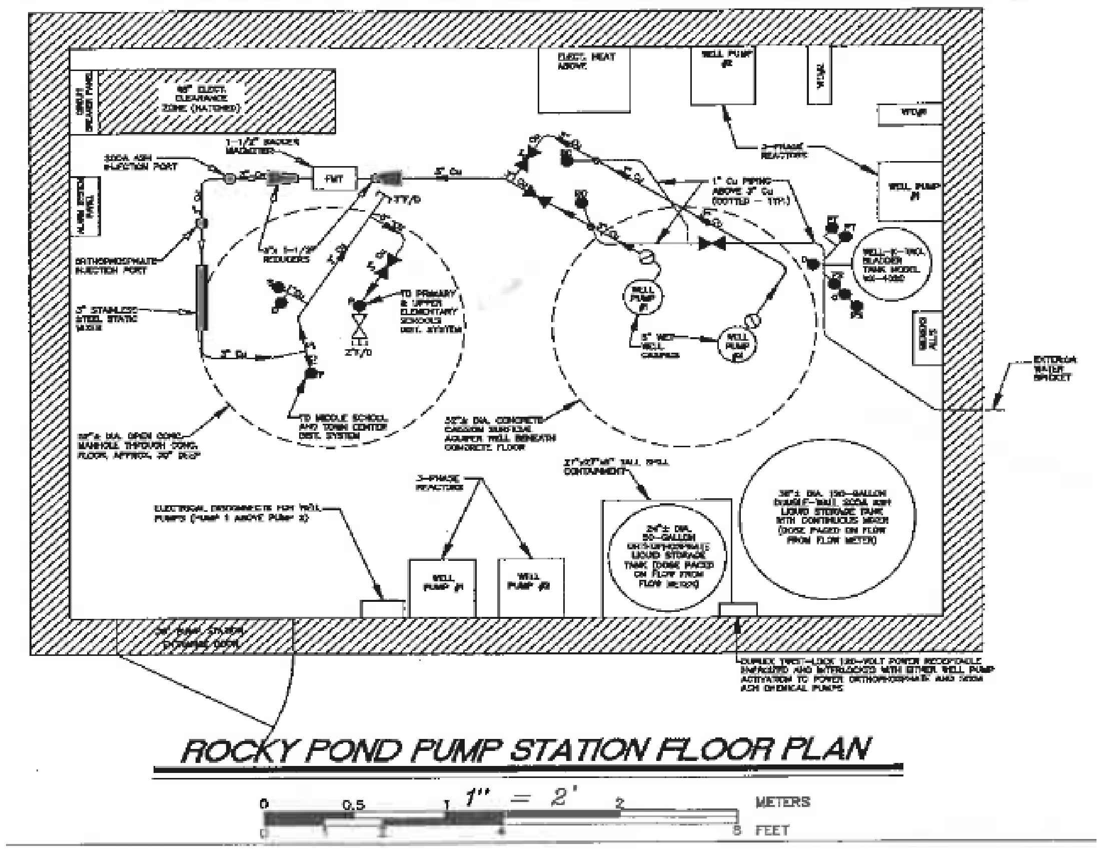



**Figure 2-2.** Well Pump Station Floor Plan Layout, 2010

Two submersible pumps are set in the well in 8” diameter casings. The pumps discharge to a common pipe and are equipped with variable frequency drives to maintain a set discharge pressure of 120 psi (pounds per square inch). Normal pumping rate is reportedly 35 gpm (gallons per minute). The well water is treated with soda ash and orthophosphate (Carus 8700) for corrosion control and is disinfected with sodium hypochlorite.

According to water quality reports submitted to NHDES over the years, the well water is generally of high quality requiring relatively little treatment. The water is very soft with little hardness and low alkalinity and is low in such parameters as nitrates and nitrites, sulfates, iron, manganese, sodium and chlorides.

[1] Provencher Engineering, LLC, *Overall Water Supply System Evaluation and Recommendations, Public Water Supply – Hollis School District, Hollis New Hampshire*, November 5, 2010 hereinafter referred to as the “2010 Provencher Report”

[2] R.H. White Construction Company, Inc., *Preliminary Study of the Hollis School Department Water System*, October 1981

Volatile organics, radionuclides and coliform bacteria are reportedly absent. Corrosivity due to the soft nature of the water is treated with the chemical additions mentioned above. There are no water quality violations noted on the NHDES website; available records of results from samples taken for the Total Coliform and Lead and Copper Rules are all in compliance.

Potential concerns relative to the Rocky Pond Well include:

- Drawdown limitations of a very shallow well which could reduce the pumping capacity at times,
- No source redundancy because of reliance on a single well

The 2010 report recommended the addition of backup power and the installation of a water level sensor in the well to monitor drawdown. The water level sensor has since been added but not backup power.

## 2.3. Distribution Piping

The distribution piping is reportedly a mix of 3" Schedule 80 PVC, 4" AWWA C-900 PVC and 4" HDPE and possibly some copper piping around the Middle School. Among other considerations are that each type of pipe material generally utilizes different types of pipe joints (glued, push-on, fused and soldered, respectively) and require adapters at the transitions. Table 2-2 contains a summary of the pipeline segments based on the limited information available. The total length of pipeline is estimated to be a bit over 10,000 feet (almost 2 miles). This summary does not include the service lines to the buildings, the irrigation piping, or the interior building plumbing.

**Table 2-2:** Estimated Distribution Pipeline Lengths and Materials

| Pipeline Segment | Length (ft) | Material |
|---|---|---|
| Rocky Pond Well to Elementary School | 2,000 | 4" C-900 PVC |
| Rocky Pond Well to Rocky Pond Road | 500 | 4" C-900 PVC |
| In Rocky Pond Road to Proctor Hill Road | 1,860 | 3" Sch 80 PVC |
| Proctor Hill Road to the Abandoned Well | 1,960 | 3" Sch 80 PVC |
| Abandoned Well to Farley Building | 1,200 | 2.5" Copper |
| Farley Building to Lawrence Barn | 2,600 | 4" HDPE |

If the entire pipeline were subject to a standard AWWA pressure test, the allowable leakage based on length would calculate to be about 2 gallons per hour[3]. Estimates of past system leakage of 1 to 2 gpm are 50 to 100 times greater than that considered acceptable by AWWA.
Pipeline breaks have been documented and are located on Figure 2-3 on the next page. This list is not considered exhaustive; based on discussions with Town staff, there have been other past leaks and repairs for which there is no documentation available. As can be seen, most of the documented leaks have occurred in the area near the Town Hall and in the line to Lawrence Barn which was documented in a 2010 engineering report to be 4" HDPE[4]. However, some of the break information indicates that line to be small diameter (1.5") plastic so the current pipe size and material need confirmation. Some further notes regarding these leaks follow.

<u>July, August 2008 break:</u> 2 breaks in the pipe at #7 and #16 Depot Street were repaired with brass fittings. Also included concrete sidewalk repair.

[3] Assuming 10,000 feet of 3.5" diameter piping at an average pressure of 60 psi.
[4] Provencher Engineering, LLC, Water Supply Master Plan, *Overall Water Distribution Plan*, November 4, 2010

December 2008 valve replacements: 2 leaking valves replaced. One was a ball valve on the service line at Town Hall. The other was a 1-way valve on the feed line at Lawrence Barn at several pipe connections. It appears that the feed line at Lawrence Barn was also repaired in 2018 (see Figure 2-4). Note that the feed line size appears smaller than 4".


**Figure 2-3.** Annotated Lawrence Barn Leak Photo, 2018

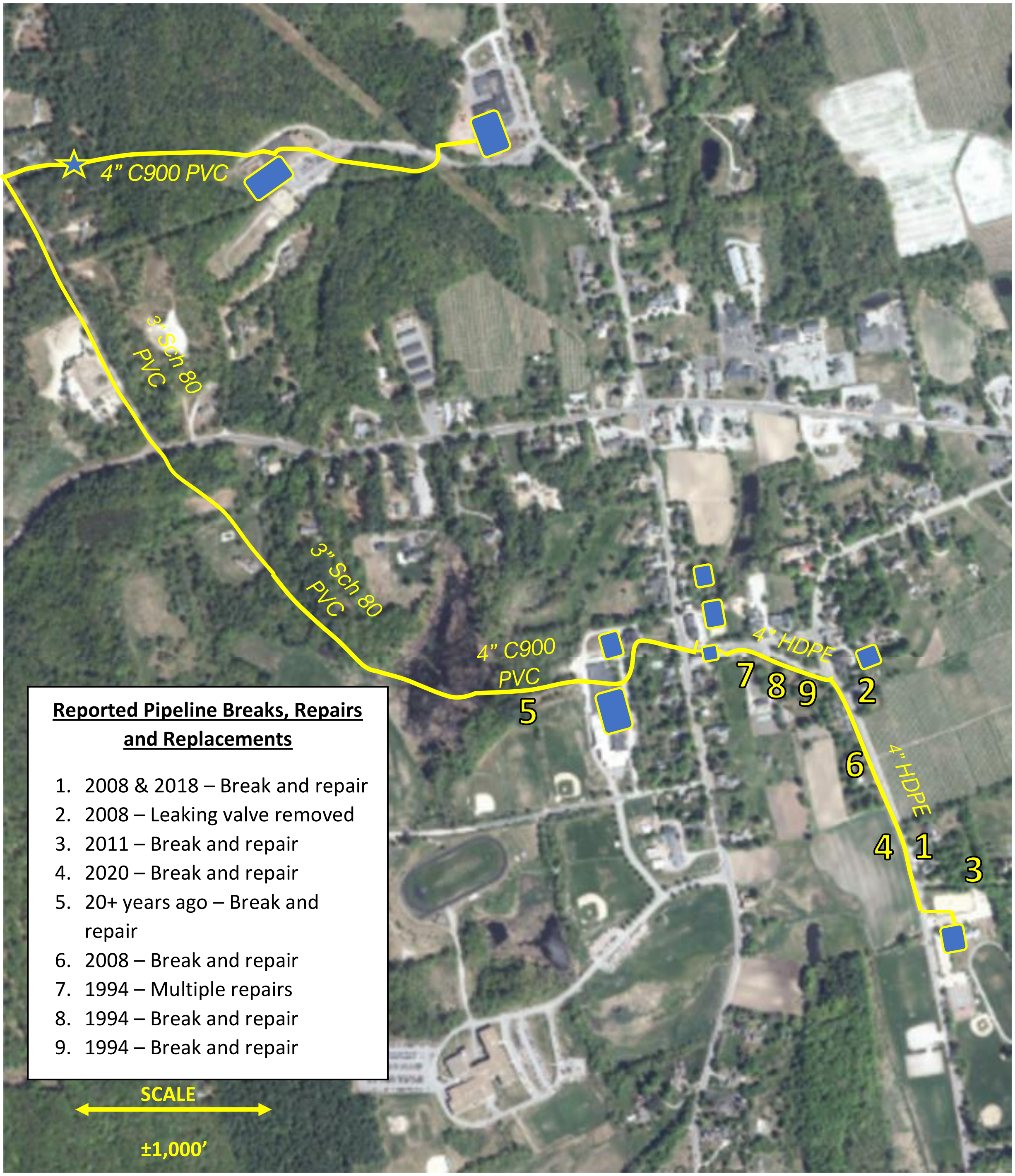



**Figure 2-4.** Leak Repair Map

In summary, the distribution piping system and service lines consist of various, unsubstantiated pipe sizes and materials and valving which have been subject to breaks, leaks, and repairs over the years. Continuous leakage of 1 to 2 gpm (or more) may be occurring which could account for 1,400 to 3,000 gpd of daily water loss. Based on the information reviewed, more leaks and repairs can be expected as the system continues to age.

This distribution system piping does not provide fire protection to any private or town-owned buildings.

## 2.4. Distribution Storage, Booster Pumps and Fire Protection

Distribution potable water storage is limited to the Primary School booster pump station and hydropneumatics tanks located in some buildings including the Lawrence Barn. Two schools served by the water system – the Upper Elementary school and the Middle school – contain fire suppression systems that include storage tanks and pumps. The fire suppression systems are filled by but are separate from the potable water system.

The basement layout of the Primary School booster pump station is reproduced from the 2010 Provencher Report in Figure 2-5 on the next page.

## 2.5. Estimated Water Demand

The limited amount of water use data indicates that the average daily system demand is approximately 8,200 gpd (gallons per day) when the schools are in session and the Town buildings are open. This estimate is derived from reported water statistics from 2011 and 2014 which also indicates that the peak daily system demand is about 11,200 gpd. The data indicates the following expected daily water use:

- “Town” usage of 2,300 gpd during days when Town buildings are open. When Town buildings are not open, there is still usage from the residences served. Peak Town usage appears to be approximately 4,000 gpd.

- Usage by the schools served (Primary, Elementary and Middle Schools) appears to be about 3,700 gpd when in session. Peak school usage appears to be approximately 5,000 gpd.

- System leakage appears to average about 1.5 gpm resulting in about 2,200 gpd.

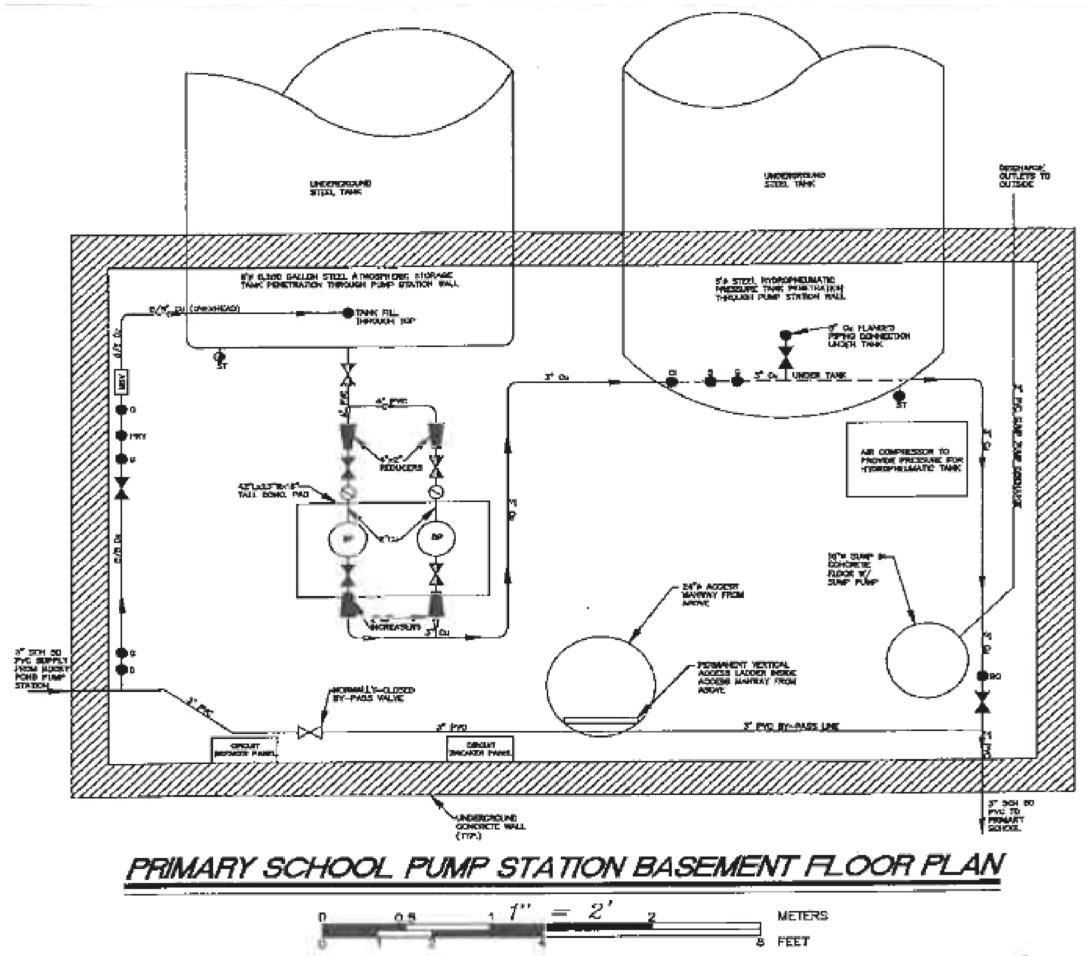



**Figure 2-5.** Primary School Booster Pump Station Basement Layout

# 3. Alternatives Assessment

In this section, two alternatives are evaluated for creating a new, Town water system separate from the current school system: A) a system utilizing shallow, overburden wells for supply; and, B) a system utilizing deep-drilled, bedrock wells for supply. The third alternative evaluated, C, is continued use of and reliance on the existing school system but with recommended improvements for increased reliability and sustainability. The fourth alternative, D, is to provide individual bedrock wells for the non-school facilities currently served.

## 3.1. Alternative A: New Town Water System Utilizing Shallow, Overburden Wells

A separate Town water system would serve the following buildings currently served by the School system as shown in Figure 3-1:

1. Farley Building
2. Town Hall
3. Lawrence Barn (south of area shown in Figure 3-1)
4. The "Block"
5. The Wheeler House
6. The Old Fire House
7. The Main Street Residence

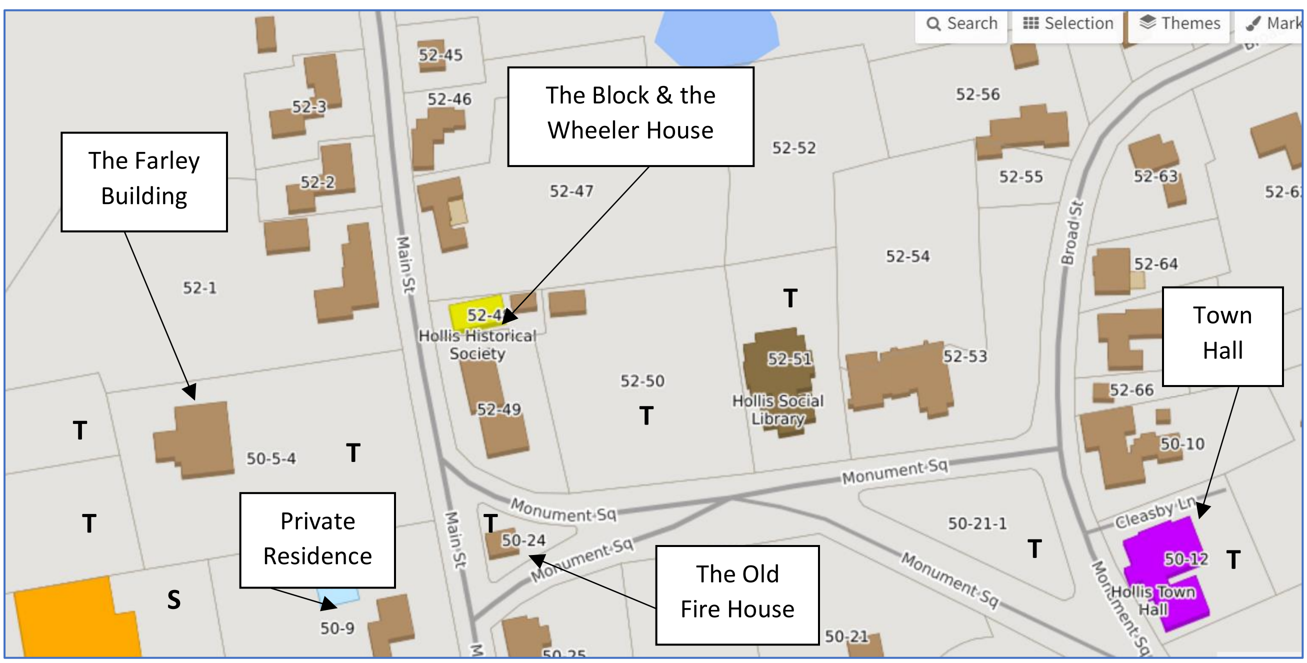



**Figure 3-1**. Buildings Proposed to be Served by A New Town System

*(T = Town Owned Property; S = School Owned Property; Lawrence Barn not shown)*

At this time there are no plans to expand the service area to include more buildings and facilities.

A key question for any water system is where the water will come from. Two potential groundwater sources – shallow aquifer wells and deep drilled bedrock wells – are discussed in Alternatives A and B, respectively. Based on estimated daily demands of 2,300 gpm for ADD (Average Day Demand) and 4,000 gpm for MDD (Maximum Day Demand), the needed pumping hours/day depending on the well yield is shown in Table 3-1. Ideally, a well yielding at least 5 gpm would meet the Town's needs.

**Table 3-1.** Estimated Well Pumping Hours/Day to Meet Town Demands

| Well Yield (gpm) | Pumping Hours/Day to Meet ADD | Pumping Hours/Day to Meet MDD |
|---|---|---|
| 3 | 13 | 22 |
| 5 | 8 | 13 |
| 10 | 4 | 7 |
| 15 | 3 | 4 |
| 20 | 2 | 3 |

### 3.1.1. Shallow Groundwater Availability

The Rocky Pond Well currently used by the school system has been a reliable source of supply for decades. Figure 3-2 shows the location of the Rocky Pond Well superimposed on an aquifer transmissivity map obtained from the New Hampshire GraniteView web site. This map indicates the existence of a surficial aquifer likely an early course of Beaver Brook perhaps dating to the glacial era although this map may not have been developed with actual field testing. As can be seen, the current course of Beaver Brook meanders off the aquifer. Aquifer transmissivity is a measure of the hydraulic capacity of the aquifer soils to transmit water flow and an indicator of the possible extent of the aquifer.

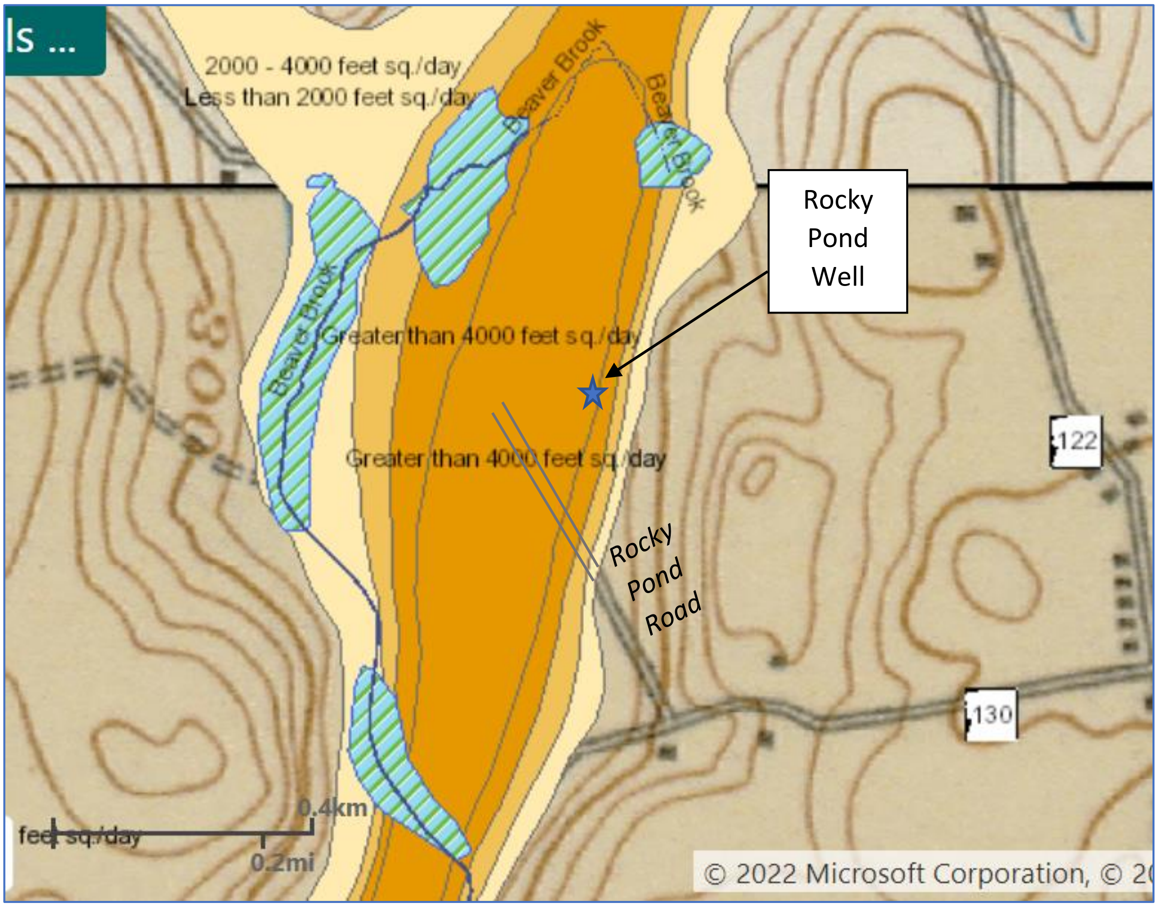



**Figure 3-2.** Hydrogeologic Setting of Rocky Pond Well *(Map Source: GraniteView)*

Considering the Rocky Pond Well history, the Beaver Brook aquifer appears to be extensive with good transmissivity, although shallow in depth, with sufficient storage and recharge to support the existing well withdrawals. In April 2002, a 2.5-inch diameter test well was driven approximately 70 feet from the Rocky Pond Well to find a second well location[5]. The well was driven to a depth of 20 feet but pulled back to 15 feet to set a 5-foot well screen in a coarser soil zone. The well pumped at 70 gpm for an hour with a 1-foot drawdown – a strong result for a 2.5-inch well. The static water level was at 3.44 feet.[6]

The reported results of the 2002 test well are consistent with the reported performance of the Rocky Pond Well which indicates highly transmissive soils with shallow to bedrock conditions. However, it is possible that deeper portions of the Beaver Brook aquifer may exist.

Steps for developing a new Town well in the Beaver Brook aquifer would include:

- Identification of potential properties to locate a well within the aquifer with sufficient wellhead protection setbacks and access to a roadway,

[5] This exploration well is erroneously labeled in the NHDES data base as the “Hollis High School” well ID# 119.1209. Additional information regarding the well was obtained during a July 15, 2022 telephone discussion between David Edson and the well driller, Barrie Miller.

[6] Barrie Miller indicated that this test well should still be in place and that there was another, older 2-inch diameter test well also nearby.

- A well exploration program that could include a combination of geophysics and test well drilling to identify the most transmissive and deepest locations, and
- Water quality testing.

Obtaining NHDES approval for the well would be relatively simple provided that the new Town system were a non-transient, non-community system. If NHDES were to classify the new Town system as a community water system, the well approval process would be more complex and expensive.

### 3.1.2. System Concept

The Town would locate and develop a shallow well within the Beaver Brook aquifer to serve the proposed Town system. A preliminary review of possible locations on land parcels believed to be owned by the Town, the Conservation Commission or the Beaver Brook Association is shown on Figure 3-3. As can be seen, most of the land within the aquifer between Rocky Pond Road and Proctor Hill Road is privately owned.

NHDES requires that a non-community, public water supply well with a permitted annual average production rate of 28,801 to 57,600 gpd (gallons per day) has a circular sanitary protection area with a 200-foot radius[7]. The wellhead sanitary protection area for lesser permitted well withdrawals can range from 125 to 175 feet. The Town would need to own or control the land within the sanitary protection area so that only acceptable uses listed in the regulations could occur[8]. The sanitary protection area for the two possible well sites are shown on Figure 3-3; for each of these, either land acquisition or easements would be needed. The land use on the Town parcel at Possible Shallow Well 1 may preclude locating a well there.

Any potential site must be confirmed with field testing.

[7] Env Dw 406.12(c).

[8] As per Env Dw 406.11(c), acceptable land uses with the sanitary protection area include roads and parking areas greater than 50 feet from the well, tennis courts and surface water bodies.

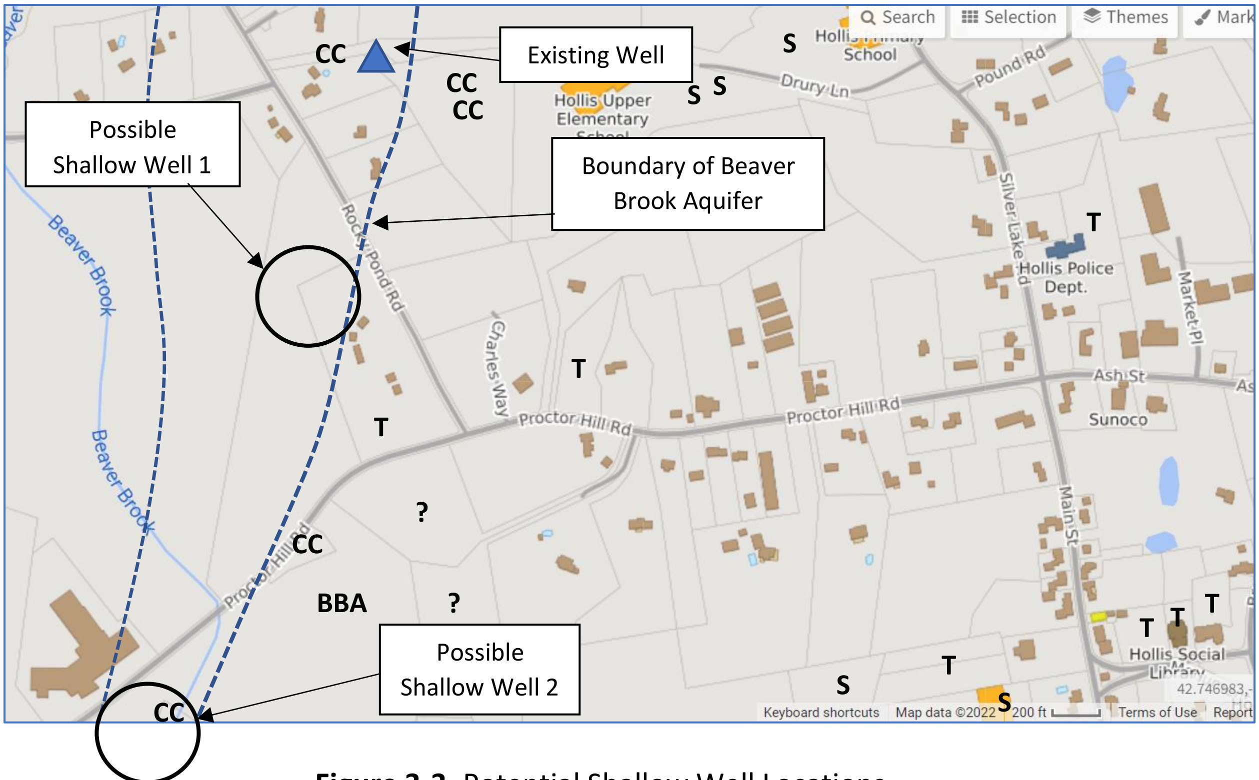



**Figure 3-3.** Potential Shallow Well Locations

*(T=Town-owned land; CC=Conservation Commission; BBA=Beaver Brook Association; S=School District;?=uncertain ownership)*

The concept for a new Town water system utilizing shallow wells completed in the Beaver Brook Aquifer would include the following items for budget estimating purposes:

- Initial well exploration, testing and site approval
- Two shallow, gravel-packed wells equipped with pitless adapters and well pumps
- A well water treatment and control building including:
    - Site development including an access road
    - A 14' x 22' concrete block building on a concrete slab foundation with a wood truss roof and asphalt shingle roofing
    - Plumbing, heating and ventilation and access doorway
    - Chlorine storage, day tank and feed system
    - Sodium hydroxide tank and feed system
    - Hydropneumatic water storage tank
    - A desk and basic testing equipment
    - Well pump controllers (2)
    - PLC (Programmable Logic Controller) and programming
    - Instrumentation (flow rate, pressure, well water level)
    - General interior electrical conduit and wiring
    - Site electrical

    - Electrical service, panels, and lights
    - Backup power generator and automatic transfer switch
    - On-line pH and chlorine monitors
    - Telemetry equipment
- New pipelines to convey the well water to the Town center and Lawrence Barn assuming:
    - 6,600’ of 4” PVC, AWWA C-900 piping in roadway shoulders
    - 4 roadway crossings by HDD (Horizontal Directional Drill)

The estimated capital cost is $1,697,000 as summarized in Table 3-2 and detailed in Appendix B. The construction cost estimates include a 25% contingency. The capital cost estimate does not include land or easement acquisition costs and it may be possible to reduce the pipeline length and cost by obtaining overland easements. There is no provision for building fire protection in Alternative A.

**Table 3-2.** Alternative A Capital Cost Estimate

| | | |
|---|---|---|
| <u>Construction</u> | | |
| Wells (2) | $ 80,000 | |
| Treatment and Control Building | $ 548,000 | |
| Pipelines | $ 659,000 | |
| Subtotal – Construction | | $ 1,287,000 |
| <u>Engineering</u> | | |
| Test Well Exploration, Testing and Permitting | $ 80,000 | |
| Building and Site Design & Permitting | $ 85,000 | |
| Pipeline Design and Permitting | $ 56,000 | |
| Bidding | $ 9,000 | |
| Construction-phase Engineering | $ 180,000 | |
| Subtotal – Engineering | | $ 410,000 |
| **Total Opinion of Capital Cost** | | **$ 1,697,000** |

Besides the capital cost, the Town would incur annual system administration and operations and maintenance (O&M) expense. Because the expected water production is so small, costs such as chemical and power are minimal – probably less than $200 annually each. The more significant costs would be with system operations, including regular compliance water quality sampling and analysis, and administration. Depending on whether a Town employee would obtain an operator’s license or a contract operator is retained, annual costs could range from $25,000 to $35,000 or more.

## 3.2. Alternative B: New Town Water System Utilizing Deep Drilled, Bedrock Wells

As with Alternative A, a new Town water system would serve the Farley Building, Town Hall, Lawrence Barn, The “Block”, The Wheeler House, the Old Fire House and the private residence as shown in Figure 3-1. With Alternative B, the water supply would be deep drilled bedrock wells.

### 3.2.1. Bedrock Groundwater Availability

There is a history of deep drilled bedrock wells in the area with a number of reported abandoned wells. The abandoned well shown in Figure 2-1 is presumably a bedrock well. An active bedrock well reportedly serves the "Snack Shack" and field irrigation system at Nichols field. Obviously, active individual house and commercial building wells exist in the area.

The newer high school well shown in Figure 2-1 was installed in 2011 and described in a pumping test report submitted for NHDES approval[9]. Data for this well are listed in Table 3-3. A 48-hour pumping test was conducted at a constant pumping rate of 10 gpm after the well yield was improved by hydrofracking.

**Table 3-3.** Newer High School Well Data

| Parameter | Value |
|---|---|
| Depth to bedrock | 17 feet |
| Total drilled depth | 1,000 feet |
| Borehole diameter | 6 inches |
| Initial yield estimate | 3 gpm |
| Yield estimate after hydrofracking | 10 gpm |

The newer well was reportedly installed because the three pre-existing bedrock wells could not provide enough supply. These wells were actually deeper at 1,200 to 1,820 feet. Notably, these wells were treated with then-existing arsenic removal filters.

The well water quality was moderately hard but, except for arsenic, overall good quality. In the single water analysis reported, the arsenic concentration was reported as 5 µg/L which matches the current New Hampshire public drinking water MCL (maximum contaminant level).

The new well was piped to bypass the arsenic removal filters because the New Hampshire arsenic public drinking water standard at the time was 10 µg/L. (It was reduced to 5 µg/L last year.)

In 2017, a hydrogeological investigation was conducted in an area near the Middle School that appeared to have potential for a new bedrock well.[10] The field investigation consisted of an electrical resistivity survey just west of the Middle School (see Figure III-4).

[9] *Pumping Test Report, Bedrock Public Water Supply Well No. BRW4, PWS ID No. 1175050, Hollis-Brookline High School* prepared by Northeast Geoscience, Inc, November 2011

[10] Northeast Geoscience, Inc., report to Mr. Ed Hinckley, Hollis-Brookline School District, re: *Geophysical Survey Results, Hollis-Brookline Middle School,* dated October 17, 2017

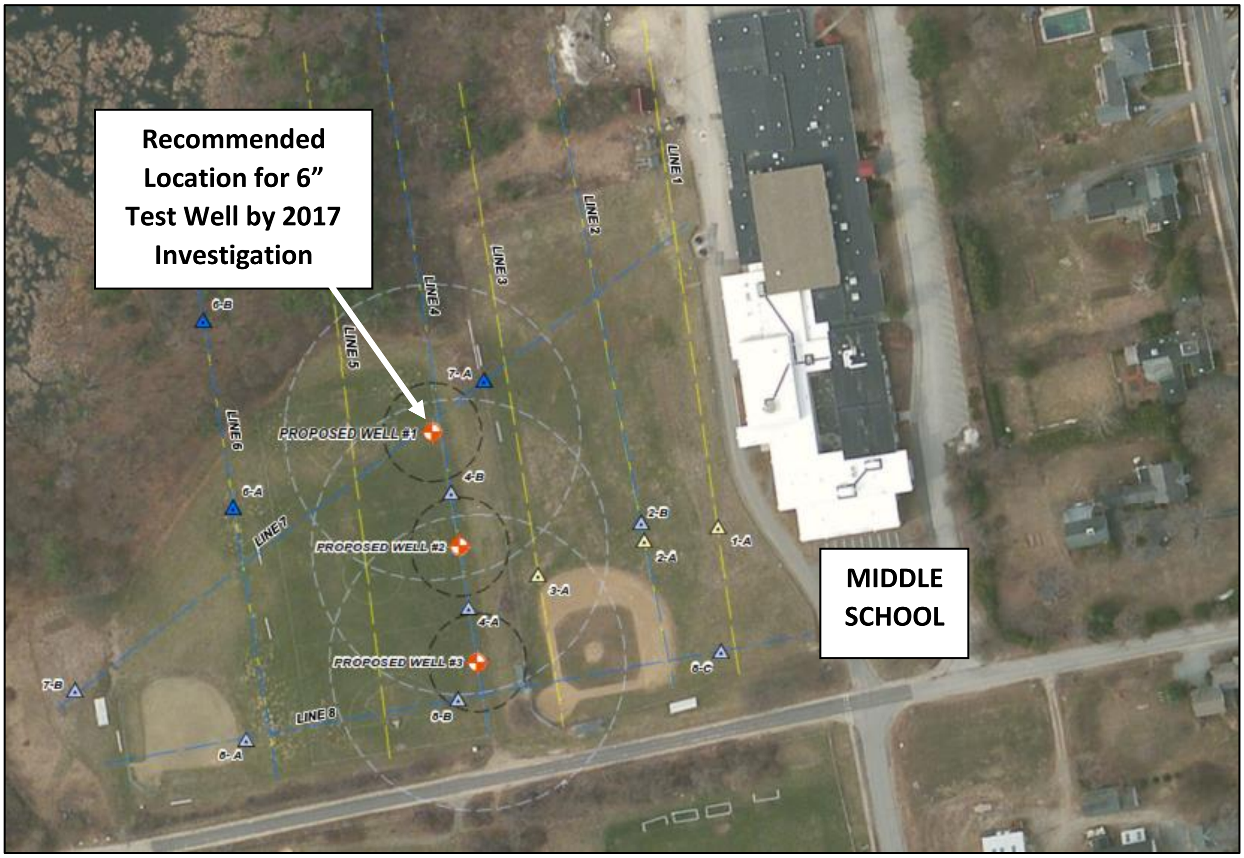



**Figure 3-4.** 2017 Geophysical Survey Location

*(Source: Northeast Geoscience, Inc.)*

Eight Very Low Frequency (VLF) "lines" of electrical resistivity were performed resulting in the identification of three potential locations for test well drilling where bedrock fracture zones may be present and favorable for supply development. The location shown in Figure 3-4 was recommended for the installation of a 6-inch diameter test well which was not done.

To summarize, the bedrock well option in this area appears to deliver very little yield at the expense of drilling to 1,000 feet or more. Even then, the newer high school well needed hydrofracking which doesn't always produce results. Based on past experience, any proposed bedrock well should incorporate plans for arsenic removal and softening.

### 3.2.2. System Concept

A preliminary review of possible locations for deep drilled bedrock wells on land parcels believed to be owned by the Town, the Conservation Commission or the Beaver Brook Association is shown on Figure 3-5. As with Alternative A, the 200-foot radius sanitary protection zones are shown. Any potential site must be confirmed with field testing.

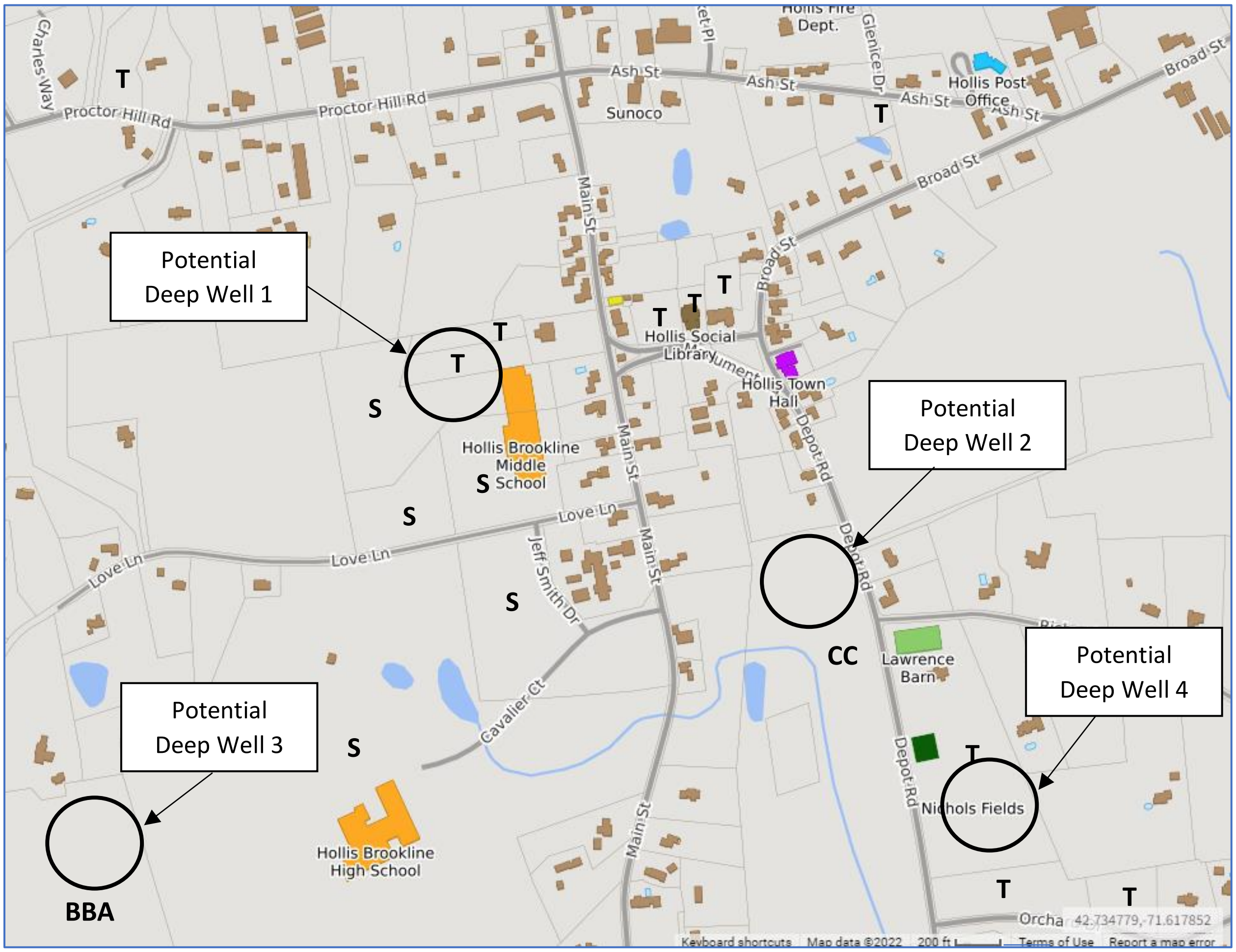



**Figure 3-5.** Potential Sites for Deep Drilled, Bedrock Well Development

*(T=Town-owned land; CC=Conservation Commission; BBA=Beaver Brook Association; S=School District;?=uncertain ownership)*

The Nichols Field location, shown as Potential Deep Well 4 on Figure 3-5, reportedly contains an existing well used for irrigation 640 feet deep yielding 6 gpm. In 2011, the well was considered for potable water supply. A water sample obtained from the well indicated a relatively low arsenic concentration reported as <0.002 mg/L, however, nitrate-N was elevated at 7.92 mg/L presumably reflecting the agricultural and farm animal history of the area. This level of nitrates is almost 80% of the MCL (10 mg/L) suggesting that treatment for nitrate reduction should be expected for a well in that area. Treatment would require filtration similar in concept to arsenic removal.

The three parcels owned by the Town at Nichols Field and Lawrence Barn are shown on Figure 3-6 which also shows the existing well location. The land across Depot Road from Nichols Field is owned by the Conservation Commission. Three potential locations for deep drilled, bedrock wells are indicated by the 200-foot radius well protective zones.


**Figure 3-6.** Nichols Field Property Map

The concept for a new Town water system utilizing deep drilled, bedrock wells would include the following items for budget estimating purposes:

- Initial well exploration, testing and site approval
- Two deep drilled bedrock wells equipped with pitless adapters and well pumps
- A well water treatment and control building including:
  - Site development including an access road and filter backwash lagoons
  - An 18’ x 24’ concrete block building on a concrete slab foundation with a wood truss roof and asphalt shingle roofing
  - Plumbing, heating and ventilation and access doorway
  - Chlorine storage, day tank and feed system
  - Two arsenic or nitrate removal filters piped in series (lead/lag)
  - Hydropneumatic water storage tank
  - A desk and basic testing equipment
  - Well pump controllers (2)
  - PLC (Programmable Logic Controller) and programming

    - Instrumentation (flow rate, pressure, well water level)
    - General interior electrical conduit and wiring
    - Site electrical
    - Electrical service, electrical panels, and lights
    - Backup power generator and automatic transfer switch
    - On-line chlorine monitor
    - Telemetry equipment
- New pipelines to convey the well water to the Town center and Lawrence Barn:
    - 3,000’ of 4” PVC, AWWA C-900 piping in roadway shoulders
    - 2 roadway crossings by HDD (Horizontal Directional Drill)

The estimated capital cost is $1,343,000 as summarized in Table 3-4 and detailed in Appendix B. The construction cost estimates include a 25% contingency. The pipeline costs are much less than Alternative A assuming the wells would be closer to the town center. The capital cost estimate does not include land or easement acquisition costs. There is no provision for building fire protection in Alternative B. As with Alternative A, the Town would also incur annual O&M and administrative expense. If both arsenic and nitrate reduction were required, the capital cost estimate could increase by up to 30%.

**Table 3-4.** Alternative B Capital Cost Estimate

| | | |
|---|---|---|
| Construction | | |
| Wells | $ 87,000 | |
| Treatment and Control Building | $ 631,000 | |
| Pipelines | $ 308,000 | |
| Subtotal – Construction | | $ 1,026,000 |
| Engineering | | |
| Test Well Exploration, Testing and Permitting | $ 45,000 | |
| Building and Site Design & Permitting | $ 88,000 | |
| Pipeline Design and Permitting | $ 31,000 | |
| Bidding | $ 9,000 | |
| Construction-phase Engineering | $ 144,000 | |
| Subtotal – Engineering | | $ 317,000 |
| **Total Opinion of Capital Cost** | | **$ 1,343,000** |

## 3.3. Alternative C: Continued Use of School System with Recommended Improvements

Under Alternative C, the non-school buildings would continue to be served by the school system. Alternative C would be the “No Change” alternative except with recommended improvements to enhance and increase system reliability and sustainability so that a comparison can be made with the new system alternatives A and B.

NHDES regulations, notably Env-Dw 406 – *Design Standards for Non-community Water Systems*, were considered in developing the improvement recommendations as well as our engineering experience with public water supplies.

It is noted that the school department has performed recent maintenance at the well pump station including:

- Regular chemical feed pump rebuilds
- Replacement of the hydropneumatic tank
- Replacement of well pump VFDs due to a power surge
- Water meter replacement and leak repair
- Well pump replacement

Recent maintenance items at the booster pumping station have included replacement of the control panel and the air compressor.

### 3.3.1. Source of Supply

Probably the most pressing deficiencies of the current source of supply is the lack of a backup well and emergency power at the pump house. While there is redundancy with two well pumps, past concerns with low well water levels have been noted. Env-Dw 406.02(c) and Env-Dw 406.10(c) state that any NTNC water system "whose reliability is directly important to public health" such as serving a public building including schools that could be used for shelters during public emergencies is required to have at least two wells.

As discussed earlier in this section, the Rocky Pond Well is located within the Beaver Brook aquifer as indicated by the New Hampshire GraniteView web site although apparently along the edge of the higher transmissive zone. Recollections of the 2002 test well support the potential for developing one or more additional wells in the aquifer. The simplest, least expensive way to add a second well would be the "satellite" well approach. The satellite well would be equipped with a submersible pump and pitless adapter (underground) connection with the well discharge either piped into the existing caisson well for repumping into the system or connected separately to the pump station discharge piping. Power and controls for the satellite well would be run from the existing pump station.

Other recommended improvements to the well and pump station include:

- Addition of an emergency power generator and automatic transfer switch
- Provision for flow-pacing of chemical addition
- Addition of a return water quality monitoring pipeline tapped 75' outside the pump station running to a sample sink in the pump station
- Addition of on-line pH and chlorine monitors with setpoints for alarms
- Improved system controls and telemetering capabilities

It is noted that the Elementary School booster pump station is primarily buried which raises confined space concerns for workers. For that reason, an operator emergency alarm and telemetering should be added at that location.

### 3.3.2. Distribution Piping

Based on the information provided, replacement of the distribution piping from the well pump house to both the Primary and Upper Elementary Schools and to the Middle School is not recommended at this time. Those water mains are identified in the 2010 Provencher report as 3- and 4-inch Schedule 80 and

C-900 PVC pipe, both of which are robust materials. However, it is noted that these pipelines are system-critical with no redundancy.

The water mains from the Middle School into the town center and to the Lawrence Barn are more of a mix of various piping and are more suspect with a greater history of breaks and leaks. Replacement of that piping is recommended. Also recommended is the proper abandonment of the old well and underground vault located about 900 feet west of the Middle School.

### 3.3.3. Water Storage

Except for the Primary School booster pump station, potable water storage in the system is minimal consisting of small hydropneumatic pressure tanks in some of the buildings. The addition of live distribution system storage should be seriously considered.

Ideally, the water system should have two or three days of available storage – about 20,000 to 30,000 gallons. The addition of a storage tank, perhaps near the Lawrence Barn at Nichols Field, in combination with adding a second well, would be significant upgrades in terms of system redundancy and reliability.

The logical concept would be at-grade, boosted storage, as suggested in the 2010 Provencher report, rather than an elevated, gravity tank which would need to be about 80 to 90 feet high to meet minimum system suggested pressure. With pumped storage, the tank would fill and shut off. Water would be pumped back into the system. The storage pump operation would be controlled to maintain a regular turn-over of the water volume in the tank to maintain water quality.

### 3.3.4. Summary

The estimated capital cost of the recommendations described for continued Town use of the existing water system, not including adding storage, is $796,000 as summarized in Table 3-5 and detailed in Appendix B. The construction cost estimates include a 25% contingency. There is no provision for building fire protection in Alternative C.

**Table 3-5.** Alternative C Capital Cost Estimate without Storage

| | | |
|---|---|---|
| Construction | | |
| Source of Supply including New Well | $ 286,000 | |
| Pipelines | $ 302,000 | |
| Subtotal – Construction | | $ 588,000 |
| Engineering | | |
| Test Well Exploration, Testing and Permitting | $ 24,000 | |
| Building and Site Design & Permitting | $ 63,000 | |
| Pipeline Design and Permitting | $ 30,000 | |
| Bidding | $ 9,000 | |
| Construction-phase Engineering | $ 82,000 | |
| Subtotal – Engineering | | $ 208,000 |
| **Total Opinion of Capital Cost** | | **$ 796,000** |

The estimated capital cost for addition of a pumped storage facility consisting of the following items is $497,000 as shown in Table 3-6 and detailed in Appendix B:

- A 16-foot diameter by 16-foot high insulated, glass-lined steel, at-grade water storage tank containing 24,000 gallons near the Lawrence Barn
- A 12-foot by 14-foot precast concrete pumping and control building to control the water flow into and out of the tank and to pump the water into the system
- Site piping and fencing

**Table 3-6.** Addition of 24,000-gallon Storage Tank and Pumping Facility

| | | |
|---|---|---|
| Construction | | |
| 24,000-gallon water storage tank | $ 129,000 | |
| Pre-cast Pumping and Control Building | $ 258,000 | |
| Subtotal – Construction | | $ 387,000 |
| Engineering | | |
| Design | $ 48,000 | |
| Bidding | $ 8,000 | |
| Construction-phase Engineering | $ 54,000 | |
| Subtotal – Engineering | | $ 110,000 |
| **Total Opinion of Capital Cost** | | **$ 497,000** |

## 3.4. Alternative D: Individual Deep Drilled, Bedrock Wells

An alternative that has been mentioned is to serve each of the non-school buildings (the Farley Building, Town Hall, Lawrence Barn, The "Block", The Wheeler House, the Old Fire House and the private residence) with individual bedrock wells. For this alternative, the following assumptions are made:

- Seven bedrock wells can be drilled at each location that will provide an acceptable yield
- Each well is 1,000 feet deep
- Each building has sufficient existing space to house an arsenic removal filter, small UV disinfection system and hydropneumatic tank system
- Each building has available electrical circuits for the well and for the treatment system
- None of the wells, including those for public buildings, are considered by NHDES to be public water supply wells[11]

The estimate capital cost for Alternative D subject to the assumptions listed above is $340,000 as summarized in Table 3-7 and detailed in Appendix B. The construction cost estimates include a 25% contingency.

[11] NHDES considers a water system that "regularly serves at least 25 individuals daily at least 60 days out of the year" to be a Noncommunity Water System that would be regulated. So, that would include the Town Hall, for example, if 25 people including employees and the public are typically there or visit when the building is open.

**Table 3-7.** Alternative D Capital Cost Estimate

| | | |
|---|---|---|
| Construction | | |
| Wells (7) | $ 212,000 | |
| Treatment systems, plumbing, electrical (7) | $ 65,000 | |
| Subtotal - Construction | | $ 277,000 |
| Engineering | | |
| Bid specifications | $ 22,000 | |
| Bidding | $ 8,000 | |
| Construction-phase Engineering | $ 33,000 | |
| Subtotal – Engineering | | $ 63,000 |
| **Total Opinion of Capital Cost** | | **$ 340,000** |

# 4. Comparison of Alternatives & Recommendations

This section includes a comparison of the alternatives and our recommendations.

## 4.1. Comparison of Alternatives

Four alternatives for the Town to consider have been evaluated including:

A. A new Town system utilizing shallow, overburden wells for supply
B. A new Town system utilizing deep-drilled, bedrock wells for supply
C. Continued use of and reliance on the existing school system but with recommended improvements for increased reliability and sustainability, and
D. Individual bedrock wells for the non-school facilities currently served.

Alternatives A, B and D would separately serve the Farley Building, Town Hall, Lawrence Barn, The "Block", the Wheeler House, the Old Fire House and a private residence at 27 Main Street. A summary matrix comparing the alternatives is shown in Table 4-1 followed by a discussion.

**Table 4-1.** Alternative Comparison Summary Matrix

| Alternative | Advantages | Disadvantages / Risks | Estimated Costs |
|---|---|---|---|
| A. New Town System with Shallow, Overburden Wells | • Town-owned and controlled | • System administration<br>• Regulatory compliance<br>• Need licensed operator<br>• Annual O&M costs<br>• Need to obtain well site(s) | • Capital: $1.697M n/i land acquisition<br>• Annual O&M: $20-30,000+ |
| B. New Town System with Bedrock Wells | • Town owned and controlled | • Same as Alternative A<br>• Well exploration may not be successful | • Capital: $1.343M n/i land acquisition<br>• Annual O&M: $20-30,000+ |
| C. Continued Use of School System with Recommended Improvements | • Existing, permitted, functioning system<br>• No operating cost passed on to Town | • Needs investment to increase reliability<br>• Continued reliance on school system | • Capital = $796,000<br>• Add pumped storage = $497,000 |
| D. Individual Bedrock Wells | • Not a public water system (to be confirmed with NHDES) | • Well exploration may not be successful<br>• Buildings may not have room for treatment systems and storage tanks<br>• Building electrical systems may need updating | • Capital = $340,000 |

The least expensive alternative appears to be D which provides an individual well for each of the seven buildings to be served. However, there are risk factors that could render this alternative non-feasible or could increase costs:

1. Each well would be drilled on each property and the wells may not yield sufficient water. The cost estimate does not include drilling multiple wells at each location.
2. The well water is expected to be high in mineral content which could include arsenic, iron, manganese and/or hardness. That could increase the treatment cost estimates which only include an arsenic filter. Also, each building would need space for the arsenic filter and hydropneumatic tank.
3. NHDES may consider a well serving a Town building open to the public to be a public water supply well thereby increasing regulatory compliance requirements and costs.
4. The electrical systems in some of the older buildings may be insufficient to add a well pump or not meet current code, either of which could add costs.

The two alternatives involving a new town water system, A and B, are the most expensive and likewise involve risk factors. One risk factor relates to the need for a water supply. A shallow but reasonably productive aquifer does appear to exist within the Beaver Brook watershed. The school system well is constructed in this aquifer and has been producing water for decades. The groundwater is of high quality and relatively low production cost requiring only chemical treatment for corrosivity and disinfection. Finding a productive location for a similar well source would seem likely although land and/or easements with restrictions may need to be acquired for the well site and sanitary protection area. A new well in the Beaver Brook aquifer would require a lengthy pipeline to deliver the water to the Town center.

It is likely that a deep-drilled bedrock well supply could be located closer to the town center on land owned by the Town or Conservation Commission. Based on the bedrock well supply at the High School, treatment for arsenic would be expected. Similarly, water quality records for the irrigation well at the Nichols Field indicated that nitrate reduction may be required at that location. For either shallow or deep-drilled, bedrock wells, a treatment building containing the filters and chemical addition would be needed.

Alternative A or B would create a public water system regulated by NHDES and the Town would incur recurring annual costs for system administration, operations, and maintenance and for meeting regulatory requirements including water quality and production data submissions.

Alternative C is the middle ground from a cost standpoint, although with no cost of water directly charged to the Town, this alternative is advantageous from that standpoint. The school water system ownership, configuration and buildings served would not change. The current system has been reviewed and recommendations for improvements provided to reduce future risk and increase reliability and sustainability.

## 4.2. Recommendations

Based on the evaluation and cost estimates presented in this report, the best alternative for the Town is to continue water service to the non-school buildings currently served from the existing school water system with the recommended improvements described in Alternative C. In our opinion, Alternative C offers the best value for the Town considering a combination of cost, risk, and sustainability considerations. To summarize, the current school system is fully operational and permitted, appears to be well managed, and is in compliance with New Hampshire public water system regulations and requirements. Additionally, the Town is served by the system with no direct costs assessed by the school department.

The recommended upgrades to improve the current system reliability and sustainability can be implemented in two steps:

Step A including:

- Addition of a second well at the Rocky Pond well site
- Improvements at the Rocky Pond pump house including:
  - Addition of an emergency power generator and automatic transfer switch
  - Provision for flow-pacing of chemical addition
  - Addition of a return water quality monitoring pipeline tapped 75’ outside the pump station running to a sample sink in the pump station
  - Addition of on-line pH and chlorine monitors with setpoints for alarms
  - Improved system controls and telemetering capabilities
- Replacement of distribution piping serving the non-school buildings from the Middle School through the town center to the Lawrence Barn

Step B would include adding a 24,000-gallon water storage tank and pumping/control facility to be tentatively located at the Lawrence Barn town property.

The opinions of capital cost are $796,000 for Step A and $497,000 for Step B. Potential cost savings could be achieved if both steps are done simultaneously. Each step would likely take 16 to 24 months to complete. All costs presented are in current dollars.

# APPENDIX A: Regulatory Requirements for a New NTNC Water System

The steps for developing a new, public non-transient, non-community (NTNC) water system in New Hampshire are summarized as follows:

- Requesting conceptual approval by the New Hampshire Department of Environmental Services (NHDES)
- Submission of an application and accompanying documents outlined in the Design Review Checklist.
- Submission of the design review application fee.
- Submission of a water treatment process application and accompanying proposal documents.
- Final inspection.

Steps for expanding or modifying an existing public non-community water system would include:

- Submission of an application and accompanying documents outlined in the Design Review Checklist.
- Submission of the design review application fee.
- Submission of a water treatment process application and accompanying proposal documents.
- Final inspection.

___

The following terms as they are defined may be used in the below steps for developing a new, public non-community water system:

“Public water system” means a system for the provision to the public of piped water for human consumption, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. Such term includes (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system, and (2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system.

Any water system which meets all of the following conditions is not a public water system:
(a) Consists only of distribution and storage facilities (and does not have any collection and treatment facilities);
(b) Obtains all of its water from, but is not owned or operated by, a public water system; and
(c) Does not sell water to any person.

“Community water system” means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

“Non-community water system” means a public water system that is not a community water system.

“Transient non-community water system (TNC)” means a non-community water system that serves at least 25 persons in a transitory setting such as a restaurant for more than 60 days each year.

“Non-transient non-community water system (NTNC)” means a system which is not a community water system, and which serves the same 25 people, or more, over 6 months per year.

The steps summarized above for developing a new, public non-community water system are more fully described as follows:

1. A proposed non-community water system must receive concept approval issued by NHDES before well construction or water system design can commence. Criteria to be considered can be found in Env-Dw 206.04.b-d. To request concept approval, the applicant shall submit a brief letter identifying the:
    a. The size of the proposed system
    b. The type of the proposed system
    c. The nature of the proposed system, and
    d. A map showing the proposed service area.
2. The person proposing to construct a new non-community water system or to expand or modify an existing non-community water system shall provide the following Design Review Checklist items to the department:
    a. A completed application form, or a letter, signed and dated, with the information specified in Env-Dw 406.05.c.
    b. A copy of the concept approval obtained pursuant to Env-Dw 406.04
    c. A site plan of the project which includes the complete protective radius area surrounding each well
    d. The well driller's well completion report for each well as required in We 800
    e. The water quality analysis of the water from each well as specified in Env-Dw 406.14
    f. A pumping test log for each well, if required by Env-Dw 406.13
    g. If water treatment is or is proposed to be provided, an operations and maintenance manual in accordance with Env-Dw 503; and
    h. For a NTNC water system:
        i. A preliminary business plan in compliance with Env-Dw 602
        ii. A revised business plan in compliance with Env-Dw 602
        iii. A final business plan in compliance with Env-Dw 602, and
        iv. Identification of the certified operator
3. For a proposed NTNC water systems whose reliability is directly important to public health as specified in Env-Dw 406.02(c), the applicant shall also submit the following:
    a. Plans and specifications for the pump house and any water distribution system as specified in rules in Env-Dw 405
    b. An operation and maintenance manual in accordance with Env-Dw 503, and
    c. A verification of any water distribution pipe installation in accordance with Env-Dw 405.31
4. The applicant shall pay an application fee for the review of a proposed non-community water system. The fee shall be determined in accordance with Env-Dw 406.06.b. The design review fee shall be paid in conjunction with the final design review submittal.
5. Each water system owner who wishes to install or modify a water treatment process shall submit the following to the department in writing:
    a. The name, location, and PWS ID number of the system
    b. The name, mailing address, and daytime telephone number of an individual who is knowledgeable about the proposed treatment process who can answer questions about the proposal on behalf of the owner
    c. A description of the proposed treatment process, including how the process functions conceptually

   d. A technical design proposal which identifies necessary equipment, chemicals, plumbing, and electrical elements, as specified in Env-Dw 406.21
   e. A description of the anticipated treatment wastes and their disposal, in accordance with Env-Dw 406.22
   f. An operation and maintenance manual, as specified in Env-Dw 406.23, and
   g. A monitoring plan for determining the quality of the treated water and waste flows, as specified in Env-Dw 406.24
6. Upon completion of the construction of a non-community water system, but before any service is offered, NHDES shall conduct a sanitary survey, or inspection, of the water system.
7. All proposed NTNC water systems shall comply with the requirements of Env-Dw 602 before the operation of such water system begins.

Design standards shall be as described in their respective sections of Env-Dw 406.

Those NTNC water systems whose reliability is directly important to public health, such as schools or other facilities that are used as shelters during public emergencies, shall comply with the design criteria contained in Env-Dw 405 pertaining to the sizing of the water storage tanks and booster pumps, and other related appurtenances, as specified therein.

Information on waivers and expiration of design approvals is located in Env-Dw 406.28 and 406.29 respectively.

# APPENDIX B: Opinions of Capital Cost

**Alternative A: New Town System with Shallow, Overburden Well Supply**

Assumptions

| | | |
|---|---|---|
| 1. 20' deep gravel-packed well with submersible pump & pitless adapter | | |
| 2. Treatment building 14' x 22' | 308 | sf |
| 3. Backup power | | |
| 4. corrosion control & disinfection | | |
| 5. No land acquisition cost | | |
| 6. 4" PVC C-900 DR 18 pipe cost | $ 16.00 | per foot |
| 7. Daily pipeline crew cost | $ 5,000 | per day |
| 8. Feet of pipe installed per day | 120 | feet per day |
| 9. Traffic control | $ 800 | per day |

**A. CONSTRUCTION**

| Item | Quantity | UNITS | Unit Cost | Total |
|---|---|---|---|---|
| **Civil** | | | | |
| Well site preparation, access road, grading | 1 | LS | $ 30,000 | $ 30,000 |
| Well site paving | 1 | LS | $ 5,000 | $ 5,000 |
| Well site yard piping | 1 | LS | $ 15,000 | $ 15,000 |
| Well construction including pitless adapter | 2 | LS | $ 22,500 | $ 45,000 |
| Well site fencing, gates | 1 | LS | $ 16,000 | $ 16,000 |
| Power to well site | 1 | LS | $ 5,000 | $ 5,000 |
| Distribution pipe materials - 4" PVC - in roadway shoulder | 6,600 | FT | $ 16.00 | $ 105,600 |
| Distribution pipe installation - 4" PVC - in roadway shoulder | 55 | DAYS | $ 5,000 | $ 275,000 |
| Roadway Crossings by Directional Drill | 4 | LS | $ 4,000 | $ 16,000 |
| Traffic Control | 55 | DAYS | $ 800 | $ 44,000 |
| Building Connections | 6 | LS | $ 800 | $ 4,800 |
| **Treatment & Electrical Building** | | | | |
| Building superstructure - 14' x 22' | 308 | SF | $ 250 | $ 77,000 |
| Building foundation - 14' x 22' | 308 | SF | $ 35 | $ 10,780 |
| Plumbing | 1 | LS | $ 8,000 | $ 8,000 |
| Heating, Ventilation | 1 | LS | $ 15,000 | $ 15,000 |
| Double metal door | 1 | LS | $ 1,200 | $ 1,200 |
| **Mechanical / Process** | | | | |
| Well pumps | 2 | LS | $ 4,500 | $ 9,000 |
| Process Piping | 1 | LS | $ 12,000 | $ 12,000 |
| Chlorine storage & feed pump system | 1 | LS | $ 8,000 | $ 8,000 |
| Sodium hydroxide storage & feed pump system | 1 | LS | $ 8,000 | $ 8,000 |
| Hydropneumatic storage tank | 1 | LS | $ 1,500 | $ 1,500 |
| Lab equipment, furniture | 1 | LS | $ 2,500 | $ 2,500 |
| **Electrical / I&C / SCADA** | | | | |
| Well pump controller | 2 | LS | $ 4,000 | $ 8,000 |
| Programmable Logic Controller | 1 | LS | $ 5,000 | $ 5,000 |
| SCADA system programming | 1 | LS | $ 5,000 | $ 5,000 |
| Instrumentation | 1 | LS | $ 10,000 | $ 10,000 |
| General interior wiring, conduit | 1 | LS | $ 40,000 | $ 40,000 |
| Site electrical | 1 | LS | $ 10,000 | $ 10,000 |
| On-line pH monitor | 1 | LS | $ 2,000 | $ 2,000 |
| On-line Chlorine monitor | 1 | LS | $ 2,000 | $ 2,000 |
| Electrical service, panels, lights | 1 | LS | $ 35,000 | $ 35,000 |
| Backup generator, transfer switch | 1 | LS | $ 35,000 | $ 35,000 |
| Telemetering | 1 | LS | $ 4,000 | $ 4,000 |
| Subtotal | | | | $ 870,000 |
| Mobilization/Demob | 5% | | | $ 44,000 |
| OH&P | 18% | | | $ 157,000 |
| Construction contingency | 25% | | | $ 216,000 |
| **Total construction contract cost estimate** | | | | **$ 1,287,000** |

**B. ENGINEERING**

| | |
|---|---|
| Well Exploration, Testing and Permitting | $ 80,000 |
| Building & Site Design and Permitting | $ 85,000 |
| Pipeline Design and Permitting | $ 56,000 |
| Bidding | $ 9,000 |
| CA/RPR | $ 180,000 |
| **Total Engineering** | **$ 410,000** |
| **TOTAL OPINION OF CAPITAL COST** | **$ 1,697,000** |

**Alternative B: New Town System with Deep Drilled, Bedrock Well Supply**

| | | | | |
|---|---|---|---|---|
| <u>Assumptions</u> | | | | |
| 1. 1000' deep rock well with submersible pump & pitless adapter | | | | |
| 2. Treatment building 18' x 24' | 432 | sf | | |
| 3. Backup power | | | | |
| 4. arsenic removal & disinfection | | | | |
| 5. No land acquisition cost | | | | |
| 6. 4" PVC C-900 DR 18 pipe cost | $ 16.00 | per foot | | |
| 7. Daily pipeline crew cost | $ 5,000 | per day | | |
| 8. Feet of pipe installed per day | 120 | feet per day | | |
| 9. Traffic control | $ 1,200 | per day | | |

**A. CONSTRUCTION**

| Item | Quantity | UNITS | Unit Cost | Total |
|---|---|---|---|---|
| **Civil** | | | | |
| Well site preparation, access road, grading, backwash lagoons | 1 | LS | $ 40,000 | $ 40,000 |
| Well site paving allowance | 1 | LS | $ 5,000 | $ 5,000 |
| Well site yard piping | 1 | LS | $ 15,000 | $ 15,000 |
| Well construction including pitless adapter | 2 | LS | $ 25,000 | $ 50,000 |
| Well site fencing, gates | 1 | LS | $ 16,000 | $ 16,000 |
| Power to well site | 1 | LS | $ 5,000 | $ 5,000 |
| Distribution pipe materials - 4" PVC - in roadway shoulder | 3,000 | FT | $ 16.00 | $ 48,000 |
| Distribution pipe installation - 4" PVC - in roadway shoulder | 25 | DAYS | $ 5,000 | $ 125,000 |
| Roadway Crossings by Directional Drill | 2 | LS | $ 5,000 | $ 10,000 |
| Traffic Control | 25 | DAYS | $ 800 | $ 20,000 |
| Building Connections | 6 | LS | $ 800 | $ 4,800 |
| **Treatment & Electrical Building** | | | | |
| Building superstructure - 18' x 24' | 432 | SF | $ 250 | $ 108,000 |
| Building foundation - 18' x 24' | 432 | SF | $ 35 | $ 15,120 |
| Plumbing | 1 | LS | $ 8,000 | $ 8,000 |
| Heating, Ventilation | 1 | LS | $ 15,000 | $ 15,000 |
| Double metal door | 1 | LS | $ 1,200 | $ 1,200 |
| **Mechanical / Process** | | | | |
| Well pumps | 2 | LS | $ 4,500 | $ 9,000 |
| Process Piping | 1 | LS | $ 12,000 | $ 12,000 |
| Chlorine storage & feed pump system | 1 | LS | $ 8,000 | $ 8,000 |
| Arsenic filters with flow controllers | 2 | EA | $ 7,500 | $ 15,000 |
| Arsenic filter media | 2 | EA | $ 5,000 | $ 10,000 |
| Hydropneumatic storage tank | 1 | LS | $ 1,500 | $ 1,500 |
| Lab equipment, furniture | 1 | LS | $ 2,500 | $ 2,500 |
| **Electrical / I&C / SCADA** | | | | |
| Well pump controller | 2 | LS | $ 4,000 | $ 8,000 |
| Programmable Logic Controller | 1 | LS | $ 5,000 | $ 5,000 |
| SCADA system programming | 1 | LS | $ 5,000 | $ 5,000 |
| Instrumentation | 1 | LS | $ 5,000 | $ 5,000 |
| General interior wiring, conduit | 1 | LS | $ 40,000 | $ 40,000 |
| Site electrical | 1 | LS | $ 10,000 | $ 10,000 |
| On-line Chlorine monitor | 1 | LS | $ 2,000 | $ 2,000 |
| Electrical service, panels, lights | 1 | LS | $ 35,000 | $ 35,000 |
| Backup generator, transfer switch | 1 | LS | $ 35,000 | $ 35,000 |
| Telemetering | 1 | LS | $ 4,000 | $ 4,000 |
| Subtotal | | | | $ 693,000 |
| Mobilization/Demob | 5% | | | $ 35,000 |
| OH&P | 18% | | | $ 125,000 |
| Construction contingency | 25% | | | $ 173,000 |
| **Total construction contract cost estimate** | | | | **$ 1,026,000** |

**B. ENGINEERING**

| | |
|---|---|
| Well Exploration, Testing and Permitting | $ 45,000 |
| Building & Site Design and Permitting | $ 88,000 |
| Pipeline Design and Permitting | $ 31,000 |
| Bidding | $ 9,000 |
| CA/RPR | $ 144,000 |
| **Total Engineering** | **$ 317,000** |
| | |
| **TOTAL OPINION OF CAPITAL COST** | **$ 1,343,000** |

| | | | | |
|---|---|---|---|---|
| **Alternative C: Upgrade School System** | | | | |
| | | | | |
| Assumptions | | | | |
| 1. Add backup satellite well | | | | |
| 2. Replace piping from Middle School to Lawrence Barn | | | | |
| 3. 4" PVC C-900 DR 18 pipe cost | $ 16.00 | per foot | | |
| 4. Daily pipeline crew cost | $ 5,000 | per day | | |
| 5. Feet of pipe installed per day in roadway shoulder | 120 | feet per day | | |
| 6. Traffic control | $ 800 | per day | | |
| 7. Feet of pipe installed per day overland | 200 | feet per day | | |
| 8. Addition of emergency generator | | | | |

**A. CONSTRUCTION**

| Item | Quantity | UNITS | Unit Cost | Total |
|---|---|---|---|---|
| **Civil** | | | | |
| Well site preparation | 1 | LS | $ 8,000 | $ 8,000 |
| Well site yard piping | 200 | FT | $ 35 | $ 7,000 |
| Sample return line | 80 | FT | $ 25 | $ 2,000 |
| Well construction including pitless adapter | 1 | LS | $ 25,000 | $ 25,000 |
| Well site fencing, gates | 1 | LS | $ 6,000 | $ 6,000 |
| Power to well | 1 | LS | $ 2,000 | $ 2,000 |
| Distribution pipe materials - 4" PVC - in roadway shoulder | 2,500 | FT | $ 16.00 | $ 40,000 |
| Distribution pipe installation - 4" PVC - in roadway shoulder | 21 | DAYS | $ 5,000 | $ 104,167 |
| Roadway Crossings by Directional Drill | 2 | LS | $ 5,000 | $ 10,000 |
| Traffic Control | 21 | DAYS | $ 800 | $ 16,667 |
| Distribution pipe materials - 4" PVC - overland | 700 | FT | $ 16.00 | $ 11,200 |
| Distribution pipe installation - 4" PVC - overland | 4 | DAYS | $ 5,000 | $ 17,500 |
| Building Connections | 6 | LS | $ 800 | $ 4,800 |
| **Mechanical / Process** | | | | |
| Well pump | 1 | LS | $ 4,500 | $ 4,500 |
| Process piping modifications | 1 | LS | $ 4,000 | $ 4,000 |
| New chemical feed pumps for pacing | 4 | EA | $ 1,000 | $ 4,000 |
| **Electrical / I&C / SCADA** | | | | |
| Well pump controller | 1 | LS | $ 4,500 | $ 4,500 |
| Programmable Logic Controller | 1 | LS | $ 10,000 | $ 10,000 |
| SCADA system programming | 1 | LS | $ 10,000 | $ 10,000 |
| Instrumentation | 1 | LS | $ 4,000 | $ 4,000 |
| General interior wiring, conduit | 1 | LS | $ 35,000 | $ 35,000 |
| On-line chlorine monitor | 1 | LS | $ 1,500 | $ 1,500 |
| On-line pH monitor | 1 | LS | $ 1,500 | $ 1,500 |
| Backup generator, transfer switch | 1 | LS | $ 60,000 | $ 60,000 |
| Telemetering | 1 | LS | $ 4,000 | $ 4,000 |
| Subtotal | | | | $ 397,000 |
| Mobilization/Demob | 5% | | | $ 20,000 |
| OH&P | 18% | | | $ 71,000 |
| Construction contingency | 25% | | | $ 100,000 |
| **Total construction contract cost estimate** | | | | **$ 588,000** |
| | | | | |
| **B. ENGINEERING** | | | | |
| Well Exploration, Testing and Permitting | | | | $ 24,000 |
| Source of Supply Design and Permitting | | | | $ 63,000 |
| Pipeline Design and Permitting | | | | $ 30,000 |
| Bidding | | | | $ 9,000 |
| CA/RPR | | | | $ 82,000 |
| **Total Engineering** | | | | **$ 208,000** |
| | | | | |
| **TOTAL OPINION OF CAPITAL COST** | | | | **$ 796,000** |

| Alternative C: Add Pumped Storage to School System | | | | |
|---|---|---|---|---|
| | | | | |
| Assumptions | | | | |
| 1. Circular, at-grade storage tank - 16' diameter x 16' high | 24,000 | gallons | | |
| 2. At-grade storage tank with insulation, foundation cost | $ 3.00 | per gal | | |
| 3. Precast pump and control building - 12' x 14' | 168 | sf | | |
| | | | | |
| **A. CONSTRUCTION** | | | | |
| **Item** | **Quantity** | **UNITS** | **Unit Cost** | **Total** |
| **Civil** | | | | |
| Tank site preparation | 1 | LS | $ 8,000 | $ 8,000 |
| Tank site yard piping | 200 | FT | $ 35 | $ 7,000 |
| Tank site fencing, gates | 1 | LS | $ 15,000 | $ 15,000 |
| Insulated, glass-lined steel water storage tank with foundation - 16' dia x 16' high | 24,000 | GAL | $ 3.00 | $ 72,000 |
| Power to site | 1 | LS | $ 5,000 | $ 5,000 |
| **Building** | | | | $ - |
| Precast building w/door, openings - 12' x 14' | 168 | SF | $ 250 | $ 42,000 |
| Foundation - 12' x 14' | 168 | SF | $ 50.00 | $ 8,400 |
| HVAC | 1 | LS | $ 10,000 | $ 10,000 |
| **Mechanical / Process** | | | | |
| Booster pumps | 2 | LS | $ 3,500 | $ 7,000 |
| Interior piping | 1 | LS | $ 10,000 | $ 10,000 |
| Tank fill control valve, check valves | 3 | LS | $ 2,000 | $ 6,000 |
| **Electrical / I&C / SCADA** | | | | |
| Programmable Logic Controller | 1 | LS | $ 5,000 | $ 5,000 |
| SCADA system programming | 1 | LS | $ 5,000 | $ 5,000 |
| Instrumentation - flow, pressure | 1 | LS | $ 7,000 | $ 7,000 |
| General interior wiring, conduit | 1 | LS | $ 30,000 | $ 30,000 |
| Electrical power panels | 1 | LS | $ 12,000 | $ 12,000 |
| Lights, alarms | 1 | LS | $ 8,000 | $ 8,000 |
| Telemetering | 1 | LS | $ 4,000 | $ 4,000 |
| Subtotal | | | | $ 261,000 |
| Mobilization/Demob | 5% | | | $ 13,000 |
| OH&P | 18% | | | $ 47,000 |
| Construction contingency | 25% | | | $ 66,000 |
| **Total construction contract cost estimate** | | | | **$ 387,000** |
| | | | | |
| **B. ENGINEERING** | | | | |
| Design | | | | $ 48,000 |
| Bidding | | | | $ 8,000 |
| CA/RPR | | | | $ 54,000 |
| **Total Engineering** | | | | **$ 110,000** |
| | | | | |
| **TOTAL OPINION OF CAPITAL COST** | | | | **$ 497,000** |

| Alternative D: Individual Building Well Supplies | | | | |
|---|---|---|---|---|
| | | | | |
| Assumptions | | | | |
| 1. 1000' deep rock well with submersible pump & pitless adapter | | | | |
| 2. Include arsenic removal filter & UV disinfection | | | | |
| | | | | |
| **A. CONSTRUCTION** | | | | |
| | | | **Unit** | |
| **Item** | **Quantity** | **UNITS** | **Cost** | **Total** |
| **Civil** | | | | |
| Well construction including pitless adapter | 7 | LS | $ 18,000 | $ 126,000 |
| Power to well | 7 | LS | $ 500 | $ 3,500 |
| **Mechanical / Process** | | | | |
| Well pump | 7 | LS | $ 1,000 | $ 7,000 |
| Piping/plumbing | 7 | LS | $ 1,000 | $ 7,000 |
| Arsenic filter | 7 | EA | $ 800 | $ 5,600 |
| UV Unit | 7 | EA | $ 600 | $ 4,200 |
| Hydropneumatic storage tank | 7 | LS | $ 800 | $ 5,600 |
| **Electrical** | | | | |
| Well pump controller | 7 | LS | $ 1,500 | $ 10,500 |
| General interior wiring, conduit | 7 | LS | $ 2,500 | $ 17,500 |
| Subtotal | | | | $ 187,000 |
| Mobilization/Demob | 5% | | | $ 9,000 |
| OH&P | 18% | | | $ 34,000 |
| Construction contingency | 25% | | | $ 47,000 |
| **Total construction contract cost estimate** | | | | **$ 277,000** |
| | | | | |
| **B. ENGINEERING** | | | | |
| | | | | |
| Bid specifications | | | | $ 22,000 |
| Bidding | | | | $ 8,000 |
| Construction phase engineering | | | | $ 33,000 |
| **Total Engineering** | | | | **$ 63,000** |
| | | | | |
| **TOTAL OPINION OF CAPITAL COST** | | | | **$ 340,000** |