CDM

Town of Harvard, Massachusetts

Phase 1 Bedrock Well Feasibility Study

March 2010

Technical Memorandum

Jefferson Mill
670 N. Commercial Street, Suite 201
Manchester, New Hampshire 03101
tel: 603-222-8300
fax: 603-628-7675

March 4, 2010
(Finalized April 26, 2010)

Board of Water Commissioners
Town of Harvard
47 Depot Road
Harvard, Massachusetts 01451

Mr. Richard Nota
Director of Public Works
47 Depot Road
Harvard, Massachusetts 01451

Subject: Phase 1 Bedrock Well Feasibility Study

Dear Board Members and Mr. Nota:

CDM is pleased to submit these copies of the Phase 1 Bedrock Well Feasibility Study, in fulfillment of our December 2009 agreement. We are grateful for the opportunity to assist you in this review.

This Technical Memorandum was prepared by the undersigned and by Mr. Alan G. LeBlanc, P.E., Principal Engineer, who is also certified by the State of New Hampshire as a small systems Water Works Operator (Combined Treatment and Distribution System Grade C1A).

Please feel free to call Adam Yanulis (617-452-6548) or me with any questions.

Very truly yours,

Jeffrey E. Diercks

Jeffrey E. Diercks, P.E.
Associate
Camp Dresser & McKee Inc.

cc: Adam Yanulis, CDM
Al LeBlanc, CDM

1 - Introduction

The Town of Harvard operates a small water system serving residential, commercial, and municipal water users in the center of town. Water is derived from two bedrock wells, located close together off Pond Street. The Town has been concerned for years that a contamination incident could affect both wells, leaving the system without a supply source.

In 1995-97, the Town located a potential bedrock well site behind the Bromfield School and pursued field testing. This work included construction of a bedrock water supply well, and performance of a 48-hour pumping test in October 1996. Water quality results indicated that the produced water had high levels of naturally-occurring radioactivity. A re-test in April 1997 confirmed the presence of high levels, and the Town decided to terminate further work at the site.

In 2006, the Town conducted a four-week pumping test on the bedrock well, to determine whether the concentrations of radionuclides might decrease with extended pumping. Unfortunately, the radionuclide levels remained high during the pumping test, so work was again terminated.

Recognizing that there are limited alternatives for additional water supply, the Town decided in late 2009 to obtain additional information regarding the nature of water treatment needed for radionuclides, and the costs for developing the bedrock well as a public water supply source. It was recognized that additional field work would be required to obtain DEP Source Approval and to answer all questions about facilities and costs for water supply development. Given that the Town's available funding did not permit additional field work at this time, it was decided to pursue a multiple-phase approach. This Phase 1 feasibility study answers many questions about facilities and costs, and demonstrates the technical feasibility of utilizing this site as a supply source. Possible Phase 2 efforts that would be needed before proceeding with design and construction are also discussed herein.

2 - Water Quality Overview

Table 1 presents a compilation of general water quality data from the 48-hour test in 1996. The water may be characterized as having moderate pH, minimal iron and manganese, high chloride, high total dissolved solids, and high hardness.

Table 2 presents a summary of the laboratory analyses for radionuclides during both testing periods, and also shows the current drinking water standards for radionuclides. It is apparent from the data in Table 2 that treatment would be needed for the following parameters:

- Radium. Compliance is measured by comparing the sum of the Radium-226 and Radium-228 isotope concentrations to the drinking water standard. The well's radium levels are more than four times the standard.

- Uranium. Two analyses are available. One result was barely above the drinking water standard, and one was barely below.

- Adjusted Gross Alpha. An alpha particle contains two protons and two neutrons, and is a common emission during radioactive decay. There are two analytical results available. One of them equaled the drinking water standard, while the other was more than twice that amount.

In addition, EPA expects to regulate radon in drinking water in the future. At one time, EPA proposed a drinking water standard for radon, but it was later withdrawn. The radon analyses for the Harvard well are roughly twice the proposed standard. EPA has not yet decided what to propose for a revised standard, or when.

As shown on Table 2, prior analyses also included Gross Beta, which is required by DEP on a case-by-case basis. A beta particle is a negatively-charged or positively-charged particle with the mass of an electron. The most common sources of beta particle emissions are nuclear materials. If a gross beta analysis indicates results above 50 picoCuries per liter (pCi/L), DEP requires additional testing for specific isotopes. The 1996-97 levels were less than 20 pCi/L, not high enough to require this additional testing. Given these results, and given that the area of this well is not proximate to any known sources of nuclear materials or nuclear waste, we have assumed that treatment of this well water does not need to address beta particle emissions.

3 - Water Treatment Approach

Numerous water systems treat water for the removal of uranium, radon, and radium, but Harvard's proposed well is unusual in that it faces all of these challenges concurrently.

USEPA cites multiple "Best Available Technologies" for radionuclides, with ion exchange, lime softening, and reverse osmosis noted for uranium and radium removal. For simplicity of operations and minimization of electrical power requirements, ion exchange is commonly the treatment process of choice for this challenge.

The reduction of gross alpha may also be achieved through the ion exchange processes. Cation exchange (+) will address all radium contaminants and that portion of the gross alpha which has a positive valance. Anion exchange (-) addresses uranium and the remaining factors contributing to gross alpha. These radionuclides will accumulate on the ion exchange resins until the resin is replaced or regenerated.

Radon removal via aeration is a common industry approach, and is the basis for this analysis.

CDM discussed Harvard's water quality and possible treatment schemes with five process equipment vendors: Lowry Systems, Water Remediation Technology (WRT), Layne Christensen Company, Calgon, and Siemens Water Technologies Corporation. CDM's communications with these vendors only identified "a proposed drinking

water / well supply in Central Massachusetts" to be sure the Town would not be inundated with vendor sales calls at this stage of planning. All treatment regimes and equipment proposals were based upon treating an instantaneous maximum flow rate of 32 gallons per minute (gpm).

Detailed process equipment recommendations were received from Lowry, WRT and Layne. Cursory information was received back from Calgon, while Siemens was not responsive to our request for treatment equipment proposals.

Primary Treatment Mechanisms

For planning and project pricing at this stage of evaluation, we have assumed there will be a cation exchange system for radium removal, an anion exchange system for uranium removal, and a bubble diffusion system for radon removal with integral booster pumping. Although the radon removal is not an absolute regulatory necessity, CDM recommends addressing the issue now given the high radon levels and the high likelihood that radon will be regulated in the future.

Lowry's analysis indicates no expectation of scaling upon air stripping. Lowry anticipates the pH will be about 7.9 in the treated water, as their equipment will also strip what little carbon dioxide there is the water. The water is not expected to be corrosive before or after air stripping.

Ancillary Treatment Systems

Several ancillary components warrant planning and consideration at this stage of review:

- A raw water particulate strainer is commonly provided upstream of the treatment processes noted herein. This would likely be a 20-micron basket strainer installed on the piping upstream of the first ion exchange vessel.

- As the water is very hard, potassium chloride for regeneration, rather than sodium, may be worthy of consideration if future evaluations show elevated, post-ion exchange sodium levels to be of concern. This is a consideration in systems requiring in-situ regeneration and backwash, and is not applicable to one-use type resin containers.

- Anion exchange removes alkalinity from the water and thus could make the water somewhat more corrosive for lead and copper in the plumbing system. This can be partially mitigated by using soda ash in the regeneration solution. As Harvard's proposed well water quality indicates naturally high alkalinity, we have not included a soda ash feed system at this stage of planning.

- A small sodium hypochlorite feed system is also included in our planning at this juncture, to account for the air break at the radon removal system. Chlorination downstream of the ion exchange processes is recommended. We note chlorination

upstream of radon aeration will be acceptable, as the chlorine will not be stripped out.

- While seeking to minimize building size and project scope, we have planned space allocations for a control panel, electrical panel, an eyewash station, and supplies shelving.

Operational Approach

Operational strategies are worthy of discussion at the planning stage of the project.

Given the low cost of operating its existing wells, and the inherently higher cost of operating this proposed well and treatment system, CDM expects that Harvard will operate this proposed well on a limited basis to ensure the equipment is operations-ready at all times. To ensure good equipment exercising, maintenance, and housekeeping, the town may elect to conduct operations on the order of 8 hours per week.

A strategy to lengthen resin life is to treat only a portion of the flow, and not the full flow. This strategy is employed by water system operators particularly when the radionuclide concentration is only a modest amount above the Maximum Contaminant Level (MCL). This may well be appropriate for Harvard's uranium removal efforts, though not for its very high radium or radon content. In detailed design, bypass piping provisions can be considered to allow flow splitting to be practiced.

Operator Safety

The presence of radioactive constituents is often of concern to persons unfamiliar with radionuclides. Drawing on USEPA's *A Regulators' Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies*, available online from EPA, we offer the following comments:

- ***Alpha radiation***: Numerous radionuclides removal facilities exist throughout the United States. While concerns relating to worker exposure radiation are common among persons unfamiliar with such drinking water treatment processes, it is important to remember that alpha radiation can be contained behind barriers as thin as a piece of paper, and certainly within the confines of a closed pipe or ion exchange vessel. Alpha radiation is emitted from uranium and radon. It is of concern if inhaled or ingested, but cannot penetrate human skin.

- ***Beta radiation*** is emitted by Radium-228 and facilities disposing of radioactive material. It can penetrate outer layers of skin, but beta-emitting radionuclides are more of an internal hazard if ingested or inhaled.

- ***Gamma radiation***, also referred to as "photon" emissions (radium-226 emits both alpha and gamma radiation). Gamma radiation originates from processes inside the

nucleus. Radioactive materials that emit gamma radiation are of concern because the gamma rays pose an external radiation exposure hazard and can penetrate the body.

Typically, closed piping, pressure-rated closed ion exchange vessels, proper venting from radon aeration, and good building ventilation, are sufficient to prevent radionuclide concerns in the indoor groundwater treatment environment. One New Hampshire water system that treats groundwater for uranium and radon has taken the practical approach of strapping a portable dosimeter (such as those worn by persons working in or visiting nuclear power plants) to its anion exchange vessel. The water system manager reports that experience has shown minimal radiation measurements on the instrument, which is accumulating radiation continuously. In a facility that is visited for short periods of time, the "24/7/365" measurements of low radiation have provided peace of mind to that system's operation staff.

National studies by the American Water Works Association Research Foundation (formerly AwwaRF, now WRF) and findings by the Nuclear Regulatory Commission have found that the health risk associated with operating water treatment equipment that remove radionuclides from drinking water is low.

Operator Certification

Currently, the Town's water system is classified as a Class I-D system, based on its small size and the lack of water treatment. On that basis, the Primary Operator must possess a Grade I-D operator's license.

The construction of treatment facilities for the proposed well would lead to a change in water system classification. Further discussion with DEP would be needed to finalize the water system classification and operations staff requirements, but our preliminary opinion is that the new treatment facilities would change the system classification to Class I-T. On that basis, the water system's Primary Operator would therefore need to possess a Grade I-T operator's license, unless otherwise indicated by DEP.

Waste Stream Management

The handling of waste streams is an important aspect of radionuclide removal and ion exchange planning, and is reviewed herein.

Ion exchange processes are offered in two varieties: (1) those that feature one-use resins that are hauled off-site to suitable radionuclide disposal facilities, and (2) those that are backwashed and regenerated on-site, with waste directed to the sewerage system.

Depending on the amount of water treated per day, ion exchange one-use systems could last for many years. This would provide a very economical operation and a radionuclide broker could pick up the units and dispose of them for a fee. This

approach would allow the town to handle no resin, as the tanks and resin go to disposal. Brokers such as Chase Environmental offer such disposal services. Those tanks are pre-bedded and only need to be positioned with a handcart and connected with cross-linked polyethylene (PEX) quick-connectors.

To present one vendor's one-use resin life projections, WRT estimated the following costs and resin life:

Parameter	**Uranium**	**Radium**
Initial Equipment Cost	$45,530	$51,840
Replacement Tanks' Cost	$25,100	$22,700
Gallons Treated Before Tank Replacement	38,030,000	8,225,000
Treatment Operation Time at 32 gpm	19,807 hours	4,284 hours
Treatment Operation Duration at 32 gpm for 8 hours/week	48 years	10 years

WRT's figures show that resin replacement would be very infrequent. It should be noted that CDM's opinion of costs (presented below) are based on the above-noted WRT budgetary equipment cost for radium. Lesser initial estimates from Lowry and Layne are the basis of the uranium equipment component of our concept-level opinion of construction cost.

Backwashing the ion exchange vessels, with discharge to the sewer, is also a commonly practiced approach. Low level radioactivity in the waste flow has been found acceptable by several wastewater treatment operators by systems in Massachusetts and elsewhere. Though unusual, we learned that one wastewater provider in New England mandates *weekly* backwashing (far more frequent than would otherwise be required) of a uranium removal vessel, to ensure radionuclide content in the wastewater is minimized to a great extent.

We understand Harvard has a wastewater treatment plant (WWTP) and a small village system. The wastewater is discharged to the ground right at the WWTP. The high school is already on the sewer system. There is presently a design ongoing for a significant expansion of the WWTP and collection system.

Although backwashing and on-site regeneration are possible, this evaluation focused on the avoidance of sending a liquid radioactive waste to the WWTP. Given the limited use of this well system, and resulting infrequent regeneration, a process featuring one-use resins with full-service off-site hauling appears advantageous from the standpoint of operational ease. Costs to build wastewater handling facilities at the proposed well water treatment building, and a sewer (albeit not a long one) are not included in our overall Opinion of Probable Construction Cost. The use of these facilities for disposal of water treatment residuals with low level radioactivity could be examined in Phase 2 if desired by the Town.

4 - Opinion of Probable Construction Cost

CDM has assumed that the project will encompass well pumping, piping to a treatment building, the treatment works and associated building, and piping into the distribution system. We have assumed the use of a two-piece, 15'-6" x 21'-0" precast concrete building, wherein a perimeter foundation wall and building slab would be poured to accommodate the setting of process equipment and the building itself. In this manner, raw water and treated water piping would enter the building below grade and pass through the slab, requiring no further freeze protection measures. Per discussions with the Town, we have assumed the treatment building would be located at the site of the existing basketball court.

Electrical service from Massachusetts Avenue to the treatment building, and from the treatment building to the well head, will be required. As discussed with the Town, standby power is not included, but the building's electrical facilities will allow use of a portable generator to power the facility during a power outage. Instrumentation and minor site work will also be included in the project. The general arrangement of the project's major elements is presented on Figure 1.

Our opinion of probable construction cost is as presented in Table 3. The main body of the table contains the core, basic project components necessary to convey and treat the groundwater. Depending upon the town's preferences and site-specific requirements, the provision of architectural features such as a wood-framed peaked roof, upgraded architectural wall treatments, and reinforced concrete duct bank protection for buried electrical and signal conduits may be considered, and are each presented as possible additional project elements.

A small-scale photovoltaic array, capable of 1.5 to 2.0 kilowatt output, is also presented as a possible, additional allowance. The provision of a sustainable, renewable energy source would offer the town a valuable opportunity to educate the public, to lead by example, garner positive public relations benefits, and to provide a resource to students at the adjacent high school. Incorporation of renewable energy elements is consistent with the goals of the Harvard Energy Advisory Committee (HEAC), which advises all town boards, departments and institutions on a full range of ways to reduce energy consumption and costs, and improve energy efficiency use and practices. We note that the HEAC web page actually presents an August 2009 assessment of solar power potential on the roof of the adjacent Bromfield School.

CDM normally recommends inclusion of a 25% contingency in costs prepared at the planning stage. We have included this contingency on Table 3. As shown therein, the total estimated construction cost including the contingency is $604,000, not including the various optional construction costs which are also listed on the table. This total estimated construction cost does not include land acquisition, legal fees, reconstruction of recreational facilities, permitting, or engineering. Discussion of permitting and engineering appears in the following section.

Operational costs related to the pumping of groundwater were considered common to existing and new wells in town, and were not considered in this report. The operating costs pertaining to the treatment of this well's radionuclides and radon are discussed below.

As noted previously, this report considers the well's operation at 32 gpm for 8 hours per week. This equates to 416 hours per year, or nearly 800,000 gallons of throughput per year. Considering the one-use systems offered by the vendors we contacted, vessels for radium removal resin would likely average less than $2,500 per year, with comparable vessels for uranium than $600 per year. Though disposal costs will add to these amounts, the first transport of spent resin is expected to occur a decade or more after startup.

The operation of an aeration-based radon removal system would feature an estimated 2.5-horsepower blower. At the operating frequency noted above, the blower operating cost would be less than $500 per year.

One source reviewed by CDM states *"…managing radionuclides in this manner will add $1 - $2/1,000 gallons to the price of providing water."* Perhaps driven by Harvard's notably high radium concentrations, our estimates exceed but correlate reasonably well with this rule of thumb.

5 – Permits and Approvals for Supply Source Development

This section lists the various permits and approvals that would be required for Harvard to develop the well as a public water supply source.

DEP Source Approval

The DEP Source Approval process consists of 25 steps beginning with the initial groundwater exploration phase, and concluding with addressing certain water quality issues on the final supply source itself. A list of the 25 steps appears on Table 4. Of these 25, a total of ten steps are flagged as being not applicable in Harvard's case; the other 15 must be addressed.

Section 4.1 of the DEP's "Guidelines and Policies for Public Water Systems" presents a synopsis of the 25-step process. For ease of reference, a copy of Section 4.1 appears in the Appendix. Additional details of the various steps are present in other sections of Chapter 4 of the DEP Guidelines, which is available online from DEP.

Previously in 1997, Harvard terminated the Source Approval process after Step 7 (shutdown of the pumping test) and before Step 8 (submitting a Source Final Report). For the purpose of this Technical Memorandum, CDM is assuming that Harvard will be required to pick up the Source Approval process again at Step 3, by preparing a Request for a Site Examination and a Pumping Test Proposal. We recommend,

however, that Harvard discuss this issue with DEP to determine any savings that might be realized in light of the prior efforts.

Examination of the 25-step list and the DEP Source Approval guidelines will demonstrate that the process includes wide-ranging efforts. These will include, but are not limited to, the following:

- Demonstration of how the Town will meet the Zone I land acquisition/control requirements. If the DEP-approved yield of the well were to be 32 gpm, then the Zone I would be a circular area, centered on the well, with a radius of 350 feet (not the 345-foot value which was shown on a 1995 plan). Meeting the Zone I requirements will be a challenge in Harvard's case, because privately-owned land and some municipal recreational facilities lie within the Zone I. Further discussion with DEP about this issue is warranted.

- Documentation of groundwater protection measures for the Zone II protection area. Typically for production wells of this size, an Interim Wellhead Protection Area (IWPA) is designated instead of a formal Zone II. The IWPA is a circular area centered on the well, with a radius that depends upon the approved yield. For an approved yield of 32 gpm, for example, the radius of the IWPA would be 1,424 feet.

- Performance of a 48-hour (minimum) pumping test, preferably during a period with no precipitation.

- Review of effects of well pumping on any nearby sensitive receptors such as wetlands or other bedrock wells.

- Final design of all needed facilities.

- Evaluation, after the supply source is placed online, of risk associated with surface water influence upon the quality of the bedrock well water.

- Similarly, assessment monitoring of the new source to determine whether the water contains pathogens that could require filtration under the EPA's new Groundwater Rule.

We understand that Harvard anticipates a well yield of 32 gpm (46,100 gpd), because the 48-hour pumping test in 1996 was conducted at that rate. Two facts should be noted, however: (1) DEP limits the approved yield of a new bedrock production well to 75% of the approved pumping test rate, and (2) the 1996 Source Approval process was terminated before confirmation of successful completion of the test at the 32 gpm pumping test rate. Therefore, the approved yield of this site, assuming for now that DEP would have approved the 32 gpm pumping test, would be 24 gpm (34,600 gpd). This would lead to a Zone I radius of 331 feet and an IWPA radius of 1,168 feet.

If the Town desires to obtain an approved well yield of 32 gpm, then an attempt should be made during future Source Approval testing to run a pumping test at 43 gpm. This would, however, represent a substantial additional drawdown in the well, and it is not clear that a test could be run successfully at this higher rate.

We also note for the record that the four-week pumping test in 2006 was run, for the most part, at a rate of 19 gpm (27,400 gpd) and resulted in a pumping water level over 270 feet below ground. If 19 gpm were to be the final approved pumping test rate in a Source Approval process, then the permanent facility's approved yield would be only 14.2 gpm (20,500 gpd).

DEP Pilot Treatment Testing

Wells that need treatment for radionuclide removal may or may not require formal pilot treatment testing. This is determined by DEP on a case-by-case basis. In Harvard's case, there are multiple radiological parameters of interest, as reviewed earlier. Further discussion with DEP will be needed to determine whether this raises a concern to them regarding pilot testing. Such testing is a significant effort and may require a pumping period of several months. Any such testing should be coordinated with the Source Approval pumping test. For the purpose of this Technical Memorandum, we have assumed that no pilot treatment testing will be required.

Other Permits and Approvals

Some of the State approvals commonly required for new municipal wells will not be needed in this case because of the small capacity of the proposed well. The Massachusetts Environmental Policy Act (MEPA) reviews are not expected to be triggered, because the supply source capacity is less than 100,000 gpd and because the site is not in an Area of Critical Environmental Concern (ACEC). The Massachusetts Water Management Act permitting requirements are not triggered, again because the capacity will be less than 100,000 gpd.

On the other hand, a Massachusetts Endangered Species Act (MESA) review will be triggered because the well site is mapped as being in an area subject to the jurisdiction of the Natural Heritage and Endangered Species Program (NHESP). The same, incidentally, is true for Harvard's two existing wells. A map of the jurisdictional area is included in the Appendix. As shown on that map, the well site and the basketball court (i.e., the proposed treatment building site) are within the jurisdictional area, but the adjacent tennis courts and school are not. The Town can file a "MESA Information Request Form" at any time to determine the degree of regulatory review by NHESP that may be involved. CDM recommends this be done soon.

It should be noted that NHESP has the right to require that this project proceed through the MEPA process, if NHESP believes the project involves significant habitat alteration or disturbance. Given the nature of the construction needed for this project, we believe it unlikely NHESP would make such a finding.

Any eventual NHESP review will be coordinated with the required submittal to the Harvard Conservation Commission, which is triggered by the fact that work will occur within 100 feet of wetland resource areas. These two permitting processes will be somewhat eased by the fact that the project would involve no construction directly in wetland resource areas. It should be noted that both the pumping test phase of work and the eventual construction are subject to the approval of both these agencies.

The typical local construction permits will also be needed for the construction project.

It can be seen that the scope of work for future permitting efforts has uncertainties at this point, which means that one cannot confidently assign a budget for the permitting phase. For discussion, and assuming no pilot testing requirement, we suggest using a planning range of $60-80,000 for the study-and-permitting phase, which would include survey and test boring work. The plan for the facilities should be finalized during the remaining permitting work, which will allow establishment of an engineering design budget. For a planning range, we suggest $65-75,000. The Town may also desire some engineering assistance during bidding and for shop drawing review, coordination with DEP, field inspection, startup assistance, and other efforts during construction. The budget would depend upon the desired services.

6 - Potential Phase 2 Feasibility Review

Should the Town desire to pursue further the feasibility of this well as a municipal water supply source, some or all of the following tasks would need to be addressed:

1. Meet with DEP to discuss the project and determine their position regarding pilot treatment testing. We recommend this be done immediately. If pilot treatment is required, develop a conceptual plan and cost estimate for the work. During this meeting, the status of lands within Zone I should also be discussed.

2. At the same time as item 1 above, the project should be discussed with the Harvard Conservation Commission and the Massachusetts Natural Heritage and Endangered Species program personnel, to finalize their permitting requirements for the project.

3. If desired by the Town, evaluate the facilities and costs needed to connect the proposed well water treatment building to the municipal sewer system. Compare the capital and operational costs of the two methods of handling residuals from the treatment process.

4. Unless DEP indicates it is not necessary on the basis of prior work completed, prepare and submit a Request for Site Examination and a Pumping Test Proposal.

5. Conduct the pumping test as approved by DEP, which would establish the approved yield for the site. Refine the construction cost estimate as needed. Prepare the Source Final Report for review by DEP.

7 - Conclusion

Harvard should consider whether to pursue the Phase 2 work identified above, or instead to seek another site for a bedrock well.

The costs presented herein are substantial for a relatively-small water supply source, yet it may be very difficult and costly to locate another new productive well site for municipal use. In Harvard's case, such a site would need to be in fairly close proximity to the existing water system, to avoid the cost of extending water main and 3-phase power to a remote area. If Harvard has not previously performed hydrogeologic studies to seek potentially-feasible sites near the center of Town, this work could possibly be considered before deciding whether to pursue the bedrock well site reviewed herein. Ultimately, however, test bedrock well drilling and water quality sampling would be needed at any other well site to determine the treatment requirements for that water.

Given the substantial distances to adjacent municipal water systems, it does not appear that interconnections are likely to be a cost-effective means of obtaining additional water supply for Harvard.

Despite the challenges of this bedrock well site, or the challenges of locating another site, we recommend that Harvard continue in its efforts to secure a backup water supply source. This will reduce or eliminate the risk of a contamination incident or other problem affecting the Town's only two existing supply source wells, which could leave the Town without water supply.

TABLE 1
PROPOSED GROUNDWATER WELL
GENERAL WATER QUALITY DATA, 48-HOUR TEST IN 1996

Parameter	Result	MCL	Detection Limits	Date of Analysis	Over MCL?
Arsenic, mg/L	0.007	0.01	0.005	11/1/1996	no
Barium, mg/L	0.05	2	0.001	11/4/1996	no
Fluoride, mg/L	0.2	4	0.1	11/19/1996	no
Aluminum, mg/L	ND	0.2	0.005	11/1/1996	N/A
	ND	0.2	0.005	11/4/1996	N/A
Calcium, mg/L	111	--	0.01	10/30/1996	N/A
	117	--	0.01	10/31/1996	N/A
Copper, mg/L	ND	1	0.01	10/30/1996	no
	ND	1	0.01	10/31/1996	no
Iron, mg/L	0.01	0.3	0.01	10/30/1996	no
	0.05	0.3	0.01	10/31/1996	no
Magnesium, mg/L	10.7	--	0.01	10/30/1996	N/A
	11.1	--	0.01	10/31/1996	N/A
Manganese, mg/L	0.04	0.05	0.01	10/30/1996	no
	0.04	0.05	0.01	10/31/1996	no
Sodium, mg/L	12.3	--	0.1	10/30/1996	N/A
	14.4	--	0.1	10/31/1996	N/A
Potassium, mg/L	1.2	--	0.1	10/30/1996	N/A
	2.1	--	0.1	10/31/1996	N/A
Silver, mg/L	0.002	0.01	0.001	11/19/1996	no
	0.002	0.01	0.001	11/19/1996	no
Zinc, mg/L	ND	5	0.01	10/30/1996	no
	0.02	5	0.01	10/31/1996	no

Parameter	Result	MCL	Detection Limits	Date of Analysis	Over MCL?
Alkalinity, mg/L	43	--	1	10/30/1996	N/A
	45.5	--	1	10/31/1996	N/A
Chloride, mg/L	237	250	1	10/31/1996	no
	233	250	1	10/31/1996	no
Color Apparent, CU	0	15	0	10/30/1996	no
	2.5	15	0	10/31/1996	no
Hardness, Total, mg/L	321	--	2	10/30/1996	N/A
	338	--	2	10/31/1996	N/A
Nitrates, mg/L	0.96	10	0.1	10/31/1996	no
	1	10	0.1	10/31/1996	no
Nitrites, mg/L	ND	1	0.1	10/30/1996	no
	ND	1	0.1	10/31/1996	no
Odor, TON	0	3	0	10/30/1996	no
	0	3	0	10/31/1996	no
pH, pH at 25 degrees C	7.6	6.5 to 8.5	--	10/30/1996	no
	7.6	6.5 to 8.5	--	10/31/1996	no
Sulfate, mg/L	22.2	250	1	10/31/1996	no
	22.3	250	1	10/31/1996	no
Total Dissolved Solids, mg/L	695	500	1	11/5/1996	**YES**
	534	500	1	11/5/1996	**YES**
Turbidity, ntu	<0.10	Not spec	0	10/30/1996	no
	0.2	Not spec	0	10/31/1996	no

Notes:
MCL = Maximum Contaminant Level.
Alkalinity and pH are very high, which is good for corrosion control purposes.
Iron is low (good), while manganese is sometimes low and sometimes near the secondary MCL (aesthetics-related standard).
The one sample for arsenic was relatively high (0.007 mg/L) though below the current standard (0.010 mg/L).
The trace amount of toluene in one sample was likely an artifact of the drilling process.
Hardness, chloride and total dissolved solids (TDS) are very high. TDS is above the secondary MCL (aesthetics-related standard).

TABLE 2
PROPOSED GROUNDWATER WELL
SUMMARY OF RADIONUCLIDE RESULTS

Date	Gross Alpha (pCi/L)	Uranium (mg/L)	Radium 226+228 (pCi/L)	Radon (pCi/L)	Adjusted Gross Alpha (pCi/L)	Gross Beta (pCi/L)
10/31/1996	22	--	--	8,100	--	7.2
4/22/1997	35	0.029	22.4	--	15	18
4/23/1997	53	0.031	21.7	--	32	19
9/28/2006	62.5	--	--	8,600	--	--
10/5/2006	54.7	--	--	8,100	--	--
10/19/2006	54.6	--	--	7,800	--	--
STANDARDS	(None)	**0.030**	**5**	(None yet)	**15**	(4 millirem/yr)

Abbreviations

pCi/L = picoCuries per liter

mg/L = milligrams per liter (parts per million)

Notes on Radionuclide Results

"Adjusted Gross Alpha" equals Gross Alpha, except that it excludes Uranium and Radon.

To express Uranium results in pCi/L, multiply the mg/L results by 677.

Although there are no Uranium results from 2006, it is clear the Adjusted Gross Alpha would have exceeded the standard.

EPA's originally-proposed standards for radon were 300-4000 pCi/L. Final standard is several years away.

TABLE 3
PROPOSED GROUNDWATER WELL AND TREATMENT WORKS
OPINION OF PROBABLE CONSTRUCTION COST

Capital Cost Element	Cost
Wellhead completion (pump, motor, pitless unit, transducer, casing, fence)	$31,000
Treatment building	
Building	$79,000
Process equipment, electrical, instrumentation	$167,000
Water main (2" plastic)	$20,000
Overhead 3-phase power (Mass. Ave. to building)	$44,000
Underground 3-phase power and conduits (building to well)	$24,000
Subtotal	$365,000
Bonds and insurance	$22,000
General conditions, overhead, profit (22%)	$80,000
Subtotal (February 2010 estimate, 20-city ENR 8672)	$467,000
Inflation at 2%/year to construction midpoint (October 2011)	$16,000
Subtotal	$483,000
Contingency (25%)	$121,000
Total Project Construction Cost (not including engineering or permitting)	**$604,000**

Possible additional allowances:	
Wood-frame peaked roof:	$7-10,000
Different architectural wall treatment:	$10-15,000
Encase underground electrical in reinforced concrete ductbank:	$50-60,000
Roof solar panels:	$10-15,000

Notes:

1. No connection to sewer system and/or modifications to wastewater treatment plant included; it is assumed ion exchange resins would be replaced periodically without backwashing.
2. No allowances included in this construction cost estimate for land acquisition, legal fees, recreational facility reconstruction, permitting or engineering.
3. See text for discussion of permitting and engineering efforts.

TABLE 4
DEP'S 25-STEP SOURCE APPROVAL PROCESS

(from the 2008 version of Chapter 4 of the "Guidelines and Policies for Public Water Systems")

1. Explore Potential Sources of Groundwater
2. Water Management Program Site Screening Requirements*
3. Application for Approval to Site a Source and Conduct a Pumping Test
4. Conduct Site Exam/Pumping Test Proposal Approval
5. Federal Notice of Intent (NOI) Application 404 Permit/MassDEP 401 Water Quality Certification Program*
6. Conduct Pumping Test
7. Pumping Test Shutdown
8. Submit Source Final Report to MassDEP Regional Office
9. Assess Capacity (Community and NTNC systems only)*
10. Water Management Permit Application*
11. Submit Interbasin Transfer Application to DCR*
12. Submit Environmental Notification Form (ENF) to MEPA*
13. Submit MassDEP 401 Application*
14. Submit Environmental Impact Report (EIR) to MEPA (if required)*
15. Submit Final Environmental Impact Report (FEIR) to MEPA (if required)*
16. Submit 404 Permit Application to Army Corps of Engineers*
17. Source Final Report Approved (WMA Permit Approved)
18. Submit Design Plan for Permanent Works to MassDEP Regional Office
19. Begin the Wellhead Protection and/or Best Effort Compliance Process
20. Submit Notice of Intent (NOI) to Local Conservation Commission
21. Notify MassDEP Regional Office When Construction is Complete
22. Site Inspection of Permanent Works
23. Final Source Approval
24. Meet Requirements of the Surface Water Treatment Rule
25. Implications of the Groundwater Rule

*Not expected to be applicable in Harvard's case

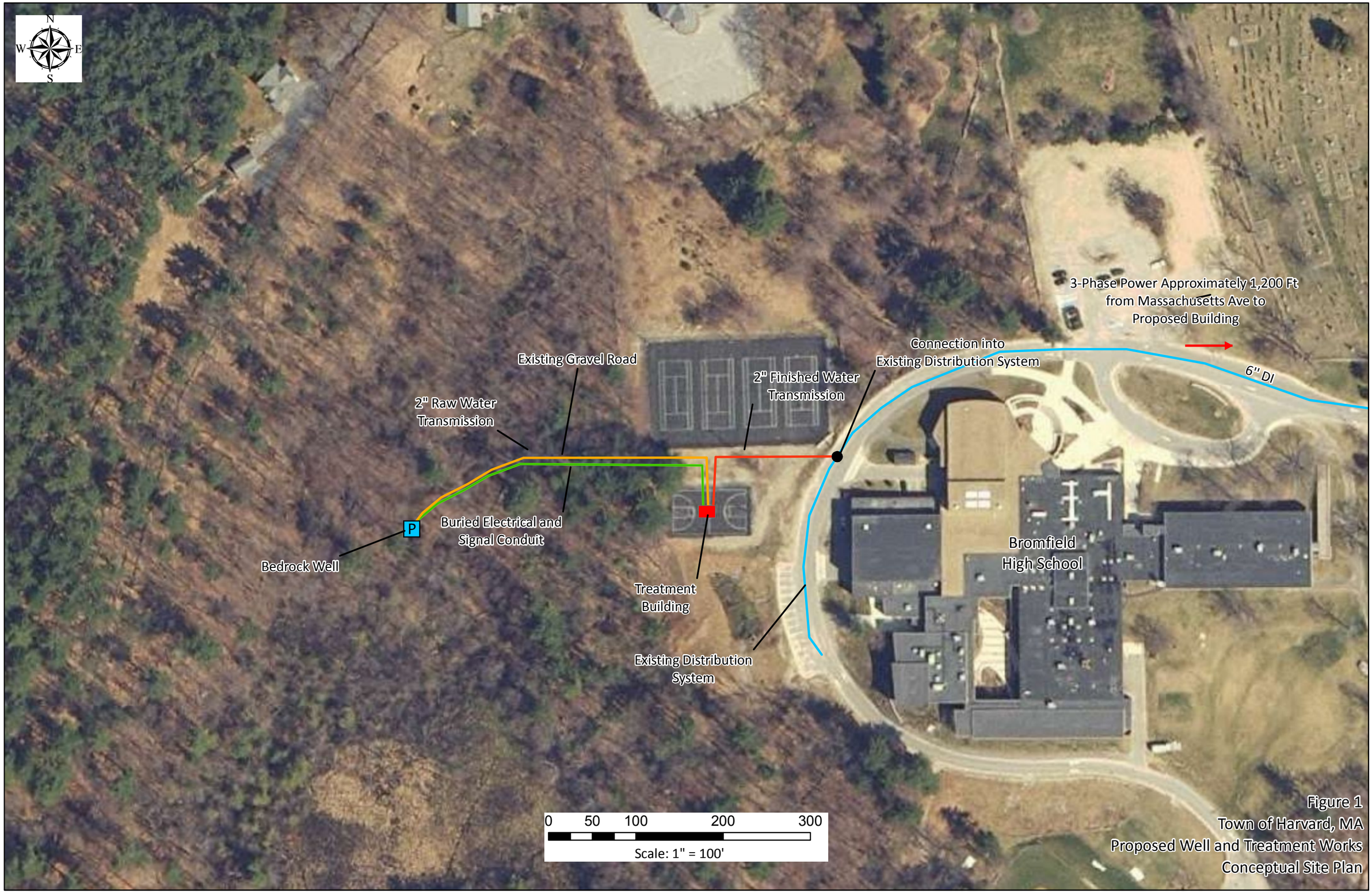

Figure 1
Town of Harvard, MA
Proposed Well and Treatment Works
Conceptual Site Plan

Appendices

Map of MESA Jurisdictional Area around Town Well Sites
Section 4.1 of DEP's "Guidelines and Policies for Public Water Systems"

http://maps.massgis.state.ma.us - NHESP's 2008 Priority and Estimated Habitats - Microsoft Internet Explorer

Natural Heritage & Endangered Species Program

2008 Priority Habitat & Estimated Habitat

- NHESP Review
- Dept. of Fish and Game Home Page
- Priority Habitat Info
- Estimated Habitat Info

Legend

EOT-OTP Roads Names

EOT-OTP Roads

Limited Access Highway

Multi-lane Hwy, Not Limited Access

Other Numbered Hwy

NHESP 2008 Priority Habitats of Rare Species and also Estimated Habitats of Rare Wildlife

NHESP 2008 MA Priority Habitats of Rare Species

Color Orthos 2005

Produced by the NHESP GIS Program with the Assistance of MassGIS and the DFWELE GIS Program.

MASSGIS

Choose a Town

GO

Tools to Use with the Map

Click on an icon below, then perform action with mouse on map. Red square indicates active tool.

Click the map or draw a box to zoom in

Click the map or draw a box to zoom out

Drag the map to move it

Get an ID value for Priority Habitat

Next 4 icons: action happens when icon is clicked.

Zooms all the way out

Hide/show the overview map

Internet

start | Proposal.doc [Comp... | Harvard, MA | Harvard Meeting Ha... | 2 Internet Explorer | 6:53 PM

CHAPTER 4.....

GROUNDWATER SUPPLY DEVELOPMENT.....

Acronyms used in this chapter:

API - American Petroleum Institute
ASTM - American Society for Testing and Materials
AW - available water
AWWA - American Water Works Association
AY - approvable yield
BWSC - Bureau of Waste Site Cleanup
CFS - cubic feet per second
CFSM - cubic feet per square mile
DCAM - Division of Capital Asset Management and Maintenance
DCR - Department of Conservation and Recreation
DWP – Drinking Water Program
DWW - Division of Wetlands and Waterways
EIR - environmental impact report
ENF - environmental notification form
EPA - US Environmental Protection Agency
FEIR - final environmental impact report
GPD - gallons per day
GPM - gallons per minute
GQ - geologic quadrangle
GWR - Groundwater Rule
HIA - hydrologic investigations atlas
IWPA - interim wellhead protection area
MassDEP – MA Dept. of Environmental Protection
MCL - maximum contaminant level
MDL - method detection limits
MEPA – MA Environmental Policy Act
MESA - Massachusetts Endangered Species Act
MPA - microscopic particulate analysis
NHESP - Natural Heritage and Endangered Species Program
NOI - notice of intent
ORW - outstanding resource water
O&M - operation and maintenance
ORS - Office of Research and Standards
SC - specific capacity
SMCL - secondary maximum contaminant level
SOC - synthetic organic chemicals
SWTR - Surface Water Treatment Rule
TCR - Total Coliform Rule
TNC - transient non-community
USGS - US Geological Survey
WMA - Water Management Act Program
7Q10 - seven-day period that will occur on average once in 10 years

Chapter 4
Groundwater Supply Development and the Source Approval Process

The development of a public groundwater source in Massachusetts is governed by the Source Approval process. Regulations governing this process are set forth in the Groundwater Supply Protection section of the Massachusetts Drinking Water Regulations (310 CMR 22.21). The process is a step-by-step exploratory and development procedure that culminates in MassDEP approval of a public water system. The process differs for *wells with yields less than 100,000 gallons per day (gpd)* and *wells with yields 100,000 gpd and greater*. The process also differs depending upon whether the groundwater source is developed in a bedrock aquifer, confined sand and gravel aquifer, unconfined sand and gravel aquifer, or spring.

Prior to commencement of the development of a *new public water supply source with a planned yield of 100,000 gpd and greater*, the proponent shall conduct a thorough analysis of system demand and have a viable water conservation program in place. Conservation shall include the full range of water supply conservation, demand management, and water reuse activities and devices. Water conservation is a requirement of the Water Management Act. Additional information about water conservation and Water Management Act Program (WMA) requirements can be found in Chapter 10.0 of this document.

Impacts to natural resources are evaluated throughout the water supply development process. The Source Approval process, in conjunction with the WMA permitting process, requires detailed information regarding potential withdrawal impacts. MassDEP coordinates WMA Withdrawal Permit application reviews with Source Approval reviews and solicits comments and recommendations from other state environmental agencies. The WMA Withdrawal Permit application further solicits comment from stakeholders within the community through the Public Notification process.

Section 4.1 provides a synopsis of the requirements for new public water supply source approvals. A more detailed explanation of these requirements can be found in subsequent sections.

Chapter 4 also addresses requirements for obtaining source approval for springs as public water supplies, the delineation of aquifer protection zones, zoning and non-zoning controls for aquifer protection, well abandonment and decommissioning procedures, and requirements by other state and federal agencies for source development.

Some activities in the source development process and the delineation of Zone IIs will require a permit. For a list of activities, the proponent is referred to 310 CMR 4.00. Assistance can also be obtained from MassDEP Infoline (1-800-462-0444) or the Regional Service Center located in each MassDEP regional office.

To Whom the Source Approval Process Applies:

The Source Approval process, including applicable permits, shall be applied by MassDEP when considering the following:

1. A new public water supply source or well (includes existing private wells converted to public water supply use)

2. An increase in the approved yield of an existing public water supply source, or an exceedance of the approved yield

3. The reactivation of a public water supply source that has been off-line per order of MassDEP

4. The reactivation of a public water supply source not in use for the last 5 years

5. The Source Final Report Approval permit application package (BRP WS 15 or 19) has not been submitted within 3 years of MassDEP approval of the Request for Site Exam/Pumping Test Proposal permit application (BRP WS 13 or 17).

6. The pumping test is not conducted within 2 years of MassDEP approval of BRP WS 13 or 17.

7. An approved source that was not developed and used within 5 years of the date of approval and for which the Zone I is not owned or controlled and wellhead protection requirements have not been met. For sources meeting the Zone I and bylaw requirements, additional testing or other work may be required by MassDEP before the source can be brought on-line.

8. The installation of a replacement well including satellite wells. Replacement wells are subject to the new source requirements as deemed applicable by MassDEP.

The level of effort required to satisfy the Source Approval requirements for Numbers 2 through 8 will depend on the quality and applicability of existing hydrogeologic data and shall be left to the discretion of the Drinking Water Program in the regional office.

4.1 Synopsis of the Source Approval Process for all Public Water Supply Wells

The following section outlines the major components of the Source Approval process for *all public water supply wells*. For informational purposes we have included components that are not administered by the Drinking Water Program. An in-depth description of the technical requirements for each step of the Source Approval process is described in subsequent sections for the specific type of aquifer supplying the well. MassDEP-approved well yields are expressed in gallons per day (gpd).

Step 1: Explore Potential Sources of Groundwater

A public water supplier or potential supplier may conduct exploratory test drilling for selection of a well site(s) without seeking approval of MassDEP Drinking Water Program.

If, during the exploratory phase of the Source Approval process, contaminants listed in the Massachusetts Primary Drinking Water standards or MassDEP's Office of Research and Standards (ORS) guidelines are discovered in the test well, the sequence of the Source Approval process will be altered. Pumping and redevelopment of the test well, followed by re-sampling and analysis using applicable sampling protocols, will be required. If contaminants are still present, alternative sources shall be considered.

In addition to maximum contaminant level (MCL) exceedances, exceedances of secondary contaminants (SMCL), guidelines, or standards may require treatment for removal to acceptable concentrations/limits.

The concentrations of contaminants found and the availability of alternative sources will determine whether the test site should be abandoned and/or referred to MassDEP's Bureau of Waste Site Cleanup (BWSC) for investigation. For contaminants that do not have drinking water standards or guidelines, the Drinking Water Program will contact ORS and request an evaluation of the health effects of the detected chemicals to determine the necessary treatment.

If treatment is necessary, the following must be performed:

1. Design and conduct a pumping test

2. Conduct standard pumping test water quality sampling

3. Review of water quality results by ORS, if appropriate

4. Design and construct wellhead treatment facility (pilot testing may be necessary)

5. Design and implement raw water monitoring program to assure early warning of dramatic changes in raw water quality that may adversely impact treatment

6. Refer site to BWSC for investigation of contaminant source

It is **imperative** that water suppliers communicate with the Drinking Water Program at MassDEP when contaminants are discovered in exploratory wells.

In addition to MassDEP Drinking Water Program requirements, it may also be necessary to obtain permits from the local conservation commission and possibly MassDEP Wetlands and Waterways Program, if the exploratory work is to be conducted in or near wetlands. If the work is to be conducted on state owned property, the proponent must apply for Special Use Permits from the Department of Conservation and Recreation (DCR). For a more detailed discussion see Section 4.19 1.b.

Step 2: Water Management Program Site Screening Requirements

MassDEP Water Management Act Program requires that proponents submit a Site Screening package (Appendix F) for all new source approvals with a *planned yield of 100,000 gpd or greater*. The Site Screening submittal package is also required when a proponent is seeking an increase in the approved yield of a public water supply source for sources that are already approved for 100,000 gpd or greater, or in the event that the increased yield being sought will result in a revised approved yield that equals or exceeds 100,000 gpd. The proponent shall submit two copies of the completed Site Screening package with the Request for Site Exam/Pumping Test Proposal to MassDEP Drinking Water Program. The Site Screening package consists of the following components:

1. Early Notice
   The proponent shall place a notification in the Environmental Monitor indicating the location where a Site Exam/Pumping Test is being requested, the intent to conduct a pumping test, and the planned withdrawal volume for the proposed new source. The Early Notice provides a 30-day public comment period so that potential issues regarding the proposed source can be identified and incorporated into the pumping test design as needed.

2. Water Conservation Plan
   Prior to commencement of the development of a new public water supply, the proponent shall conduct a thorough analysis of system demand and have a viable water conservation program in place. In addition, the proponent shall complete the Water Conservation Plan. (Refer to MassDEP/Water Management Act Program conservation guidelines, *Guidelines and Policies for Public Water Systems, Volume 1: Guidelines,* Section 10, as amended; and *Water Conservation Standards* updated 2006 (or as further revised))

3. Site Screening Worksheet
   Site Screening allows proponents to estimate the impact on flow from a proposed withdrawal on streams, thus enabling them to make informed decisions in selecting sites and evaluating alternatives for new source development. The Site Screening guidance should be used as a

planning tool, and applicants are encouraged to select alternatives that minimize environmental impact and meet other water supply planning objectives for water quality and productivity. The proponent shall complete the Site Screening Worksheet for Siting a New or Expanding Source of Public Water Supply for each source.

4. Alternative Analysis
   For the proposed withdrawal noted in the Site Screening Worksheet, explain the alternative analysis used to select potential sites and water sources, including regional sources. Discuss public supply needs, water supply system interconnection(s) and public health considerations. Costs must be discussed in terms of economic considerations including the cost of source development, treatment requirements and distribution improvements. Additional guidance on Alternative Analysis may be found in the MEPA regulation, Alternatives to the Project, 301 CMR 11.07(6)(f). If the Request for Site Exam involves an Interbasin Transfer application, the proponent must meet with DCR/Office of Water Resources before completing the Alternative Analysis.

Step 3: Application for Approval to Site a Source and Conduct a Pumping Test

The proponent must submit a Request for Site Exam/Pumping Test Proposal to the appropriate Drinking Water Program in accordance with these guidelines. The primary objective of the pumping test is to resolve questions concerning the potentially approvable yield and existing/potential water quality. At MassDEP's discretion, the objectives may be expanded. This request must be accompanied by two (2) copies of the following information:

1. Request for Site Exam/Pumping Test Proposal

   The requirements for the Request for Site Exam are described in Section 4.3.1.2. The Request for Site Exam/Pumping Test Proposal shall include maps showing nearby well locations, land uses, potential sources of contamination, surface water features, and Zone I ownership. It shall also include the planned pumping rate and duration of the pumping test, location of pumping test discharge, frequency of water level measurements and water quality sampling, exploratory well logs, a plan showing the location of observation wells (if applicable), chemical analytical results, and a discussion/evaluation of potential contamination threats.

   For *wells with planned yields 100,000 gpd and greater*, the following must also be submitted: a preliminary estimate of the Zone II (using the boundary flow-line equation (Todd[1]) or other MassDEP-approved analytical or numerical methods from the literature and a conceptual knowledge of the aquifer system); existing local wellhead protection controls; proposed local control measures to meet the requirements of 310 CMR 22.21(2); a discussion of monitoring well locations, and a discussion of methods for delineation of the Zone II (see Section 4.5.2) or Zone III.

2. Other Requirements

   Wetlands Permit / Massachusetts Wetlands Protection Act (MGL ch 131, s. 40) (310 CMR 10.00) – The Massachusetts Wetlands Protection Act is administered by MassDEP and local conservation commissions. A wetlands permit is required for any work completed within a wetlands resource area or within the 100-foot wetlands buffer zone. Work requiring a permit would include creating an access way to observation well or test well locations, drilling activities, conducting a pumping test, and any wetlands filling or other alteration that may be required. This work will likely involve the filing of a Notice of Intent (NOI) with the local conservation commission, a public hearing, and the issuance of an Order of Conditions by the local conservation commission.

[1] Todd, D. K., 1979, *Groundwater Hydrology*, John Wiley & Sons, Inc., New York, p. 535.

Massachusetts Endangered Species Act (MESA) Permit Application (for sources with planned yields of 100,000 gpd or greater) – Proponents must file with the Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program (NHESP), if the proposed project is subject to NHESP regulations. Depending upon the outcome of that filing (Information Request form), a proponent may need to file for a *Conservation & Management Permit*. If the project requires an NOI due to its location within an Estimated Habitat for Rare Wildlife under the MA Wetlands Protection Act Regulations, a copy of the NOI must be sent to NHESP.

Army Corps of Engineers 404 Permit –This permit is required when any filling of wetlands occurs in the process of well site exploration or well development. To meet the requirements for a Section 404 Permit, an Alternative Analysis must be conducted. This analysis will primarily be conducted in two phases. The first phase will be conducted at the time of the Request for Site Exam/Pumping Test Proposal, and the second phase will be submitted with the Source Final Report.

Step 4: Conduct Site Exam/Pumping Test Proposal Approval

MassDEP will not conduct the site examination until after the Early Notice public comment period, where applicable. The site exam is conducted by MassDEP's Regional Drinking Water Program staff, the water supplier, the consultant, and other stakeholders. It includes a land use/sanitary survey of the IWPA or preliminary Zone II and a review of proposed observation well locations for the pumping test. Special conditions for pumping test design and performance are also discussed. The status of Zone I ownership or control shall be discussed.

It is the proponent's responsibility to inform local officials that approval of a new drinking water well will require protection of the Zone II with municipal controls (bylaws, ordinances or health regulations) that meet MassDEP Wellhead Protection Zoning and Non-Zoning Controls 310 CMR 22.21(2). Upon MassDEP approval of the Request for Site Exam/Pumping Test Proposal, the proponents (both municipal and non-municipal systems), should provide local officials with a copy of 310 CMR 22.21(2) and inform them of the wellhead protection requirements.

Step 5: Federal Notice of Intent (NOI) Application 404 Permit / MassDEP 401 Water Quality Certification Program *(314 CMR 9.00)*

A 404 Permit from the U.S. Army Corps of Engineers may be required for filling or dredging vegetated wetlands or waters of the Commonwealth. The proponent should contact the Corps of Engineers for details. Public water supply wells that are physically located within wetlands are an example of a project that would require a 404 Permit.

A water quality certificate is intended to facilitate review of projects with the potential for large or cumulative impacts to ensure compliance with the surface water quality standards. Actions involving, but not limited to, any one activity listed below, require a 401 application review:

1. Loss of greater than 5,000 square feet of wetlands
2. Within an outstanding resource water (ORW)
3. Any real estate subdivision
4. Any wetlands alteration not subject to the Wetlands Protection Act
5. Rare or endangered species habitat in isolated vegetated wetlands

6. A salt marsh

7. Dredging greater than 100 cubic yards

Step 6: Conduct Pumping Test

This test must be conducted according to these guidelines and the conditions of the pumping test proposal approval letter.

Step 7: Pumping Test Shut Down

Recovery readings shall be taken in accordance with these and the approved pumping test proposal. The pumping test may be shut down only after consultation with MassDEP, in order to assure that MassDEP agrees that stabilization has been achieved.

Step 8: Submit Source Final Report to MassDEP Regional Office

The proponent must submit a Source Final Report as described in Section 4.6. Two copies of the report must be submitted to the appropriate MassDEP regional office. In summary, the Source Final Report shall include all data collected during the pumping test in both tabular and graphical formats; calculated aquifer characteristics; groundwater contour maps before pumping and at the end of the pumping test; calculated approvable yield (See Section 4.3.1.5.); water quality analysis results presented and explained; a discussion of treatment options (if applicable); a discussion of hydraulic connections to nearby surface water features; and, a discussion of how the well's proposed pumping schedule will affect the water table and nearby sensitive receptors.

Step 9: Assess Capacity (Community and NTNC systems only)

A new public water system (community or non-transient-non-community) must demonstrate the managerial, technical and financial ability to comply with the Safe Drinking Water Act and other drinking water requirements pursuant to 310 CMR 22.00. The applicant must submit a business plan *(and/or other financial assurance mechanisms as determined by MassDEP)* in a format approved by MassDEP. The documents must demonstrate the system's proficiency in all three capacity areas: technical, managerial and financial. The draft plan must be submitted during initial stages of the Source Approval process. A complete plan shall be submitted prior to obtaining final on-line approval (See Chapter 1, *Submission of Water Works Plans*). If a water system is part of a larger enterprise, only the water supply portion of the enterprise needs to be included in the business plan. Visit MassDEP Drinking Water Program web site at www.mass.gov/dep/water for a detailed water supply business plan.

Note: MassDEP may require parts of this step earlier in the Source Approval process. This step does not apply to existing systems that are developing a new source.

MassDEP staff will incorporate its capacity assessment and assurance comments into the Site Exam/Pumping Test approval letter and will continue the Source Approval process according to MassDEP.

Step 10: Water Management Permit Application

If applicable, an application for a Water Management Act permit or permit amendment must be submitted to MassDEP Water Management Act Program at the same time the Source Final Report is submitted. A permit amendment is required for existing permit holders adding a new source where system wide withdrawal volumes are not being increased. The WMA regulations can be found in *310 CMR 36.00.* A water withdrawal permit is required for new or expanded water withdrawals above the threshold volume.

Water withdrawal uses may include, but not be limited to public water supply, industrial uses, agricultural uses (i.e., cranberry growers), irrigation uses (i.e., golf courses), snowmaking, and hydropower. The threshold volumes are:

1. An average daily volume of 100,000 gallons for any period of three consecutive months (90 days), for a total withdrawal of not less than 9,000,000 gallons; or,

2. An average daily volume of 100,000 gallons for periods which exceed three consecutive months, calculated by dividing the total withdrawal by the period of operation.

Step 11: Submit Interbasin Transfer Application to DCR *(MGL ch 21 ss. 8B-8D)*

An interbasin transfer is defined as any transfer of the surface and groundwaters, including wastewater, of the Commonwealth outside a river basin. If a city or town partially situated within a river basin takes waters from that basin, extension of water services to a portion of the same city or town outside the basin shall not be deemed an interbasin transfer of water. If your proposed withdrawal involves an interbasin transfer, refer to Department of Conservation and Recreation (DCR) Office of Water Resources, Interbasin Transfer Act, water conservation measures in *Interbasin Transfer Act Performance Standards Guidance* and *A Guideline to the Application of the Interbasin Transfer Act and Regulations*, as amended. Any necessary Interbasin Transfer Act approval must be obtained before MassDEP will issue the WMA permit or permit amendment. Where interbasin transfer may be an issue, MassDEP recommends beginning discussions with DCR early in the Source Approval process.

Step 12: Submit Environmental Notification Form (ENF) to MEPA *(MGL ch 30 s. 61 through 62H) (301 CMR 11.00)*

All proposed new groundwater withdrawals or expansion of existing groundwater withdrawals of 100,000 gpd or greater require that an Environmental Notification Form (ENF) be filed with the Massachusetts Environmental Policy Act (MEPA) Program. The filing initiates a 30-day public review period, which commences with a notification in the Environmental Monitor of the availability of the ENF. During the ENF review, the environmental impacts associated with the proposed well are evaluated. For projects with significant environmental impacts, the ENF review can result in a requirement for the preparation of an Environmental Impact Report (EIR). However, if an EIR is not required, the MEPA review is complete at the end of the public comment period. An EIR is always required for any proposed new groundwater withdrawal or expansion of existing groundwater withdrawal of 1.5 million gpd and greater. An EIR is also required for any new groundwater withdrawal of 1 million gpd and greater that also requires an interbasin transfer. The latest, the ENF should be submitted is at the time of the WMA permit application and Source Final Report. No WMA or Source Approval permits will be issued until the MEPA process is completed.

Step 13: Submit MassDEP 401 Application

At the same time that the Source Final Report is submitted to MassDEP, the proponent shall submit a 401 Application, if required. The 401 Application process will involve a public notice and public comment period and a successful application will result in a major project certification.

Step 14: Submit Environmental Impact Report (EIR) to MEPA (if required)

Step 15: Submit Final Environmental Impact Report (FEIR) to MEPA (if required)

Step 16: Submit 404 Permit Application to Army Corps of Engineers (*Clean Water Act of 1977)*

If the new source development project involves any dredging or filling-in of a waterway or wetland the proponent may be required to apply for a 404 Permit from the U. S. Army Corps of Engineers. Section 404 of the Clean Water Act defines the landward limit of jurisdiction as the high tide line in tidal waters

and the ordinary high water mark as the limit in non-tidal waters. When adjacent wetlands are present, the limit of jurisdiction extends to the limit of the wetlands.

Step 17: Source Final Report Approved

Both the Source Final Report and the Water Management Act permit approvals occur at this step.

Step 18: Submit Design Plan for Permanent Works to MassDEP Regional Office

For *wells with approved yields of less than 100,000 gpd*, the proponent must submit the design plans and specifications to construct the new source concurrent with the submittal of the Source Final Report. For *wells with approved yields of 100,000 gpd or greater*, the proponent may submit the permit application to construct the new source either concurrently with the Source Final Report or after MassDEP has approved the Source Final Report. MassDEP will not approve construction of the source until the water supplier has demonstrated ownership or control of the Zone I. MassDEP cannot approve construction of the source until the MEPA process has been completed.

Step 19: Begin the Wellhead Protection and/or Best Effort Compliance Process

Once the Zone II has been approved, the public water system must provide a copy of the Zone II delineation and a copy of the Wellhead Protection Zoning and Non-Zoning Regulations (310 CMR 22.21(2)) to local officials. Compliance must be achieved prior to the new source going on-line.

Step 20: Submit Notice of Intent (NOI) to Local Conservation Commission

Following the approval of the Source Final Report, additional wetlands or 100-foot wetlands buffer work may be required to install a permanent road to the source, for the construction of the pump house, for construction of the finished production well or wellfield, and/or for the installation of water main. This may require the submittal of a NOI to the local conservation commission.

Step 21: Notify Appropriate MassDEP Regional Office When Construction is Complete

Any design modifications must be noted. In addition, the design plan must identify the owner and party responsible for the public water system. A public water system certified operator staffing plan shall be submitted demonstrating compliance with 310 CMR 22.11B. Any changes in designees must be reported to MassDEP.

Step 22: Site Inspection of Permanent Works

MassDEP will inspect the completed pumping facilities including any water treatment.

Step 23: Final Source Approval

MassDEP will issue a Final Source Approval after the proponent has received the following approvals (where applicable) and MassDEP has determined from its site inspection that the completed pumping facilities are acceptable for use:

1. MassDEP has issued the public water system a Wellhead Protection and/or Best Effort Compliance notification letter.

2. MassDEP Wetlands 401 Major Project Certification

3. Permanent Works Installation Approval

4. Water Management Act Approval
5. MEPA Approval
6. Interbasin Transfer Approval
7. Army Corps Section 404 Approval
8. MESA Approval

A proponent for a new source shall not bring that source on-line prior to receiving written approval from the appropriate MassDEP regional office for the permanent well and pumping facility (see Section 4.17).

Step 24: Meet Requirements of the Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR), an amendment to the federal Safe Drinking Water Act, requires MassDEP to notify the U.S. Environmental Protection Agency (EPA) of groundwater sources determined to be under the direct influence of surface water and at risk for carrying waterborne contaminants such as *Giardia*, legionella, *Cryptosporidium*, and viruses. Water suppliers developing groundwater sources must demonstrate compliance with the SWTR by either receipt of a MassDEP SWTR exemption; institution of appropriate wellhead/watershed protection and adequate disinfection; or installation of adequate filtration, disinfection, and disinfection contact time. Exemptions are granted based upon well siting, well construction, or the results of microscopic particulate analysis (MPA). The proponent of a new source should consider the location of the well relative to the nearest surface water feature and the screened interval, as those decisions will determine whether or not MPA testing is required. The MPA testing that result in a determination of whether the well complies with the SWTR is not done until after the well is constructed and on-line. See Section 4.18 for more details.

Step 25: Implications of the Groundwater Rule

The Groundwater Rule (GWR) is an amendment to the SDWA, which requires Public Water Suppliers that rely in whole or in part on groundwater sources for drinking water to determine if they are being impacted by human pathogens (viruses), usually of wastewater origin. Systems currently collect samples under the Total Coliform Rule (TCR). Under the GWR, when a distribution sample tests positive for total coliform, source sampling will be required. For new wells, if the proposed source tests positive for total coliform, then the sample must be analyzed for *enterococci* (and/or coliphage at MassDEP's discretion). Proposed sources that test positive for *enterococci* (and/or coliphage) are advised that treatment may be needed. Furthermore, the public water system must attempt to correct significant deficiencies under the GWR (for example: nearby failing septic systems or leaking sewer lines) prior to the collection of the initial assessment monitoring sample. Assessment monitoring will be required under the GWR for all new sources at startup.

Additional Requirements:

Certain hydrogeological, geological, or logistical situations may exist that cause MassDEP to require activities during the Source Approval process that may exceed the minimum requirements of these guidelines.

1. In certain complex hydrogeologic situations, it is difficult to predict the zone of contribution for a well without employing a numerical computer model. Based on the geologic and hydrogeologic complexity of the aquifer, MassDEP may require that a specific modeling approach be used to delineate the Zone II.

2. In situations with several independent wells pumping simultaneously, a numerical computer model may be necessary.

3. When water quality problems are known to exist proximal to or at a proposed public supply well, the need for water quality information obtained from a pumping test increases.

4. In the aforementioned situations, MassDEP may **require**:

   a. The use of a numerical computer model;

   b. The installation of as many monitoring or observation wells as are necessary to properly characterize the aquifer and impacts of the withdrawal, to validate the assumptions used in the computer model and/or to assess existing or suspected water quality problems;

   c. All of the wells within the same aquifer be pumped at their approved yield for the duration of the pumping test;

   d. The proposed well be pumped at the rate for which source approval is sought;

   e. The duration of the pumping test exceed the minimum requirements of these guidelines; and,

   f. Additional water quality parameters be examined, or more frequent sampling be employed than is called for in these guidelines.

   It shall be left to the discretion of MassDEP to decide when these supplemental activities are required.

4.2 Site Screening for Siting a New or Expanding Source of Water Supply

Site Screening for Siting New or Expanding Source of Water Supply allows proponents to screen each site under consideration, enabling them to make informed decisions in selecting sites and evaluating alternatives for new source development. Project proponents of new *sources with planned yields 100,000 gpd or greater* shall apply the screening criteria to each source under consideration. This guidance shall not be considered to be a final determination of the approvability of sites, but is intended to provide direction regarding significant issues that will have to be addressed if a particular site is pursued. Applicants are encouraged to select alternatives that minimize environmental impact and meet other water supply planning objectives for water quality and productivity.

The proponent shall complete the Site Screening Package (Appendix F) for Siting a New or Expanding Source of Public Water Supply for each source and shall submit two copies with the Request for Site Exam/Pumping Test Proposal to MassDEP Drinking Water Program. The Site Screening Package requirements for the Water Management Act Program consist of four components: 1) the Early Notice, 2) the Site Screening Worksheet, 3) the Water Conservation Plan, and 4) the Alternative Analysis. Guidance and/or forms for all of these components are available on MassDEP website.

Impacts on streamflow are best determined through physical characteristics of the watershed, site hydrology and pumping tests. However, the site screening criteria provides guidance concerning a withdrawal's potential for impact on flow. Further data collection during the pumping test and analysis will be necessary to determine the potential impact of all proposed withdrawals and mitigating circumstances.