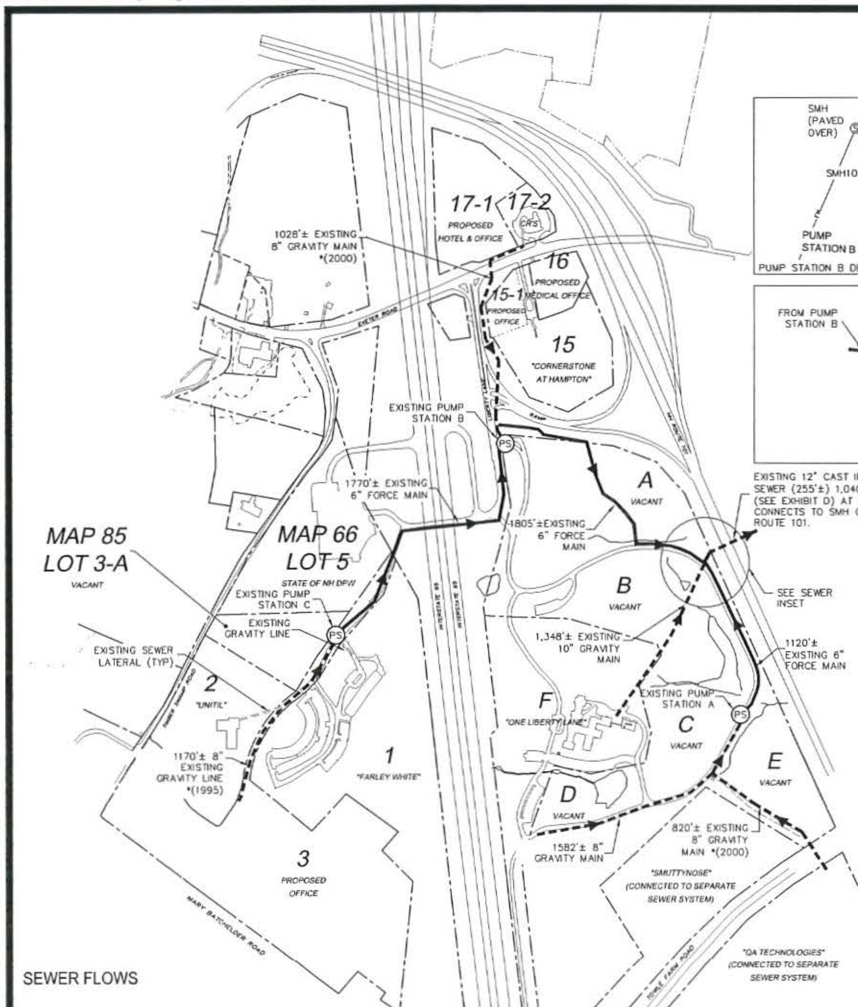
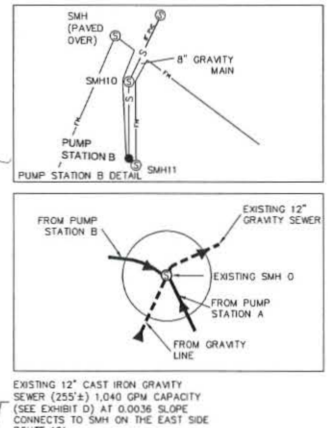
EXHIBIT A





NOTES

1. ASSUMES MAP 66 LOT 5 AND MAP 85 LOT 3-A DO NOT CONTRIBUTE TO SEWER FLOWS.
2. ALL PROPOSED DEVELOPMENT SHOWN IS TO AID WITH THE SEWER SUMMARY FOR THE LIBERTY LANE SEWER ASSOCIATION AND IS SUBJECT TO CHANGE. ALL DEVELOPMENT IS SUBJECT TO THE REVIEW AND FINAL APPROVAL BY THE TOWN AND OWNERS AND SHALL BE REQUIRED TO OBTAIN ALL APPLICABLE LOCAL, STATE AND FEDERAL PERMIT APPROVALS.
3. UTILITIES SHOWN HEREON ARE A COMPILATION OF FIELD LOCATION AND RECORD PLANS. THEY ARE APPROXIMATE LOCATIONS ONLY. CONTACT DIGSAFE AND DPW TO VERIFY UTILITIES.

LEGEND

- EXISTING SEWER GRAVITY LATERAL INTO MAIN (NOT PART OF LIBERTY LANE SEWER ASSOCIATION)
- EXISTING SEWER GRAVITY MAIN
- EXISTING SEWER FORCE MAIN
- (PS) EXISTING PUMP STATION
- ▶ DIRECTION OF FLOW

PLAN REFERENCES:

1. "SEWER & PUMPING STATION SCHEMATIC" DATED 7/25/08 PREPARED BY ALTUS ENGINEERING, INC. (SEE EXHIBIT F)

SEWER FLOWS

TO PUMP STATION A

PARCEL	TAX MAP/LOT	EXISTING/PROPOSED USES	EXISTING/PROPOSED FLOWS (GPD)	BASED ON
C	67/2	VACANT/30,000 SF OFFICE	0/1,500	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
D	67/2	VACANT/20,000 SF OFFICE	0/1,000	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
E	67/2	VACANT/40,000 SF OFFICE	0/2,000	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
--	--/--	INFILTRATION	1,104	SEE EXHIBIT E (INFILTRATION CALCS)

TO PUMP STATION B

PARCEL	TAX MAP/LOT	EXISTING/PROPOSED USES	EXISTING/PROPOSED FLOWS (GPD)	BASED ON
15	67/1	VACANT/HEALTHCARE FACILITY (108 BEDS, 10 EE'S)	0/13,700	NHDES - NURSING HOME (125 GPD/BED + 20 GPD/EE)
15-1	67/1	VACANT/5,000 SF OFFICE SPACE	0/250	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
16	52/4	VACANT/6,000 SF MEDICAL OFFICE	0/300	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
17-1	52/1	VACANT/104 ROOM HOTEL (15 EE'S) + 40,000 SF OFFICE	0/22,950	NHDES - HOTEL (200 GPD/ROOM + 10 GPD/EE) + UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
17-2	52/2	RESTAURANT/RESTAURANT (84 OCCUPANTS TABLE SERVICE, 30 OCCUPANTS LOUNGE, 10 EE'S)	4,160/4,160	NHDES - TABLE SERVICE: 40 GPD/SEAT + 20 GPD/EE - LOUNGE: 20 GPD/SEAT + 20 GPD/EE
--	--/--	INFILTRATION	1,284	SEE EXHIBIT E (INFILTRATION CALCS)

TO PUMP STATION C

PARCEL	TAX MAP/LOT	EXISTING/PROPOSED USES	EXISTING/PROPOSED FLOWS (GPD)	BASED ON
1	103/1	OFFICE/OFFICE [80,000 SF]	4,000/4,000	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
2	85/3-2	OFFICE/OFFICE [45,000 SF]	2,250/2,250	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
3	102/3	VACANT/200,000 SF OFFICE	0/10,000	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
--	--/--	INFILTRATION	762	SEE EXHIBIT E (INFILTRATION CALCS)

GRAVITY FLOW TO SMH 0

PARCEL	TAX MAP/LOT	EXISTING/PROPOSED USES	EXISTING/PROPOSED FLOWS (GPD)	BASED ON
A	67/2	VACANT/20,000 SF OFFICE	0/1,000	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
B	67/2	VACANT/80,000 SF OFFICE	0/4,000	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
F	104/1	OFFICE/OFFICE [80,000 SF]	4,000/4,000	NHDES - UNSPECIFIED OFFICE SPACE (5 GPD/100 SF)
--	--/--	INFILTRATION	1,770	SEE EXHIBIT E (INFILTRATION CALCS)

SUMMARY OF SEWER FLOWS (PROPOSED)

TO PUMP STATION A	= 5,604 GPD = 3.9 GPM
TO PUMP STATION B	= 42,644 GPD = 29.6 GPM (+ PUMP STATION C (17,012 GPD) = 59,656 GPD = 41.4 GPM)
TO PUMP STATION C	= 17,012 GPD = 11.8 GPM
GRAVITY FLOW TO SMH 0	= 10,770 GPD = 7.5 GPM

TOTAL = 76,030 GPD = 52.8 GPM (FLOW UNDER ROUTE 101 TO MUNICIPAL SYSTEM)

MAX CAPACITY SMH 0 OUTLET PIPE = 1,497,600 GPD = 1,040 GPM

DRAFT

SUMMARY OF SEWERAGE
TOTAL GRAVITY PIPE=6,203'±
TOTAL FORCE MAIN=4,695'±

*DATES SHOWN FOR PIPE LENGTHS ARE FROM DESIGN PLANS.

REV.#6 04/10/17 REVISED TO REVISE LATERAL SITE F
REV.#5 04/06/17 REVISED TO IDENTIFY LATERALS
REV.#4 03/16/17 REVISED PER NHDES DESIGN FLOWS
REV.#3 12/07/16 ADD PUMP STATION DETAIL
REV.#2 10/26/16 REVISE FORCE MAIN
REV.#1 09/07/16 ADD LENGTHS & DESIGN DATES

SEWER AND PUMPING STATION SCHEMATIC

LIBERTY LANE, TIMBER SWAMP ROAD AND EXETER RD HAMPTON, NEW HAMPSHIRE

PREPARED FOR
SEACOAST CROSSROADS REALTY COMPANY, LLC

SCALE: NOT TO SCALE
JULY 26, 2016

TFM MSC
Civil Engineers, Structural Engineers, Traffic Engineers, Land Surveyors, Landscape Architects, Scientists
170 Commerce Way, Suite 102 Portsmouth, NH 03801
Phone (603) 431-2222
Fax (603) 431-0910
www.mscengineers.com

20005.00 DR JRW FB CK JCC CADFILE 20005.00_Sewer & Pump Station Schematic.dwg

EXHIBIT B

Town of Hampton

James A. Waddell, Chairman
Regina M. Barnes, Vice Chairman
Richard P. Griffin, Selectman
Philip W. Bean, Selectman
Russell D. Bridle, Selectman

Frederick W. Welch
Town Manager

Kristina G. Ostman
Administrative Assistant

July 17, 2017

Deborah Szaro, Administrator
US Environmental Protection Agency
EPA New England Region 1
5 Post Office Square, Suite 100
Boston, Massachusetts 02109-3912

Re: Coakley Landfill, Greenland and North Hampton, NH

Dear Director Szaro:

The Town of Hampton, New Hampshire, acting through its Board of Selectmen, has grave concerns regarding the release of PFC's (PFOS, PFOA and others') from the Coakley Landfill located in the Towns of Greenland and North Hampton, New Hampshire. We understand that one PFC, in particular, was detected at the third highest concentration in the world in Coakley monitoring wells and Berry's Brook.

It is our understanding that these contaminants have been documented in test wells outside of the landfill. PFC's were also detected at levels above the EPA advisory approximately 8400 feet from the public water supply wells (Garland Well) located in the Town of Rye. Elevated levels of these contaminants have also been documented to exist in a public water body known as Berry's Brook that is used for public fishing and is currently stocked with fish by the State of New Hampshire Department of Fish and Game. This brook is a popular fishing area with brown trout being taken and presumably being consumed by anglers and their families for food. Sanderson Pond, another popular fishing and family swimming location has not been tested for PFCs, as far as we know.

The Town of Hampton receives its public water supply through Aquarion Water Company with well fields located in North Hampton, Stratham and Hampton, some within proximity to the Coakley Landfill. Aquarion is requesting to test pump a new deep bedrock well located in Hampton at a depth below sea level which, due to its location, may cause saltwater contamination of the valuable aquifer. The test pump is slated to be carried out in the near future at a rate of 1,350,000 gallons per day, if permitted by the State. We are informed that the outlying Coakley test wells show contamination that may be aided in their movement by tests utilizing high pumping rates as are projected for Aquarion's Well 22. A number of public water supply wells are located between Well 22 and Coakley, with the outlaying test wells for Coakley showing signs of contamination it is advisable to add additional wells further from the landfill to indicate the position, direction of movement and depth of the contamination plume to properly determine the potential for loss of drinking water wells with this task being undertaken before high yield pump tests are undertaken that may increase the movement of the plume.

The Board has been informed and is very concerned that the Aquarion wells located on Little River have shown signs of PFC contamination. The Aquarion system serves a summer population in excess of 100,000 people including the permanent population of the three communities serviced by Aquarion.

The Town of Hampton believes and requests that Aquarion must be ordered to test its wells for PFC intrusion/contamination and for VOC's on a weekly basis until such time as the release from Coakley has been arrested and disposed of either through removal of the hazardous waste, its plume and or the landfill.

The Town of Hampton requests that the EPA order Aquarion Water Company to cancel its plans to pump well 22 on a test or permanent monthly basis until further notice.

This is an urgent environmental problem. We request the EPA's immediate action to protect the hundreds of thousands of citizens how many be subjected to irreparable harm because of delayed action.

Sincerely

James A. Waddell, Chairman

Regina W. Barnes, Vice Chairman

Richard P. Griffin

Philip W. Bean

Russell D. Bridle

Board of Selectmen

CC: Christopher Sununu, Governor
Jeanne Shaheen, United States Senator
Maggie Hassan, United States Senator
Carol Shea-Porter, United States Representative
Daniel E. Innis, New Hampshire Senator

Martha Fuller Clark, New Hampshire Senator
Philip W. Bean, New Hampshire Representative
Robert Renny Cushing, New Hampshire Representative
Michael A. Edgar, New Hampshire Representative
J. Tracy Emerick, New Hampshire Representative
Rio H. Tilton, New Hampshire Representative
Mindi F. Messmer, New Hampshire Representative
Kate Murray, New Hampshire Representative
Henry A. Marsh, New Hampshire Representative
Tamare Le, New Hampshire Representative
Daniel J. Malloy, New Hampshire Representative
Laura C. Pantelakos, New Hampshire Representative
Rebecca McBeath, New Hampshire Representative
Peter F. Somssich, New Hampshire Representative
Gerald W.R. Ward, New Hampshire Representative
Pamela S. Gordon, New Hampshire Representative
Jacqueline A Cali-Pitts, New Hampshire Representative
Christine Bowman, NH DES, Drinking & Groundwater Bureau
EverSource Energy
Public Service Company of New Hampshire

EXHIBIT C

McLane

McLane, Graf,
Raulerson &
Middleton

Professional Association

FIFTEEN NORTH MAIN STREET • CONCORD, NH 03301-4945
TELEPHONE (603) 226-0400 • FACSIMILE (603) 230-4448

SARAH B. KNOWLTON
Direct Dial: (603) 334-6928
Internet: sarah.knowlton@mclane.com

OFFICES IN:
MANCHESTER
CONCORD
PORTSMOUTH

March 23, 2007

By Hand Delivery

Debra A. Howland
Executive Director and Secretary
New Hampshire Public Utilities Commission
21 S. Fruit Street, Suite 10
Concord, NH 03301

Re: DW 05-119;Aquarion Water Company of New Hampshire

Dear Ms. Howland:

Pursuant to the Settlement Agreement and Order 24,648, I enclose seven copies of Aquarion Water Company of New Hampshire's engineering review of its existing hydrants and related recommendations. The Company has already implemented most of the recommendations and will implement the rest on a phased basis.

I have provided an electronic copy of the filing to the PUC librarian and the parties, with the exception of Mr. Fuller, who is being served with a hard copy by first class mail.

Thank you for your assistance with this matter. Please feel free to call me if you have any questions.

Very truly yours,

Sarah B. Knowlton

Sarah B. Knowlton

Enclosures

cc: Service List (via e-mail)
Larry Bingaman
Steven V. Camerino, Esq.

March 22, 2007

Mr. Adam A. Torrey
Operations Supervisor
Aquarion Water Company
One Merrill Industrial Drive, Suite D
Hampton, NH 03842

Subject: Hydrant Evaluation Program
T&H No. 1838

Dear Adam:

This letter report contains the results of Tata & Howard's (T&H) evaluation of Aquarion Water Company's (Aquarion) hydrant maintenance program. This letter summarizes the physical characteristics of hydrants in the Aquarion system, current procedures that Aquarion has implemented for hydrant maintenance, a summary of the American Water Works Association suggested procedures for hydrant maintenance, and recommendations for Aquarion to improve their hydrant maintenance program. The purpose of the hydrant maintenance program is to assist in the reliable operation of the hydrants located within the distribution system.

Background

The Aquarion system serves the Towns of North Hampton and Hampton, and a portion of Rye, New Hampshire. Based on system maps provided by Aquarion, the following is a breakdown of the number of hydrants in each Town:

Hydrant Summary
Hydrant Evaluation
Aquarion Water Company

Town	Number of Hydrants
Hampton	270
North Hampton	148
Rye	66
Total	484

The hydrants in the Aquarion system vary as to manufacturer and model, which is characteristic of a system that has been in operation for 100 years. All of the hydrants in the system are dry-barrel hydrants, meaning that they automatically drain once the hydrant is turned off. Dry-barrel hydrants are often used in colder climates, where freezing water will damage hydrants if left in the barrel after use.

Currently, Aquarion has standardized on the Medallion hydrant manufactured by Clow Valve Company of Oskaloosa, Iowa. Standardizing on a single type of hydrant simplifies maintenance and spare-parts purchasing. Recently, Aquarion has standardized on a 5-1/4 inch main valve opening instead of a 4-1/2 inch opening. A hydrant with 5-1/4 inch main-valve opening can provide slightly more flow than a hydrant with a 4-1/2 inch opening based on laboratory testing performed by Utah State University. For detailed information, please refer to Attachment A for a comparison of flow characteristics between the 5-1/4 and 4-1/2 inch main valve sizes.

It is important to note that the inherent carrying capacity of the water mains impacts the available flow at the hydrant. As outlined in the draft Integrated Water Resource Plan, (IWRP), which is being finalized, there are Insurance Services Office (ISO) fire flow requirements that can not be met. Infrastructure improvements identified in the IWRP are required to improve the transmission capabilities of the system and increase the available flow from the hydrants. Replacing the existing hydrants with hydrants with 5-1/4 inch openings will not mitigate the deficient fire flows. It is acceptable practice to install hydrants with 4-1/2 inch diameter main valves and, in our experience, most public water systems have hydrants with 4-1/2 inch main valve openings. Standard nozzle sizes and styles which come on the Medallion hydrants will not cause any compatibility issues.

Aquarion Hydrant Inspection and Maintenance Procedures

Aquarion's current hydrant maintenance program has several components. The hydrants in the Aquarion system are uniquely numbered, the numbers are stenciled on the hydrants, and logs are kept to indicate the date of installation and necessary repairs.

Aquarion has an ongoing inspection program. Hydrants are formally inspected, tested and maintained in the spring and fall/winter. However, during the year hydrants may be serviced more frequently as the field staff perform maintenance on the system. Aquarion personnel visually inspect hydrants to make sure they are operational. Damaged hydrants are bagged and tagged until they are repaired. The local Fire Departments are notified within 24 hours when a hydrant is temporarily out of service. Aquarion typically repairs or replaces damaged hydrants within 72 hours. Aquarion maintains an inventory of spare

hydrants and parts to facilitate expeditious repairs.
In the fall, Aquarion performs a semi-annual inspection of the hydrants in the system to see if hydrants are functioning and draining properly. The following procedure has been implemented:

1. Listen to hydrant for any leak sound.
2. Remove caps and lubricate if needed.
3. Reinstall caps leaving one off.
4. Open hydrant until water flows about half the nozzle. Run until water runs clean.
5. Replace cap.
6. Open hydrant fully. This lubricates the stem.
7. Listen to hydrant again to check the drain rubbers to make sure they close.
8. Close the hydrant.
9. Remove cap and look to see if the hydrant is draining.
10. Pump out if not draining.
11. Listen to hydrant again to make sure it is tightly closed.

Aquarion removes brush and weeds around the hydrants in the spring and summer. This is to improve the accessibility of the hydrants. Additionally, now that all hydrants were painted in 2006, about 25% will be painted or touched up annually in subsequent summers.

In addition to the semi-annual inspection, Aquarion conducts a yearly flushing program. The primary purpose of the flushing program is to prevent the accumulation of deleterious material in the distribution system. Additionally, the flushing program provides the operators another opportunity to inspect hydrants in the system and to operate the mechanical components of the hydrant. Operating the hydrants can prevent the corrosion and breakage of mechanical parts that can result from lack of use. Aquarion developed and implemented a comprehensive unidirectional flushing program in 2006 in order to improve water quality and remove accumulated deposits from the mains. With a directional flushing program, gate valves are closed to isolate the section to be flushed from the remainder of the system and prevent stirred up debris from traveling to other areas of the system. The unidirectional flushing program will be conducted every other year in lieu of the regular annual flushing program. A standard flushing program consists of opening and flushing hydrants without closing gate valves. This is also an effective approach to removing deposits from the water mains.

Aquarion has also implemented a program that classifies hydrants based on their estimated flow capacity in accordance with AWWA's Uniform Color Scheme for Fire Hydrants. As mentioned above, flow capacity is a function of several factors, but particularly the size of the water mains. Using the existing hydraulic model of the system, the estimated available flow at each hydrant was assessed. Since approximately 90% were rated class AA (greater than 1,500 gpm), these hydrants are painted a standard color of yellow and white. Based on the AWWA system, the below color scheme will be used for class A, B and C:

more than 1500 wht/yellow

Hydrant Classification System
Hydrant Evaluation
Aquarion Water Company

Class	Flow Capacity	Paint Color
A	Between 1,000 and 1,500 gpm	Green
B	Between 500 and 1,000 gpm	Orange
C	Less than 500 gpm	Red

The aforementioned maintenance procedures are performed according to the following schedule:

Inspection and Maintenance Schedule
Hydrant Evaluation
Aquarion Water Company

Ongoing	Visual hydrant inspection
Fall/ Winter	Inspection and winterization
Spring	Inspection and brush and weed removal
Summer	Sand and paint hydrants

AWWA Hydrant Maintenance Requirements

Lubrication and inspection for debris are the most important elements of hydrant maintenance. Since the primary purpose of hydrants is to provide fire protection, it is essential that hydrants are kept operational and that non-functioning hydrants are identified and quickly repaired. Hydrants should be painted regularly so they are easily visible to fire department staff. Also, since hydrants are the most visible element of a water distribution system, regular aesthetic attention is warranted.

For the purpose of fire protection, any accumulation of vegetation around a hydrant should be removed. Access to the hydrant should be free from any physical barriers, which can arise from natural or human causes.

Most of these requirements can be met by a routine inspection schedule. The inspection would involve testing each hydrant's operational characteristics and performing a visual check of hydrant parts and of the hydrant's immediate environment. An inspection procedure developed by the AWWA is provided as Attachment B. Aquarion already incorporates many of the elements of the AWWA inspection into their yearly inspection procedures.

We have provided some operational tips taken from AWWA's "Hydrant Manual." These tips will allow for reliable operation of the hydrants in the Aquarion system. In addition, AWWA recommends that a detailed record-keeping procedure is followed whenever a hydrant is inspected, repaired, or flow-tested. Aquarion now has a detailed record-keeping procedure in place.

Operational Tips

- Hydrants are designed to be operated by one person using a 15-inch wrench. A hydrant that can not be opened in this manner should be considered malfunctioning and should be replaced.
- Wrenches not designed for use on hydrant operating nuts should not be used to open and close hydrants. Special extensions for hydrant wrenches, which are used to generate additional torque on the nuts, should also be avoided.
- Hydrants should be opened and closed very slowly to prevent water hammer in the distribution system.
- Hydrants should always be kept completely closed or completely opened. If the hydrant is left partially open, the hydrant drain may also remain open. This allows debris to become lodged in the hydrant drain. A hydrant that is left only partially closed may continue to leak out of the drain valve. This can cause erosion in the soil around the hydrant, loss of revenue from unaccounted for water and additional operational costs.
- Any time a hydrant is disassembled for repair all gaskets, packing, and seals should be replaced, regardless of whether or not they appear worn.

AWWA recommends performing annual inspections of system hydrants during the fall. This allows maintenance crews to spot malfunctioning hydrants that may not be draining properly. Repairing poorly draining hydrants before the winter will prevent cracked barrels caused by water freezing in the hydrant. The spring is the most appropriate time to conduct brush and weed removal.

Recommendations

Aquarion is currently implementing a majority of the procedures outlined by AWWA for hydrant maintenance. We recommend that Aquarion implement the inspection procedure developed by AWWA, included in Attachment B. Maintaining a strict schedule for flushing, brush removal, and inspection will assist in keeping the hydrants in the Aquarion system operational and will reduce maintenance costs into the future.

The following are recommendations for improved hydrant operation and maintenance:

1. Aquarion should continue with their ongoing inspection and maintenance program, including the flushing program, brush and weed removal in the spring; hydrant painting in the summer; hydrant inspection and winterization in the fall; and visual inspections of the hydrants year round with scheduled visual inspections in the winter, in accordance with AWWA recommendations.

2. Aquarion should continue with their ongoing inspection program in the fall, as recommended by AWWA. Additional steps can be added to Aquarion's existing program, such as exercising the 6-inch gate valves on the hydrant tee during the inspection, using ultrasonic leak detection equipment to identify leaks and main valve leakage, and checking the breakaway flange device for damage.

3. Aquarion should continue with their record-keeping procedures. The recent implementation of Aquarion's SAP information system will improve record keeping since all logs will be electronic.

4. Aquarion should continue to repair or replace damaged hydrants in a timely manner. In addition, coordination with the local fire departments should be continued so that fire protection is not compromised. The Fire Chief's Council Aquarion formed in 2006 should facilitate this coordination.

5. Although Aquarion has decided to replace damaged hydrants and install new hydrants with 5-1/4 inch main valve openings, it is not necessary to replace all existing hydrants with 4-1/2 inch valve openings that are functional. The available flow is affected primarily by the size of the main, the condition of the main, and the inherent carrying capacity of the main. As new mains are constructed or existing hydrants are damaged, hydrants with 5-1/4 inch valve openings can be installed.

We appreciate the opportunity to serve you in this matter. If you have questions, please do not hesitate to contact us.

Sincerely,

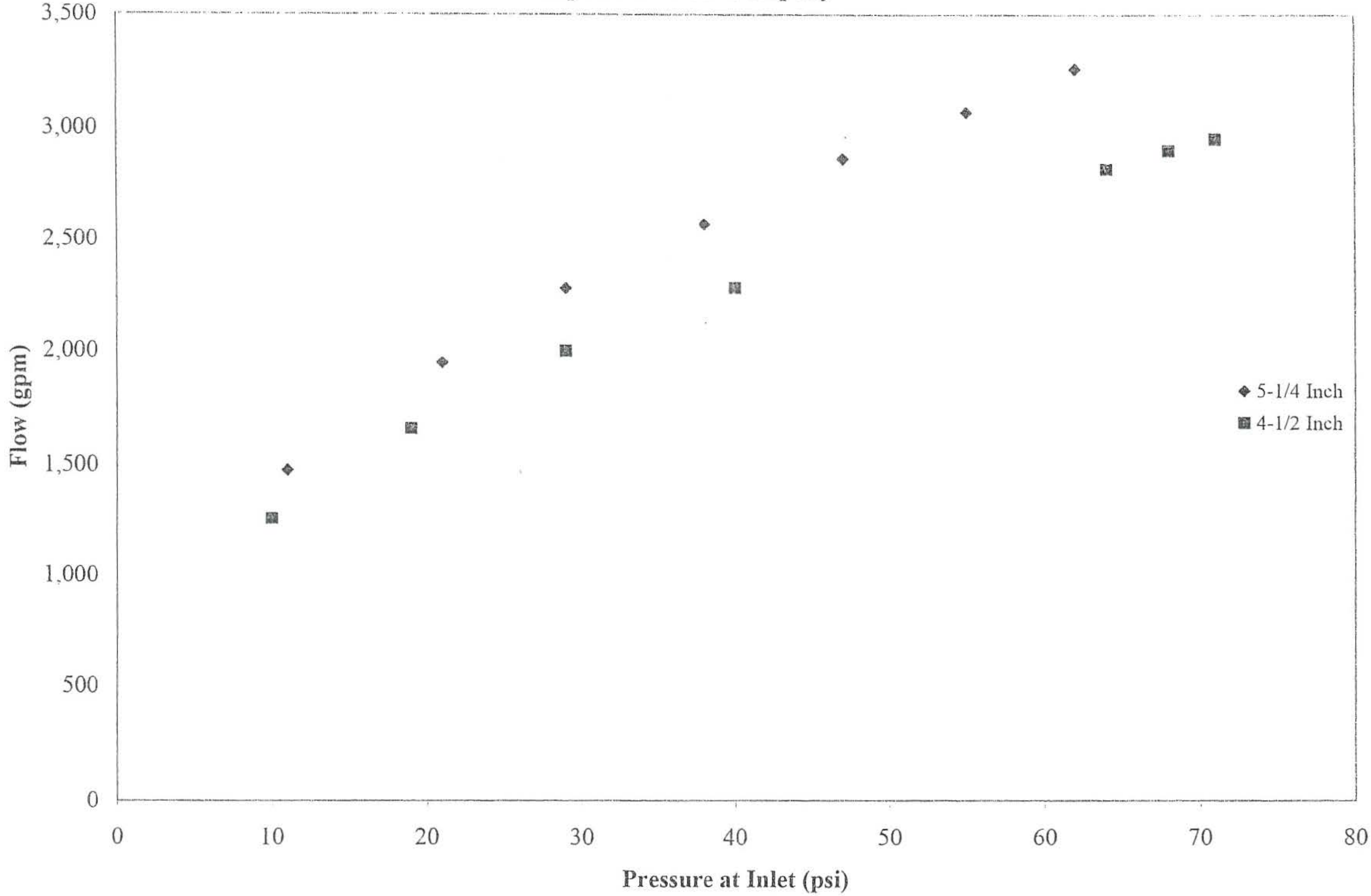
TATA & HOWARD, INC.

Donald J. Tata, P.E.
President

Attachments

cc: Mr. Larry L. Bingaman, Aquarion Water Company

Attachment A
Main Valve Size Flow Comparison
Hyrdrant Evaluation
Aquarion Water Company



23

Attachment B
AWWA Recommended Procedure for Hydrant Inspection
Hydrant Evaluation
Aquarion Water Company

	AWWA Hydrant Inspection Procedure	Notes
1.	Check the hydrants appearance. Remove obstructions around it. Raise and paint the hydrant as needed.	Changes in the the ground surface grade can necessitate the hydrant to be raised.
2.	Remove 1 outlet nozzle cap and use a listening device to check for main valve leakage.	
3.	Check for water or ice in barrel using a plumb bob.	
4.	Replace outlet-nozzle cap. Leave it loose enough to allow air flow.	
5.	Open the hydrant a few turns allowing air to vent.	
6.	Tighten the outlet-nozzle cap.	
7.	Open the hydrant fully.	Check for ease of operation. Opening and closing the hydrant repeatedly can remove any buildup that may have occurred.
8.	Check for leakage at flanges, around outlet nozzle, at packing or seals, and around stem. Repair as needed.	
9.	Partially close the hydrant so the drains open and water flows through under pressure for about 10 seconds, flushing the drain outlets.	
10.	Close the hydrant completely. Back off the operating nut enough to take the pressure off of the thrust bearing or packing.	
11.	Remove an outlet nozzle cap.	
12.	Attach a section of fire hose or other deflector for protection from water expelled at high velocity.	
13.	Open the hydrant and flush.	This removes foreign material from the interior of the hydrant.
14.	Close the hydrant. Remove the deflector and check the operation of the drain valve by placing the palm of one hand over the outlet nozzle. Drainage should be sufficiently rapid to create noticeable suction.	For no drain hydrants, pump the water from the barrel.
15.	Using a listening device, check the main valve for leakage.	
16.	Remove all outlet-nozzle caps, clean the threads, check the condition of the gaskets, and lubricate the threads. Check the ease of operation.	Graphite powder in oil works well, as do several of the never-seize compounds.
17.	Check outlet-nozzle cap chains or cables for free action. If the chains or cables bind, open the loop around the cap until they move freely.	This will keep the chains or cables from kinking when the cap is removed during an emergency.
18.	Replace the caps tighten them, and then back off slightly so they will not be excessively tight.	Leave the caps tight enough to prevent their removal by hand.
19.	Check the lubrication of operating-nut threads.	Lubricate per the manufacturer's recomedations.
20.	Locate and exercise the auxiliary valve. Leave it in the open position.	
21.	Check breakaway device for damage.	
22.	Clearly mark hydrants that are inoperable, and schedule their repair.	This may save valuable time in an emergency.

EXHIBIT D

The State of New Hampshire
Department of Environmental Services

Robert R. Scott, Commissioner

August 3, 2017

David Niemeyer
Geosphere Environmental Management Inc.
51 Portsmouth Ave
Exeter, NH 03833

transmitted via email to dniemeyer@geospherenh.com

RE: Preliminary Large Well Siting/Large Groundwater Withdrawal Permit Application
Aquarion Water Company, PWS ID 1051010
Well 22
Hampton, New Hampshire

Dear Mr. Niemeyer:

The New Hampshire Department of Environmental Services (NHDES) has reviewed the preliminary community well siting and large groundwater withdrawal permit application (Preliminary Application) titled "Preliminary Report and Large Groundwater Withdrawal Permit Application (Env-Wq 403, Env-Dw 302), Aquarion Water Company of New Hampshire, Well 22, Little River Road, Hampton, NH" prepared by Geosphere Environmental Management Inc. (Geosphere) on behalf of the Aquarion Water Co. (Aquarion), dated March 25, 2017. In summary, Aquarion is seeking large well siting approval and a large groundwater withdrawal permit for one new bedrock production well, designated Well 22, located in Aquarion's existing well field off of Little River Road in Hampton. The proposed initial permitted production volume is 1,350,000 gallons per day (gpd), or 940 gallons per minute (gpm) over a 24-hour period.

At the request of the town of Hampton, NHDES held a public hearing on the Preliminary Application on June 5, 2017, in accordance with RSA 485-C:21, IV. Per RSA 485-C:21, V, NHDES accepted written comments on the Preliminary Application for a 45-day period following closure of the public hearing. The 45-day written comment period ended on July 20, 2017.

NHDES conducted its review of the Preliminary Application in accordance with New Hampshire Administrative Rules Env-Wq 403, *Large Groundwater Withdrawals* and Env-Dw 302, *Large Production Wells and Wells for Large Community Water Systems*.

NHDES cannot approve the Preliminary Application at this time. Please submit responses to the following comments:

1. Regarding issues related to the 400-foot sanitary protective area (SPA) requirements of Env-Dw 302.10 for the proposed new well, NHDES offers the following; please be advised, although Aquarion may decide to proceed with a response to this letter, the preliminary application process, a pumping test, etc. on this source prior to securing ownership or control of the SPA, failure to demonstrate ownership or control of the SPA at the point in time when the new source testing is complete may restrict NHDES' ability to issue an approval for the well as a source for a community water system.

2. In reference to the conceptual hydrologic model of the site and surrounding area (Env-Wq 403.07, section 4.0), provide a description of any regional bedrock structural features (mapped faults, lithologic contacts, etc.) that may be pertinent to the control of groundwater flow in the area. In addition to the information from VLF and lineament analysis, provide a map that depicts these structural features.

3. In reference to the potential and known contaminant source inventories conducted in accordance with Env-Dw 302.12 and 302.13, conduct a review of file(s) related to the former Hampton municipal landfill located south of the proposed well on the boundary of the preliminary wellhead protection area identified in the application (App E). The review should provide a summary of information available in local records and NHDES' Onestop database for waste sites, and assess the potential for the proposed well to influence groundwater in the vicinity of the landfill in the context of information about the site's hydrogeology, site related groundwater quality issues, areas of contamination, groundwater flow and identification of potentially available monitoring locations.

4. In reference to the water budget estimate conducted in accordance with Env-Wq 403.07; the approach taken to complete a water budget for the site and its recharge area were based, in part, on observations during 4 to 6 hour steps tests of the proposed new [bedrock] well and two nearby shallow overburden wells that showed minimal hydraulic response to the step testing. Although the step tests were relatively short duration, the report concluded that the pumpng of the proposed [bedrock] well had limited direct hydraulic connection or influence on groundwater in shallow overburden (soil deposits). In reference to the water balance discussion in the report, however, recharge available to the proposed well was attributed to infiltration of precipitation through shallow overburden. Please clarify the description on likely recharge mechanisms to the well and discuss other geologic, physiographic or topographic features that may be relevant to recharge to the well in this setting. Based on this clarification, describe any implications to the preliminary wellhead protection area for the proposed new well, and if/how it will effect the wellhead protection area refinement approach. Please note, contrary to the statement made in section 4.1 (page 3) of the report, the extent of shallow sand and gravel deposits in the vicinity of the proposed new well were not shown on Figure 6 of the report.

5. Pumping Test Proposal

Water use inventory and private well water level monitoring:

Although the discussion in sections 5.2 and 7.3 of the report provide a summary of the proposed approach to monitoring of private wells during the pumping test, it lacks a detailed inventory of water users and doesn't provide specific information on the locations actually proposed to be monitored during the test; in general, the submittal does not comply with the water user inventory requirements of Env-Wq 403.09(d-f). Therefore, complete an inventory of those private well users within an area that extends 1,000 feet outside of the estimated cone of depression (estimated zone of hydraulic influence of the withdrawal) – per the requirement of Env-Wq 403.(d). The inventory shall be based on:

- Well driller records,
- Areas served by public water,
- Water use and billing records within the service area of the water system,
- Local records/tax map-lot information, and
- Other pertinent information

The results of the inventory shall be presented on a map that depicts those lots within the inventory area and identifies those that have, or are likely to have, a private well. Per Env-Dw 302.14(h), an offer to monitor water levels shall be extended to all private wells within 1,000 feet of the proposed well, and representative private wells within an area that extends 1,000 feet from the estimated zone of hydraulic influence of the proposed well. Therefore, the map shall also depict the lots/wells that are targeted as potential monitoring locations that will be extended an offer to monitor water levels. The map shall be accompanied by a tabular summary of information about the private lots that includes tax lot/ID, address, owner name, well construction information, etc. and the information listed in Env-Wq 403.09 (d-e), as available, and depict all pumping test monitoring points, both proposed and established.

Also note that, per Env-Dw 302.14 (h)(1), offer-to-monitor letters shall be mailed to target locations no less than 14-days prior to the intended start date of the pumping test program following approval of the mailing list by NHDES. In reference to statements made in section 7.3, consideration should be made to gather water well inventory information (via the questionnaire) substantially early(ier) in the pumping test preparation process to identify potential monitoring locations to which offer-to-monitor letters are sent. Additionally, section 7.3 of the report pre-assigned the number of private wells that will be monitored during the testing program as eight (see bottom of page 20) even though the inventory of wells was not completed, please be advised that NHDES does not approve the approach of fixing the number of private well monitoring points prior to conducting the inventory referenced above, rather, the results of the inventory of water users and response to monitoring offers shall bring definition to the number and distribution of private wells included in the monitoring network. The need for dedicated monitoring wells will be assessed following identification of the actual locations of private wells to be monitored during the test.

Water quality monitoring:

Given the fact that the proposed new well is located in a coastal region near areas that are tidally influenced with brackish/saline waters, there is need to assess the potential that use of the well poses for introduction of saltwater into the formation (per Env-Dw 302.29(h)). Therefore, concurrent with the inventory of water users completed above, propose a plan to monitor for saltwater intrusion in well(s) located south-southeast, east, and northeast of the proposed well location. Water quality monitoring for the effects of saltwater introduction into the formation should be done for a relevant parameter (e.g. salinity, total dissolved solids [TDS], or specific conductance, etc.), and include measuring for the parameter prior to the start of the pumping portion of the test as well as during pumping. The need for additional water quality monitoring at other locations shall be reassessed following the revised monitoring plan above.

Surface water monitoring:

Section 5.3 states that an NH-certified wetland scientist shall conduct an assessment of wetlands/surface water within 1,000 feet of the proposed new source. Provide a copy of the results of the assessment (either on a map or summary report) once complete and propose a revision(s) of the wetland-surface water monitoring points, as necessary, based on its findings. In reference to Table 7-2, please note that surface water level measurements at SG-1 (and any other surface water monitoring point) shall be at least once every 6-hours in accordance with Env-Dw 302.14(g), as opposed to twice per day, and NHDES recommends a substantially higher resolution of measurements. The need for additional surface water monitoring points and measurement methods shall be reassessed following submission of a revised monitoring plan.

Pumping test discharge water:

- NHDES does support the proposal for discharging pumping test water into the water system, please note that Aquarion shall obtain prior written approval to discharge water from the proposed new well into the system from the Drinking Water & Groundwater Bureau's water supply engineering section. Please contact NHDES' sanitary engineer for the system for the requirements related to pre-pumping test water quality sampling and the design of the temporary connection.

- In reference to the discussion on the discharge rate flow measurements in section 7.6, per Env-Dw 302.14(e)(2), the pumping rate shall be measured at least as often as water level measurements in the new well after the first 10 minutes of pumping [see 302.14(f)(4)].

- Section 7.6 states that a calibration report for the pumping test flow meter shall be provided with the final report, please be advised the per Env-Dw 302.14(e), the calibration report for the flow meter shall indicate the meter was calibrated within the year prior to the pumping test.

Background monitoring well:

Although the report states that an ambient/background monitoring well will be determined, propose a location for at least one background monitoring well in accordance with the pumping test requirements of Env-Dw 302.14(f)(2), and depict the location of the proposed background monitoring well on the map referenced above, or another map.

Precipitation measurements during the pumping test:

Although section 7.4 states that rainfall will be measured to the nearest 0.1 <u>foot</u> during the testing program for the proposed new well, please note that Env-Dw 302.14(i) requires that rainfall be measured to the nearest 0.1 <u>inch</u> during the testing program.

If you have any questions about this letter or any other groundwater permitting issues please contact me at (603) 271-3918 or stephen.roy@des.nh.gov .

Sincerely,

Stephen Roy

Stephen Roy, P.G.
Drinking Water and Groundwater Bureau

cc: Carl McMorran; Aquarion (email)
Ray Talkington; Geosphere (email)
Town of Hampton (email)
Town of North Hampton (email)
Brandon Kernen, Rick Skarinka; NHDES (email)

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EXHIBIT E

Streamworks, PLLC

19 July 2017

Mr. Steven Roy

Drinking Water Source Protection Program

29 Hazen Drive

Concord, NH 03301

RE: Large Groundwater Withdrawal Application by Aquarion Water Company of New Hampshire, Well 22, Hampton, NH

Dear Mr. Roy

Please find enclosed my comments with respect to the large groundwater withdrawal application by Aquarion Water Company for Well 22 located in Hampton, NH. In my capacity, I am representing the interests of the Towns of Hampton and North Hampton and their citizens. Should you have any questions or comments about what I have presented, please feel free to contact me (ph: 603.862.1405, or e-mail: tom.ballestero@unh.edu).

Sincerely

Thomas P. Ballestero, PhD, PE, PH, PG, CGWP
Principal

Review and Comments on Large Groundwater Withdrawal Application and Preliminary Report and Large Groundwater Withdrawal Permit Application (Env-Wq 403, Env-Ws 302) Aquarion Water Company of New Hampshire Well 22, Little River Road Hampton, NH (24 Mar 2017)

Thomas P. Ballestero, PhD, PE, PH, CGWP, PG

19 July 2017

Introduction

This report is submitted on behalf of the Towns of Hampton and North Hampton, NH. The cited Large Groundwater Withdrawal Application and Report was reviewed and comments about the content of the application as well as recommendations for a longer duration pumping test are detailed in the following pages.

Discussion

The report reveals a fundamental inconsistency that needs to be addressed: while bedrock recharge is assumed to be from precipitation (although never measured/tested), it is also postulated that overburden Well 7 is insulated from nearby bedrock Well 22 pumping. A restrictive layer between the overburden above and the bedrock below, which prevents a hydraulic connection during pumping, would also prevent precipitation from recharging the bedrock. This raises the fundamental question of whether there is a restrictive layer between the overburden and the bedrock at this site and if there is, the nature of its extent. Water quality analyses to age date bedrock waters is recommended to verify the Application's conclusions about recharge. Further, longer term ambient monitoring data is needed to support or reject the very significant bedrock recharge hypothesis. Seven days is far too short to test this hypothesis. Because of the unique potential for salt water intrusion at this site, a very high degree of care must be applied to assure a sustainable supply is permitted that does not result in saltwater contamination of other parts of the aquifer.

The report is silent on saltwater intrusion. The ground at Well 22 is located approximately 50 feet above sea level; thus given the Well 22 drilled depth to 560 feet, the bottom of the well is therefore hundreds of feet below sea level. This bedrock formation extends under the Atlantic Ocean. There is a real possibility of saltwater intrusion as a result of large pumping rates that may only be manifested over the long term. Without proper monitoring, salt water intrusion would occur farther away from Well 22 (and would be caused by Well 22), but not recognized until too late. A lesson learned in attempts at remediating other NH seacoast aquifers is that pump and treat or in situ techniques take decades to centuries to be successful. At a minimum, this issue needs to be addressed in monitoring and the necessary responsible remedial actions to be taken should be proposed, especially since salt water may first show up in abutting homeowners' private wells.[1]

The step tests data sets were not provided, only graphical results which are impossible to analyze. For the step test data analysis as well as for the pumping test data, derivative drawdown

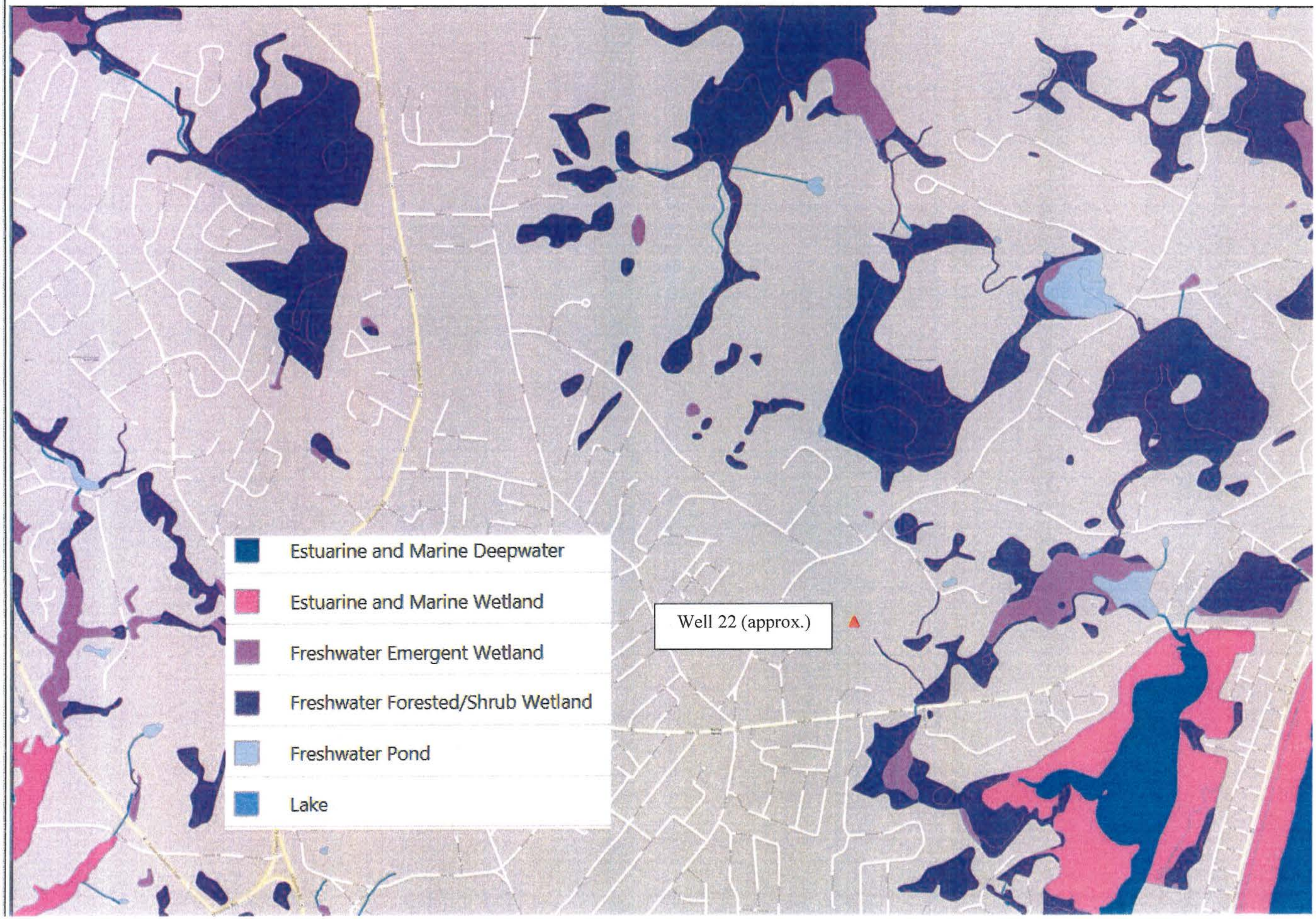
[1] Additionally, the expectation is for sea level to continue to rise, with the anticipated rise to be on the order of 4 feet by the end of the century. What will be the effects on this and other Aquarion well pumping on salt water intrusion? What is being done now to adapt and build resiliency?

analysis is recommended in order to better infer aquifer characteristics and recharge for estimates of long term consequences prior to the approval of the long term pumping test.

Bedrock groundwater studies in New Hampshire by the USGS and others demonstrate that while at the near scale fractures dictate hydraulics, at the large scale it is the low permeability zones that control the larger scale hydraulics, including recharge Shapiro, 2002). Conceptually, the bedrock is viewed as finite three dimensional zones of high permeability rock interconnected by surrounding zones of lower permeability rock. Depending on the size of (1) the high permeability zones, (2) recharge, (3) low permeability zone hydraulic conductivity, and (4) pumping rate, there are many possible outcomes for bedrock well yield. For the very high pumping rate proposed for Well 22, what often occurs is that well drawdown may follow classic groundwater hydrology until the immediate high permeability zone is dewatered, immediately followed by a dramatic increase in drawdown. This process may repeat until ultimately sufficient recharge is encountered (at great well drawdown) or pumping is reduced. The resulting well drawdown data looks very much like that of a step test. Therefore, it is essential that criteria be identified prior to the pumping test to establish the point at which pumping rates will be reduced. If, hypothetically, after two days it appears that well drawdown does stabilize at 160 feet, but within a few hours dramatically increases, at what drawdown level will the pumping rate need to be throttled? What should the new pumping rate be? How is the new pumping rate determined? How is the overall duration of the pumping test adjusted?

Wetlands were given little discussion in the report. Many towns have gone to great lengths to protect and preserve their wetlands, including Hampton and North Hampton. The mapped wetlands from NH Coastal Viewer may be found in Figure 1 below, depicting large fresh and salt water marsh complexes all within the expected wellhead area. Figure 2 below displays the mapped stratified drift deposits near to Well 22. There is overlap between the stratified drift and nearby wetlands; therefore wetlands may already be stressed by groundwater pumping. Care should be taken to clearly distinguish bedrock pumping stress from overburden stress. Additional piezometers located in appropriate wetland areas should be required as part of the pumping test monitoring regime as well as for longer term monitoring.

Monitoring is not a simple checklist task for the pumping test. A monitoring network needs to be designed and implemented to be employed not just for the pumping test, but also to accept, modify, or reject the conceptual hydrologic model and to establish a proper baseline for the long term status assessment of groundwater. A properly designed monitoring network bears witness to system health or warning signs of stress.


Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Well 22 (approx.)

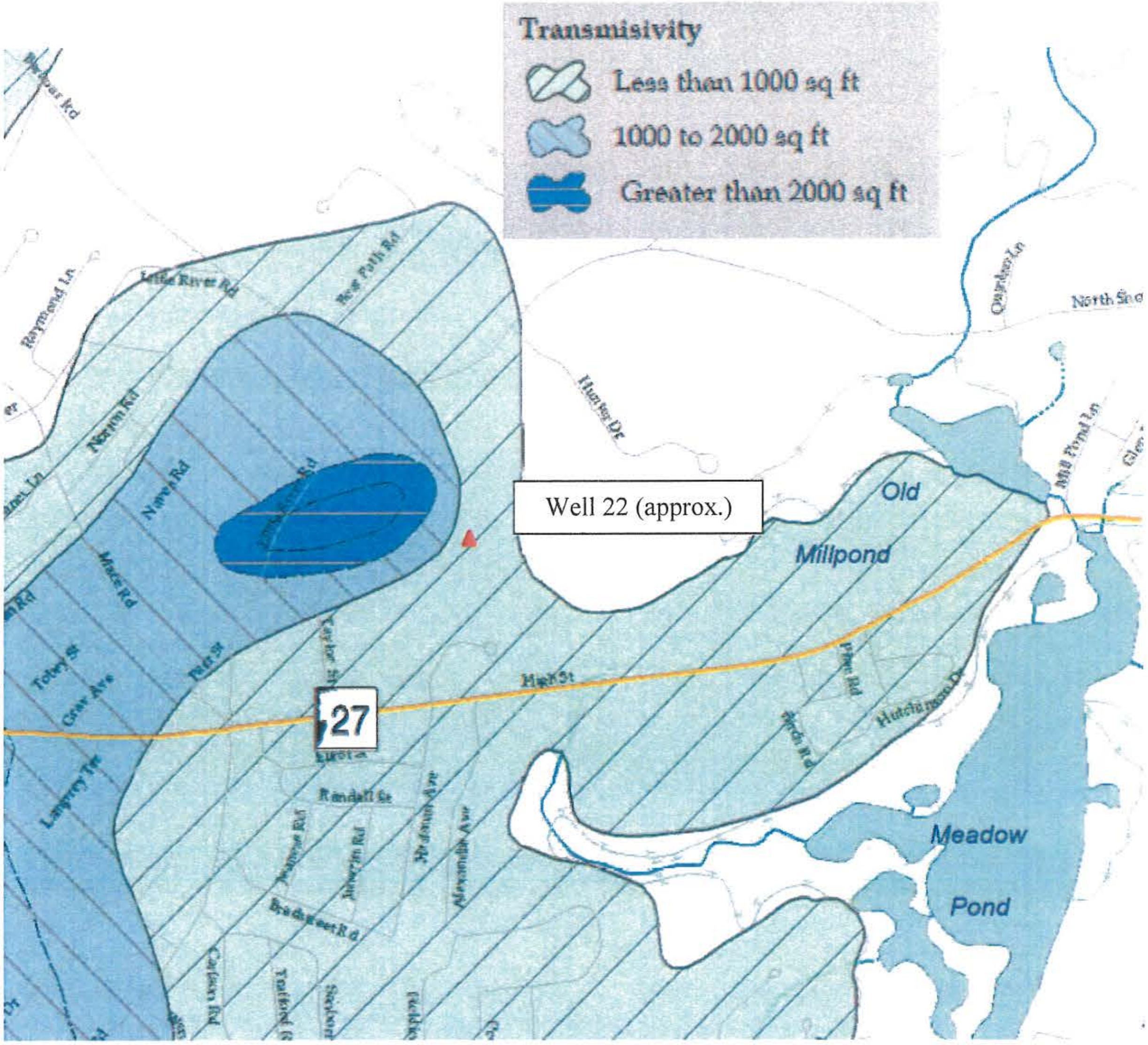


Figure 2. Mapped stratified drift deposits (USGS/NH GRANIT)

No attempt to analyze the step test data was presented in the Application. That analysis is important because developing estimates of the bedrock hydraulic characteristics from the step test assists in planning for the pumping test as well as the design of the monitoring network. For the step test data analysis as well as for the pumping test data, derivative drawdown analysis is recommended in order to better infer recharge for estimates of long term consequences. Step test data sets were not provided, only graphical results were displayed (Application, Appendix D), which prevents rigorous analysis of the step test data by reviewers. The step test information and analysis is needed to plan the pumping test and to estimate consequences of pumping scenarios. To understand the potential consequences of the pumping test and beyond, data from the 1996 pumping test of Aquarion Well 17A (then Hampton Water Works) was used to assist in the hydraulic assessment of Well 22. This pumping test included eight bedrock monitoring wells. Data analysis of this pumping test resulted in aquifer hydraulic characteristics findings of transmissivity of 337 ft^2/day and a storage coefficient of 0.00061. These values were then used to compute the drawdown at the end of the first step in each of the two Well 22 step tests as well as the 180-day predictions from same. The transmissivity of 337 ft^2/day resulted in excessive drawdowns compared to the step tests. Transmissivity that would do a better job of predicting drawdowns for these instances was 1,600 ft^2/day along with a storage coefficient of 0.0006. The drawdown predictions for these parameters in each of the step tests are found in the following Table 1.

Table 1. Predictions of end of first step drawdown and 180-day drawdown. T = 1,600 ft^2/day, S = 0.0006.

Step Test Date	Pumping Rate (gpm)	Time (days)	Computed Drawdown (ft)	Observed Drawdown (ft)
16-Oct-12	103	0.0451	14.1	5
16-Oct-12	401	180	86.6	80
4-Dec-16	400	0.0764	56.6	34
4-Dec-16	683	180	147.5	150

Using these bedrock parameters at the Well 22 site (T = 1,600 ft^2/day, S = 0.0006), distance drawdown plots for the proposed pumping test have been developed and are displayed in Figure 3 below. It is estimated that during this pumping test, the water level of Well 22 should remain above the maximum allowable drawdown of 209 feet (highest fracture at 219 ft bgs and depth to water of 10 feet). As is evident, though, there are dramatic drawdowns (over 30 feet) 1,000 feet away from the pumping well. By the end of the pumping test at 3,000 feet away from the pumping well there could be 15 feet of drawdown, certainly measurable and distinguishable from natural water level changes. Below wetlands at 1,000 feet, there could be over 30 feet of drawdown, also easily distinguishable in wetland/streambed piezometers. The nearest homeowner wells could see more than 40 feet of drawdown.

Using these same formation parameters, the long term consequences of pumping Well 22 may be estimated. While the pumping test is planned at 940 gpm, the long term sustainable yield may be much less. For the purposes of illustration, a rate of 347 gpm (0.5 MGD) was used as the long term pumping rate. Figure 4 below depicts system drawdowns under a sustained withdrawal of 0.5 MGD. Long term pumping at this rate results in the Well 22 dynamic water level maintained above the 209 feet maximum allowable drawdown. However, thousands of feet away, there are projected to be large drawdowns at Meadow Pond, the Atlantic Ocean, the closed Hampton landfill, and the Hampton-Seabrook salt marshes. There are potentially three former unlined landfills in the projected drawdown area. The first is located by the Hampton DPW, bounded by Hardardt's Way on the east and north. This site is identified in OneStop and in the Application's Appendix E. The second is located on Island Path in a marsh area. Local knowledge identifies it was probably a burn dump. The third is in the area of the bridge on Rt. 101 going towards the beach. Apparently it was another old burn dump that was used as fill under Rt. 101. These and other known or potential hazards should be considered in the development of the monitoring program, as well as integrating existing monitoring networks into same. Drawing contamination into the Aquarion wells is one issue, but another is moving contaminants into other areas of the aquifer as a result of the pumping of the new well, even for the pumping test.

Individual homeowner wells near to Well 22 could see long term well water levels reduce by 20 feet or more. This has the potential to render these wells unable to meet demands during critical dry periods. In addition, this permanently increases the pumping burden and costs to individual homeowners. One well owner has an open well geothermal system which could also be compromised by long term Well 22 pumping. This topic should be addressed by the Applicant.

The Application states on page 14 in the table at the top of the page that the desire is to pump at 940 gpm for July and August (62 days). The consequences of such pumping may also be found in Figure 3. This could have the effect of dropping the Well 22 water level to 209 ft bgs. It also magnifies all previously presented consequences.

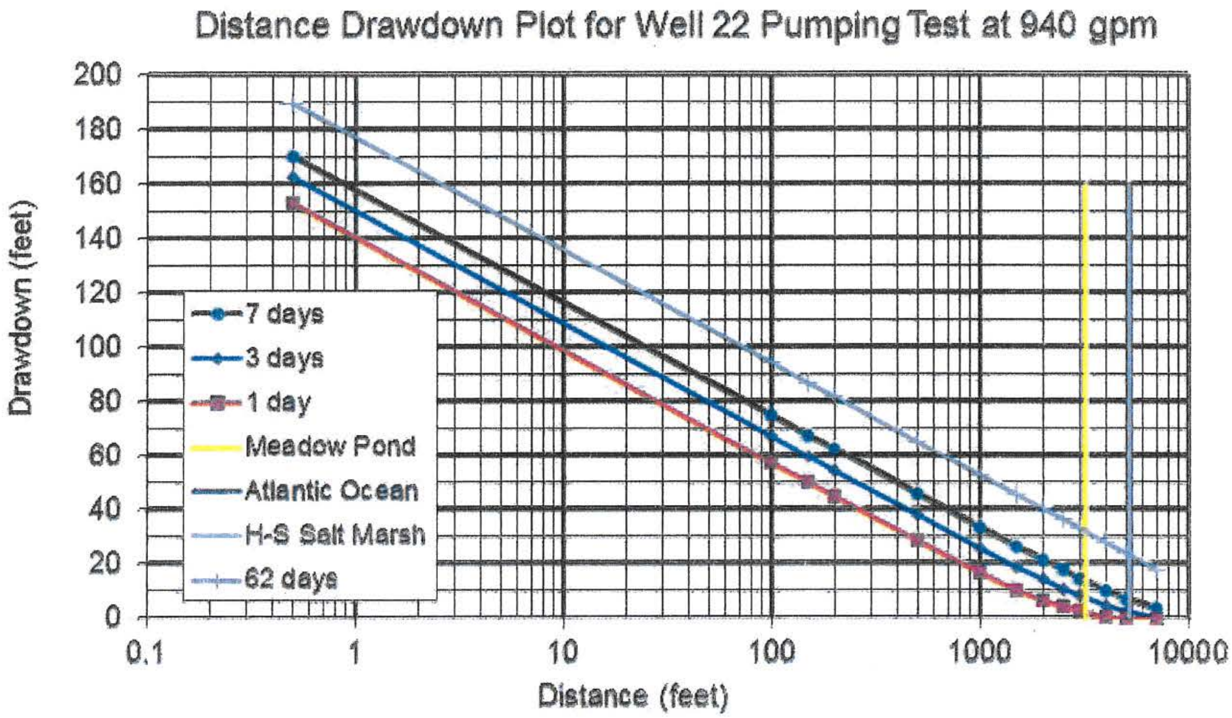


Figure 3. Projected system drawdowns during the pumping test.

Recommendations

The following recommendations are considered imperative for the long duration pumping test as well as the long term monitoring of the permitted well production rate.

A dedicated monitoring network needs to be designed and installed. This monitoring network requires new, dedicated bedrock monitoring wells capable of yielding water level and water quality data that: support the conceptual hydrologic model, assist in formation ambient condition characteristics, afford long term adaptive management, and provide data for hydraulic analyses. For the pumping test, bedrock wells are necessary at mid-distances (100 to 500 feet from Well 22) and farther distances (1,000 to 2,000 feet from Well 22).

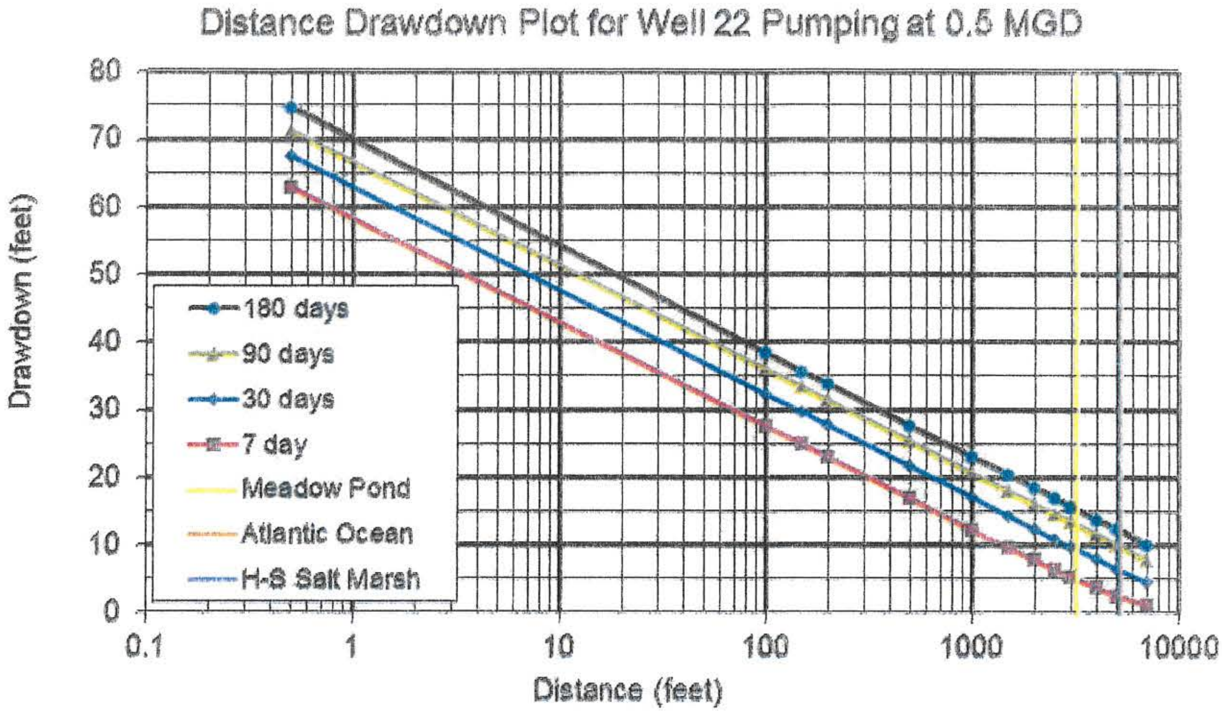


Figure 4. Distance-drawdown plot for long term pumping of Well 22 at the lowest desired withdrawal rate.

The fundamental geology of the system needs to be determined, particularly addressing the question of whether a restrictive layer exists between overburden and bedrock and its extent.

The recharge mechanism for Well 22 must be more thoroughly explored, especially due to the conflicting portrayal in the Application regarding a restrictive layer above the bedrock. If a restrictive layer exists, and if less precipitation (than assumed) is available to recharge Well 22, the well will necessarily have to reach out to other sources (dewatering, streams, wetlands, salt water) or the well discharge will have to be throttled back due to increasing well drawdown. In the same vein, less precipitation recharge to the bedrock (than assumed) magnifies the undesirable effects on homeowner wells and nearby wetlands and streams. A very important reality is that if this is a confined system, then the mechanism for storage of water and recharge are not what is portrayed in the Application.

Pumping test water quality analyses should include Arsenic, Sodium, and Chloride. Samples should be taken after 2 hours into the test, 2 days into the test, and just before shutting off the pump. During the pumping test in all monitoring wells, specific conductivity and temperature should be measured at the same frequency as water level.

An ambient monitoring period in excess of 7 days is necessary to understand ambient stresses on water levels. Without this information, interpretation of well water levels during the pumping test will result in misleading conclusions. Ambient stresses include: precipitation, ocean tides, earth tides, pumping of other nearby wells, regional water level changes, and atmospheric pressure. Because many of these stresses occur at the same time, three months or more of monitoring is required: the duration of time really defined by when sufficient data is collected such that strong relationships may be delineated between these stressors and water levels. It is recognized that the more optimal time for the pumping test to occur is within the next four months. Ambient monitoring may occur after the pumping test so long as it is recognized that data synthesis is not complete until the ambient information is complete and integrated into the interpretation of the pumping test.

Specific Comments on the Application

On the following pages may be found text, data, or statements from the Application as well as some responses to each.

Section	Page	Text/concept from application	Comment
1.0	1	Current estimates of the potential yield of Well 22 is in excess of one million gallons per day (1 MGD).	For reasons below noted later in this review on aquifer hydraulics and proximity to salt water, this estimate may be excessive.
1.1	1	Bedrock well name – Well 22, Installed in 2012, 560 ft deep	Well depth is hundreds of feet below sea level
1.1	1	120 feet northwest of overburden Well 7, 48-ft deep, 24-in gravel packed well. In operation since 1950	Conductivity history of Well 7 would be useful to assess salt water intrusion or bedrock connection impacts and should be provided.
1.2	2	Site topography from 50 to 30 ft MSL	
1.2	2	Meadow Pond is tidally-influenced and 3,300 feet east of Well 22	
1.4	2	Closest residences are 475 feet and 600 feet to north and northwest, as well as 600 feet south	
4.1	3	These deposits are delineated by their ability to transmit water (transmissivity values) and are shown in Figure 6.	The deposits are not delineated in Figure 6. Transmissivity values should be provided.
4.3.3	5	Well 22 drilled to 560 feet BGS. Open, telescoped borehole: 10-in diameter 67 feet bgs to 320 feet bgs, and 8-in diameter from 320 to 560 ft bgs.	
4.3.3	5	The uppermost water-bearing fracture was encountered at 219 feet bgs.	
4.3.3	5	During advancement of the open borehole, airlift tests were performed and flow rates measured with a 5-gallon bucket and stopwatch. The well yields measured indicated flow rates greater than 300 gallons per minute (gpm).	At 300 gpm, a 5 gallon bucket fills in 1 second. Measuring the flow rate into a 5 gallon container with a stop watch in this instance is a very imprecise method as human reaction time with a stopwatch is on the order of 0.2 to 0.3 seconds. Another confounding aspect of this method is that the water surface in the bucket would not be level.

Section	Page	Text/concept from application	Comment
4.3.3	5	Groundwater levels in Well 7-Obs, a 2-inch diameter monitoring well installed to a depth of 19.9 feet bgs and located 8 feet from production Well 7, were recorded during drilling…There were no observable fluctuations in groundwater levels in the sand and gravel aquifer…	This implies that there may be a restrictive layer between the sand and gravel formation above and the bedrock below.
4.4.1	6	October 2012, GEOSPHERE supervised the performance of a step-drawdown withdrawal test on the newly installed bedrock well (Well 22). The step drawdown test on Well 22 was run at 4 different pumping rates (103 gpm, 206 gpm, 305 gpm, and 401 gpm)	
4.4.1	6	Static water level in Well 22 prior to 2012 step test was 10.1 ft below TOC	This means static GWT at ~40 ft MSL. Also, static water level is above the top of the bedrock.
4.4.1	6	…upper most water-bearing zone in Well 22 is at 219 feet bgs.	Well static water levels must be analyzed to understand if there is a vertical hydraulic gradient between the overburden and the bedrock and its significance.
4.4.1	6	Based upon extrapolation of the groundwater level data recorded during the step-drawdown test, Well 22 can produce well over 400 gpm…	400 gpm = 0.576 MGD
4.4.1	6	Groundwater level data recorded in Well 7-Obs during the 2012 step-drawdown test indicated no observable fluctuations in groundwater levels in the sand and gravel aquifer	

Section	Page	Text/concept from application	Comment
4.4.2	7	2016 step-drawdown test with larger pump	No bedrock observation well was used in this or the previous step test. These step tests rely on an overburden well to assert lack of local connection between overburden and bedrock aquifers. More robust bedrock monitoring is necessary for the pumping test.
4.4.2	7	...pumping level under the highest rate of 683 gpm did not drop below 116.43 feet.	
4.4.2	7	The groundwater level recovered 87% from the last step in 30 minutes.	This is what would be expected from a confined formation.
4.4.2	7	Groundwater level data recorded in Well 7-Obs during the step-drawdown testing indicated negligible observable fluctuations in groundwater levels (0.6 feet) in the sand and gravel aquifer due to the bedrock aquifer groundwater withdrawals.	Negligible drawdown is not the same as zero. An effort needs to be made to understand the connection between overburden and bedrock formations at this location. This impacts sustainable pumping from Well 7 and bedrock recharge.
4.5.1	8	... default 4,000-foot radius was chosen...	Note that this radius intersects with substantial areas of salt marsh and salt water. Additionally, bedrock well demonstrates confined nature, and therefore 4,000 ft radius is most likely too small.
4.5.1	8	... insufficient data is currently available to calculate the Cone of Depression (COD).	Formation characteristics from the step test data could have been used to estimate the COD. Or, in lieu of using the step test data, other Aquarion bedrock well data could have been used to estimate formation parameters and potential pumping consequences. If the bedrock is confined, which is likely given the step-test recovery and nearby bedrock well characteristics, the COD can be enormous under the proposed long term pumping rate (0.5 to 1.0 MGD)

Section	Page	Text/concept from application	Comment
4.5.2	8	…total area of the recharge area is approximately 4.10 sq. mi. This recharge area also coincides with the Preliminary Wellhead Protection Area (WHPA).	This estimate was arrived at using topography and lineaments, a reasonable approach in the planning stage. However, it must be validated, via a sufficiently longer duration pumping test and a strong monitoring network.
4.5.3.c	9	The downgradient extent was identified by delineating the watersheds that encompass the COD and Recharge Areas to the south of Well 22, while truncating any tidally influenced areas such as Meadow Pond and tidal marshes to the south and southwest.	There is physically nothing to stop salt water from being drawn into Well 22. Thus assuming that the downgradient recharge area extent ends at a salt water location is an artificial boundary that disobeys physical reality. More emphasis should be placed on using the step test data to assist in estimating downgradient effects prior to the pumping test in order to develop a monitoring network to verify the potential for salt water intrusion during and after the pumping test.

Section	Page	Text/concept from application	Comment
4.5.5	10	Stream Stats also estimates the amount of precipitation that recharges the aquifer in the local basin to be 22.9 inches, based on a report by Robert H. Flynn and Gary D. Tasker (USGS): *Generalized Estimates from Streamflow Data of Annual and Seasonal Ground-Water-Recharge Rates for Drainage Basins in New Hampshire*. According to a report by the Army Corps of Engineers (ACOE); *Southeastern New Hampshire Water Resources Study, Groundwater Assessment-Main Report,* March, 1981, for a sand and gravel aquifer in the seacoast region of New Hampshire, approximately 43.5% of the annual precipitation is lost to evapotranspiration, 20.5% is lost to runoff, and 5% is lost to groundwater evaporation (water which evaporates from the zone of aeration). This leaves approximately 31% of the total precipitation, or 14.2 inches, to recharge the groundwater.	The two cited studies are often misapplied to bedrock formations. For example, Flynn and Tasker measured stream baseflows and attributed them to groundwater discharge. However, they never distinguished overburden flows from bedrock flows. Much of the geochemical data in other studies (USGS SRI 2010–5229; Bacca, 2004) support the conclusion that very little is from the bedrock. The data from the overburden observation well used in the step tests demonstrates little to no hydraulic connection between the overburden and the bedrock in this location. If that is correct, there will be little to no bedrock recharge from precipitation. Conversely, if there is bedrock groundwater recharge from precipitation as portrayed, then a strong hydraulic connection should exist between the overburden and the bedrock at this site (wells 7 and 22). If this is true, then during long term pumping of both wells, there will be well interference and therefore an increase to well drawdowns for both wells. This in turn also increases the likelihood of saltwater intrusion.

Section	Page	Text/concept from application	Comment
4.5.6	10-13	Thus, the annual recharge volume is 2.1 times greater than the proposed withdrawal volume. With this surplus of groundwater, the proposed groundwater withdrawals should not adversely impact the water resources within the Potential Impact Area.	One can certainly denote a footprint of land that will generate more water available than requested. However, whether all of that water is accessible or follows the suggested flow paths is another reality, especially for bedrock. Streams that bisect the expected recharge area include: Little River, Old River, unnamed stream to Mill Pond, Meadow Pond, Dow's River, Nilus Brook, Drakes River, and the Winnicut River. These drain much of the precipitation recharge now. In addition, there are many wetlands throughout the recharge area. Very little monitoring of these streams and wetlands is included in either the pumping test or for the long term. Overpumping groundwater systems can lead to wetlands loss and loss of stream baseflows. These systems do not subscribe to the very simplified water balances demonstrated in the Application. The Application is a starting point for a conceptual hydrologic model, but diligence is warranted to validate this model in order to avoid unforeseen consequences.

Section	Page	Text/concept from application	Comment
5.2	16 - 17	… AQUARION's water service records indicate the presence of several properties located within 1,000 feet of Well 22 which are not connected to the AQUARION water system. These include: 7, 8, 10, and 12 Springhead Lane to the south, and 82 Woodland Road to the north… … A windshield survey conducted by GEOSPHERE on March 1, 2017 confirmed that these addresses are single family homes which likely have private water supply wells.	Prior to the pumping test, there should be an estimation of how Well 22 pumping will affect these wells and a discussion now about how to resolve such effects both during the pumping test as well as should Well 22 be put into production.
5.3	17	According to the National Wetland Inventory (NWI), wetland areas are located on the well site property in the southeast end of the lot, approximately 1,200 feet from Well 22, and on the abutting property to the north, approximately 800 feet east of Well 22 (see Figure 3 for boundaries of wetlands).	Studies have documented that bedrock can supply source waters to coastal wetlands (Roseen, et al, OFR 03-278). The hydrologic connection between wetlands to bedrock below must be monitored before, during, and after pumping tests.
5.5	17	There are no stormwater discharge areas or drainage structures located within the 400-foot Sanitary Protection Radius.	Stormwater and other potential sources of contamination are limited to a 400 ft circle, and yet recharge is extended over 4.1 square miles. There are many unmanaged stormwater sources within the 4.1 square mile area and these should not be ignored or excluded from the analysis.

Section	Page	Text/concept from application	Comment
6.0	18	Based on drawdown measurements collected from Well 7-Obs during two short-term pumping tests performed on Well 22 in 2012 and 2016, no significant drawdown was observed in either Well 7 or Well 7-Obs, screened within the shallow sand and gravel aquifer at the Well 7 and Well 22 well site. This indicates a lack of significant hydraulic connection or communication between the bedrock aquifer and the sand and gravel aquifer on site.	If as stated here there is no significant hydraulic connection, then what is source of recharge for the bedrock well? The Application at pages 10-13 fundamentally assumes unfettered recharge from precipitation. If, however, there is a restrictive layer in the immediate vicinity of Wells 22 and 7, several questions arise: (1) How extensive is it? (2) Why is it not included in the calculations on pages 10-13? (3) What is the effect of such a restrictive layer on the wellhead area, especially if the restrictive layer is extensive? These questions underscore the need for more long term monitoring wells that are studied in an ambient state for a longer duration in order to understand ambient stresses on aquifer water levels.
6.0	18	At the completion of the short-term pumping tests performed on Well 22, Well 22 experienced rapid recovery (i.e. 82.5% recovery within 48 minutes, and 87% recovery within 30 minutes). This indicates the potential of a sustainable yield of groundwater exists within the bedrock aquifer, the direct result of water-bearing fractures encountered during the drilling of Well 22 to a depth of 565 feet bgs.	This conclusion cannot be properly based on the recovery data. Step tests like those performed on Well 22 do not sufficiently stress aquifers to draw such a conclusion. Possibly the only conclusion that could be drawn from the step test recovery data is that the bedrock acts as a confined formation.

Section	Page	Text/concept from application	Comment
6.0	18	Water level monitoring in bedrock wells beyond the well site during pumping of Well 22 has yet to be conducted. The potential for impacts to private wells and/or other water users within the Preliminary WHPA exists. The proposed withdrawal testing program will address and evaluate potential impacts to these users, by monitoring those within 1,000 ft. of Well 22, and a representative selection of those within the Preliminary WHPA.	For a confined formation, monitoring within 1,000 feet is not far enough to demonstrate the consequences of long term pumping, including: salt water intrusion, drawdown in homeowner wells, reduction in stream low flows, and wetlands dewatering. Refer to Figure 3 above to understand the magnitude of potential consequences.
6.0	18	No significant impacts to shallow groundwater resources, including the sand and gravel aquifer on site, are anticipated. Nearby shallow overburden monitoring wells (one screened in glacial till, the other screened in stratified drift deposits), two wetlands piezometers, and a surface water staff gauge will be monitored prior to and during the withdrawal test. The nearest surface water is located 1,200 ft. from the proposed withdrawal location and is located in the wetlands area in the southeast corner of the property.	Staff gages in streams to detect effects due to groundwater pumping are inferior to miniature piezometers. This is because the error in converting the staff gage data to stream flow will be much larger than potential groundwater effects during a pumping test, especially at large distances. Miniature piezometer couplets spaced at 500-ft distances along streams and wetlands within 1,000 feet of Well 22 are recommended instead.
7.1	19	Prior step tests on Well 22 have determined that there is minimal communication between the bedrock aquifer on site and the sand and gravel aquifer.	*Minimal* is not the same as *lack of*. *Lack of*, as previously stated implies no drawdown and therefore isolation between the formations. *Minimal* implies that even during the brief step test, a connection was evident. *Minimal* on this page seems to contradict or soften the posture stated on page 18: *...lack of significant hydraulic connection or communication between the bedrock aquifer and the sand and gravel aquifer on site.*

Section	Page	Text/concept from application	Comment
7.1	19	This is consistent with AQUARION's Wells 6 and 8A, sand and gravel production wells that do not affect the operations or aquifer response to pumping of AQUARION's Wells 20 and 21, located immediately proximate to Wells 6 and 8A	This implies a more extensive restrictive layer between overburden and bedrock, thereby calling into question the recharge estimates made on pages 10-13.
7.2	19	The final pumping rate will be determined and established during the first 48 hours of pumping and is not anticipated to exceed 940 gpm.	The indicators/metrics that will require reduction of this rate should be identified prior to the pumping test.
7.3	20	Monitoring network. Pumping well, two existing onsite overburden wells, one existing off-site well in till, two new wetland piezometers, and one new stream staff gage proposed for the pumping test monitoring network. In addition, other Aquarion water supply wells at distance over 6,000 feet away. Finally, 7 homeowner bedrock wells.	No new bedrock observation wells are proposed. At a minimum, one (or, preferably, more) is needed to the E or SE to understand potential for saltwater intrusion. Another should be required to the W or NW to understand the WHPA. Preferably three more to verify WHPA and recharge assumptions. Of these wells, it is recommended that at least 3 new, dedicated bedrock observation wells be constructed at distances of 100 to 500 feet from Well 22 and at least two new, dedicated bedrock wells in the expected direction of maximum hydraulic stress located 1,000 to 2,000 feet from Well 22. Homeowner well monitoring is imperative to understand undesirable consequences to these wells, but measurement of the water levels in these wells themselves is not reliable. Poor construction, cascading water, and intermittent water usage complicate the water levels in homeowner wells. To avoid these complications, dedicated bedrock observation wells should be used, as recommended above.

Section	Page	Text/concept from application	Comment
7.4	21	7-day Antecedent Monitoring	This period is too brief to assess the hydrologic issues that are extremely important to this large groundwater withdrawal request. The formation appears to be confined, and therefore atmospheric pressure changes, earth tides, and ocean tides will affect water levels. Rainfall recharge effects also need to be understood (changes in groundwater levels per unit of precipitation), especially since it is assumed that rainfall recharge dominates the bedrock recharge. At a minimum, a 3 month ambient monitoring period of water levels and other hydrologic/climatic data is recommended.
7.4	22	Rainfall measurements will be made to the nearest 0.1 foot throughout the program at AQUARION's Mill Road Facility located approximately 3,500 feet northwest of the well site.	0.1 ft is too coarse for precipitation measurements. Precipitation should be measured to at least 0.005 ft. Also, due to the large well head area, precipitation should be measured at multiple locations over this area, especially close to the pumping well. As stated above in a prior comment, the amount of precipitation during the pumping test that will require significant modifications to the pumping must be identified.
7.4	23	At the completion of the withdrawal test, the automatic pressure transducers will be removed and/or data from the transducers will be downloaded.	The transducers should remain until the recovery period is deemed complete.
7.4.1	23	Antecedent period	Barometric pressure will be monitored in order to compensate the well water levels. There is, however, no mention of atmospheric pressure effects on confined aquifers. Atmospheric pressure is important to monitor for confined formations as it affects ambient water levels. In addition, tides should also be monitored and used for data analysis.

Section	Page	Text/concept from application	Comment
7.11	25	Water Quality Monitoring	Specific conductance and temperature, at same time step interval as water level, should be monitored in pumping and all observation wells. Sampling and testing for arsenic is also recommended.
		Appendix A – Water Conservation Plan	The vast majority of leaks are not detected by surveys.
		Appendix B – Borehole log Trace clay at 54 to 50 ft bgs Bedrock at 50 ft bgs, depth to water 10 ft bgs	Trace clay does not infer an impermeable layer between overburden and bedrock. Depth to water and location of bedrock surface indicate that the bedrock is in a confined state at the site.
		Appendix D – Step Test Information	No analysis of the data is given, save for a graphic to estimate 120-day drawdown.

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