



The State of New Hampshire
Department of Environmental Services

Thomas S. Burack, Commissioner

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January 12, 2015

Her Excellency, Governor Margaret Wood Hassan
and the Honorable Council
State House
Concord, NH 03301

REQUESTED ACTION

Authorize Department of Environmental Services (DES) to enter into a **Sole Source** agreement with the U.S. Geological Survey, Pembroke, NH (VC# 175772), in the amount of \$140,000 to assess long term MtBE contamination trends in New Hampshire. The agreement is effective upon Governor and Council approval through December 30, 2016. Funding is 100% MTBE Settlement Funds.

Funding is available in the following account.

	<u>FY 2015</u>
03-44-44-444010-8893-102-500731	\$140,000
Dept. Environmental Services, MTBE Settlement Funds, Contracts for Program Services	

EXPLANATION

The purpose of this agreement is to fund a study to evaluate MtBE distribution and concentration trends in New Hampshire aquifers. DES would like to enter into a **Sole Source** agreement with USGS for this study because of their unique understanding of the original statewide studies, extensive knowledge of bedrock aquifers and high quality assurance standards. In addition to these advantages, \$110,000 in project matching funds will be provided by USGS. This study will update previous joint DES/USGS studies that were completed in 2003 and 2005. The study will result in an improved understanding of the fate, transport and persistence of MtBE in bedrock and overburden aquifers. This will improve investigation and remedial decision making at MtBE contamination sites.

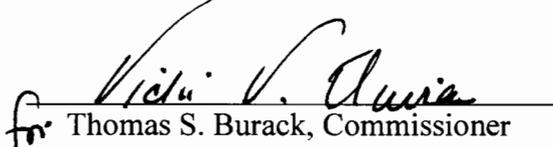
DES notes that the previous USGS studies completed in 2003 and 2005 significantly enhanced NH DES' understanding of the distribution and sources of MtBE contamination and an update of these statewide studies is desirable. The attached joint funding agreement provides additional information on the study.



Her Excellency, Governor Margaret Wood Hassan
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This agreement has been approved by the Department of Justice as to form, content, and execution. In the event the Fund is no longer available, General Funds will not be requested to support this contract.

We respectfully request your approval.


for Thomas S. Burack, Commissioner

**U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY**

JOINT FUNDING AGREEMENT

FOR

WATER RESOURCES INVESTIGATIONS

Customer #: 6000000093
Agreement #: 15ENNH000000004
Project #:
TIN #: 02-6000618
Fixed Cost
Agreement YES

THIS AGREEMENT is entered into as of the, 1ST day of JANUARY, 2015 by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the NEW HAMPSHIRE, DEPARTMENT OF ENVIRONMENTAL SERVICES, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation the resampling of ground-water wells for MTBE to compare new data to data from 2005 herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of
 - (a) by the party of the first part during the period

Amount	Date	to	Date
\$110,000.00	January 1, 2015		December 31, 2016
 - (b) by the party of the second part during the period

Amount	Date	to	Date
\$140,000.00	January 1, 2015		December 31, 2016
 - (c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.
 - (d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.
3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.

- 7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.
- 8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
- 9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered QUARTERLY. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

**U.S. Geological Survey
United States
Department of the Interior**

**State of New Hampshire
Department of Environmental Services**

USGS Point of Contact

Customer Point of Contact

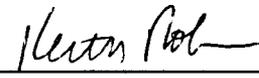
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Signatures and Date

Signature:  Date: 12/5/14
Name: Keith W. Robinson
Title: Director

Signature:  Date: 1/2/15
Name: for Thomas S. Burack
Title: Commissioner

Decadal-scale changes in Methyl *tert*-butyl Ether (MTBE) in Private Drinking Water Sources from Ground Water in New Hampshire

A Proposal to the New Hampshire Department of Environmental Services,
Waste Management Division

U.S. Geological Survey
New England Water Science Center
New Hampshire – Vermont Office

November 20, 2014

Background & Problem Statement

Contamination of ground water in New Hampshire with Methyl *tert*-Butyl Ether (MTBE) has occurred since the initiation of its use, first as a substitute for tetraethyl lead (an octane booster) in 1979, and then as an oxygenate in reformulated fuel in the 1990s (State of New Hampshire, 2000). There is no Federal standard for MTBE in public water supplies, but a Federal Health Advisory of less than 20 to 40 micrograms per liter ($\mu\text{g/L}$) was issued in 1997 (U.S. Environmental Protection Agency, 1997). Several States have developed their own drinking water standards, including New Hampshire, which has a standard of 13 $\mu\text{g/L}$. Occurrence of MTBE in ground water is greatest in the counties of Strafford, Rockingham, Merrimack and Hillsborough, where reformulated gasoline usage was mandated.

In a study by USGS and NHDES in Rockingham County, MTBE was found to be present at concentrations above 0.2 $\mu\text{g/L}$ in 40 percent of public wells tested and in 21 percent of private wells (J.D. Ayotte, Argue, & McGarry, 2005). MTBE occurrence was greatest in public wells used for residential supply, with 62 percent of wells serving apartments, condominiums, mobile home parks, and other residences having MTBE present in the water samples. This study also found that MTBE is related to depth of supply wells. A possible hypothesis of this result is that, as wells are drilled deeper in search of adequate supply, the effective capture area of the well increases, increasing the risk of wells becoming contaminated with MTBE; a second hypothesis is that deep wells (also generally low-yield wells) lack the hydraulic properties to dilute any MTBE that happens to get to the well. This means that either MTBE cannot easily be flushed once it is present or that MTBE is moving through the aquifer along fractures as “piston flow” with little mixing or degradation. In this latter case, it is possible the MTBE will move from well to well for some time before it discharges to a surface water body or attenuated. Based on a follow up study of the entire state, the potential risk of exposure to MTBE in ground water used for drinking in New Hampshire is probably greatest in southern counties and in the counties where reformulated gasoline (RFG) was used (Joseph D. Ayotte et al., 2008). These studies have shown that the occurrence of MTBE was far greater than previously documented, but that concentrations of the contaminant were generally low.

In response to the widespread groundwater contamination, many states enacted partial or complete bans on MTBE and EPA modified requirements for RFG. In 2005, the Energy Policy Act removed the oxygen requirement from gasoline, effectively ending its use nationally. As a result, MTBE use in gasoline has declined considerably and the use of MTBE was widely replaced with ethanol. Some studies conducted shortly after the decline in MTBE use have reported on trends in MTBE and have been inconclusive (Joseph D. Ayotte et al., 2008; Peckenham, 2010). The changes in the occurrence and concentrations of MTBE over time in New Hampshire was examined for a 2-year period based on samples collected in 2005 and 2003, while MTBE was still in use but when its use was diminishing (Joseph D. Ayotte et al., 2008). In that study, it was shown that MTBE was not changing in rate of occurrence, although the wells affected did change—that is, some that were contaminated became MTBE free (banned in New Hampshire on January 1, 2007). Past analysis of public water supply data, collected by the State of New Hampshire for compliance monitoring, indicated that MTBE occurrence had increased steadily over the early 2000s, especially in RFG counties (figure 1). However, little information is available on changes in MTBE concentrations over more recent time periods and for domestic supply wells where MTBE was prevalent in groundwater. Determining the temporal nature of the MTBE contamination is an important step in documenting and projecting the severity of the problem for drinking water supplies. What remains to be determined is whether concentrations and prevalence of MTBE are still increasing or starting to decline since the end in its use.

The State of New Hampshire recently (2013) settled a lawsuit with 22 oil companies claiming that the companies added MTBE to gasoline despite knowledge of water contamination problems (Heed, 2003). In the case of Exxon-Mobil, the only defendant that did not settle, the State was awarded \$236M, although that decision is being appealed.

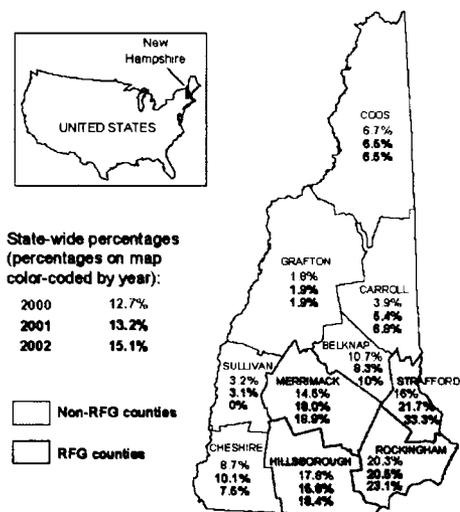


Figure 1. Percent of public water-supply wells with MTBE $\geq 0.5 \mu\text{g/L}$ by county for 2000, 2001, and 2002 for reformulated gas (RFG) and non-RFG counties.

Objectives

This proposed study has two primary objectives:

1. This study will provide a follow-up status of the occurrence and distribution of MTBE in over 300 groundwater sources used for drinking water as measured approximately 10 years ago (through follow-up sampling). Wells to be re-sampled will be primarily in the 4 southeast counties of the State of New Hampshire that used RFG (Rockingham, Strafford, Hillsborough, and Merrimack) using a laboratory reporting level (LRL) of 0.2 µg/L. These wells were randomly selected according to methods reported previously (Ayotte et al 2004, Ayotte et al 2006).
2. This study will use the Wilcoxon-Pratt signed-rank test (Pratt, 1959), which is a matched pair test used to evaluate whether the median difference between paired observations within datasets are significantly different than zero. The traditional Wilcoxon signed-rank test (Wilcoxon, 1945) uses only nonzero differences, thus biasing the result when data sets include many ties (such as a non-detects in both sampling events); however, the Wilcoxon-Pratt signed-rank test is modified such that zero difference ties are included in the calculation. The null hypothesis that the median difference between pairs is zero was rejected if the probability value was less than 0.1. The statistical test for change in concentration can be applied to the data in total and if stratified by factors such as land use, geology, and other features to test multiple hypotheses related to change. For example, is change not apparent in specific geological formations or within some distance to known releases or for certain well yield thresholds? Any reported value paired with a non-detection with a smaller value will be considered a discernable difference.

Relevance and Benefits Statement

This project meets the mission of the USGS for providing unbiased scientific data on the quality of the Nation's water resources. The project will provide a one of the first evaluations of MTBE changes over timescales of a decade in private drinking water supplies in both unconsolidated and crystalline bedrock aquifers. The resulting data will be stored in the USGS's NWIS database and will be accessible to the public, without detailed location information or other personally identifiable information. The project will utilize standard USGS techniques for water quality surveys, employing low-level analytical methods, and integrated quality assurance. This consistency also will allow comparisons to be made with other studies across the United States and regionally. Additionally, the work will allow for synthesis of the data—relating results to factors that help explain the presence and fate of MTBE in public and private water supplies. The results from the study will contribute sound, unbiased, scientific information that will support establishment of sound policies, regulations and management practices for the use of RFG at state, regional and national levels.

Approach

A number of USGS and State studies have investigated MTBE contamination of ground waters (Delzer & Ivahnenko, 2003; Flanagan, Montgomery, & Ayotte, 2001; Grady, 2002; Ivahnenko, Grady, & Delzer, 2001; Johnson, Pankow, Bender, Price, & Zogorski, 2000; M. Moran, Grady, & Zogorski, 2001; M.J. Moran & Hamilton, 2003; M. J. Moran, Lapham, Rowe, & Zogorski, 2002; M.J Moran, Zogorski, & Squillace, 2004; State of New Hampshire, 2000). The designs and results of the previous NH studies will be reviewed in the context of this investigation to assist in the developing the best design for this study. Seven major tasks are proposed for this study:

1. Review existing literature on MTBE in drinking water supplies. Reports on declines in MTBE concentrations are beginning to appear in the literature. A review of this information will provide insight on which environmental and anthropogenic variables may be most important in controlling the extent of current contamination and may be used in the stratification scheme for the data analysis.
2. Design a sampling program for private drinking water sources. A sampling program of approximately 300 existing private wells (sampled in previous studies) is proposed. Sampling will be done as close as possible to the well source, prior to any treatment system. Private wells that were previously selected based on a stratified random design will be re-sampled. The final design will allow for incorporation of targeted sampling to address specific issues or questions, based on discussion with the State of New Hampshire, Waste Management Division that will allow for determination of whether MtBE is attenuating and whether rates are variable based on likely controlling factors. Additionally, characterization of source water from 300 public systems may be done (assuming data are suitable) using data that may be collected by the State of New Hampshire; this work would be limited to comparison to private well data.
3. Selection of private wells for temporal analysis of MTBE in private drinking water sources. All 340 private wells in the four-county area will be examined for sampling. It is expected that up to two-thirds will be available for follow up testing or about 225 wells. Approximately one-third of the wells selected will have had a prior detection; two-thirds will have no prior detection. This will allow for determination of the actual number wells with prior contamination that now have less and for the possibility that wells with no prior contamination that now have MTBE are accurately determined. To the extent possible, these wells will be sampled during the same time period as before to minimize effects of season on the concentrations measured. If additional wells are needed, wells from adjacent counties will be used.
4. Conduct sampling and analysis. Due to the large number of samples proposed, sampling will be conducted over an approximately one-year period. Because the study will focus on ground water it is not expected that concentrations will vary markedly by season. Private well owners will be contacted to obtain permissions and schedule sampling activities. A database of responses and ancillary information will be maintained as part of this effort.

All sampling sites will be located in the field using the Global Positioning System (GPS). Field water-quality parameters (pH, dissolved oxygen, specific conductance, and water temperature) will be collected from each water source that is sampled. Samples will be collected by USGS scientists, using parts-per-trillion protocols. These protocols have enabled USGS scientists to collect water samples for organic compounds at or near the parts-per-trillion level (Koterba, Wilde, & Lapham, 1995; Lapham, Wilde, & Koterba, 1995) without significant contamination by the sampling procedure. These methods will be employed to ensure that meaningful data are developed from the sampling effort. These methods were used successfully in the previous Rockingham County and statewide studies.

Samples will be collected from a water source prior to any in-home treatment system using stainless steel fittings with cleaned Teflon lines where needed. Clean-hands protocols will be in effect. MTBE sampling will require 2, 40 ml amber glass septum vials. The protocol includes the following requirements: 1) Do not rinse vial; 2) Completely fill vial with sample to exclude air bubbles; 3) Preserve sample by adjusting sample with 1:1 HCl/H₂O solution to a pH of 2; 4) Protect sample from sunlight, store sample at 4 deg C; 5) ship immediately (Connor, Rose, Noriega, Murthagh, & Abney, 1998; Rose, Connor, Abney, & Raese, 1998). The laboratory holding time (time between sample collection date and lab analysis date) for these samples is 14 days. Significant quality assurance sampling will be conducted and will include 1) field, equipment, and laboratory blanks, 2) spikes, and 3) replicates. QA samples will be spaced appropriately throughout the collection period to maximize their usefulness, and will consist of about 10-15 percent of all wells sampled.

5. Laboratory analyses. Analyses of samples will be done at the New Hampshire Department of Environmental Services Water Quality Lab. The Method Detection Limit and Laboratory Reporting Level are proposed to be 0.20 µg/L for MTBE. Analytical data from the NHDES lab will be reported to well owners by USGS using standard reporting procedures. Data will be delivered to USGS from the NHDES laboratory in digital format. The NHDES laboratory is NELAC approved for VOC analyses. A USGS laboratory evaluation plan will be implemented for the project.
6. Track, manage, and analyze chemistry data returned from the lab. All data from the sampling program will be stored and maintained in the USGS National Water Information System (NWIS) database. The data will be analyzed using Geographic Information Systems (GIS) techniques and statistical methods to relate MTBE occurrence to potential explanatory variables. These variables will be identified in conjunction with NHDES and results will be presented in a format mutually agreed upon with USGS and NHDES staff and will be based in part on results of the Rockingham County and statewide studies. Types of analysis may include correlation to known point and non-point sources (such as RFG usage areas, underground storage tank sites (UST), leaking underground storage tank (LUST) sites, CERCLA sites, TRI sites, transportation

corridors, etc.), demographic data, aquifer type, well type, system type, hydrologic and geologic data, land-use data at multiple scales, and other ancillary geographic data.

7. Temporal change analysis. This analysis will focus on changes in both MTBE occurrence and concentrations. Trends in MTBE concentrations will be examined by use of the Wilcoxon-Pratt signed rank test. This will, at a minimum, provide information on the variability of MTBE in private drinking water supplies and may provide information on trends in these concentrations. This analysis will likely indicate if concentrations are generally increasing or decreasing in the RFG counties and may help identify factors related to increases or decreases over time. The temporal analysis of MTBE concentrations at these wells will be limited because only two samples will be available per site. However, important information can be derived despite this limitation. For example, comparisons of the MTBE concentrations between sampling events will be made (rank tests on paired concentration data) as well as tests on the distributions of the data to identify potential increases or decreases in concentrations (non-parametric distribution tests). To the extent possible, factors related to increases or decreases will be explored based on the observed changes in MTBE among these different previously defined controls (i.e. analysis of concentration change by variables such as yield, depth age, land use categories, known release information, geology, among others).

Report Products and Intended Audience

Project reviews will be held quarterly with staff of NHDES Waste Management Division. Informal quarterly progress reports describing completed and planned work, problems encountered, and budget status will be delivered to NHDES at these meetings. A joint USGS/NHDES journal article will be produced at the completion of the study. The report will:

- Describe the occurrence and distribution of MTBE, including the frequency of detection and range in concentrations in the water supplies of the State.
- Assess trends in MTBE occurrence and concentrations in wells.
- Identify environmental and anthropogenic variables important in predicting MTBE change that can be used in engineering-based risk assessments.
- Compare findings with those from other local, regional, or national studies.

This report, geared toward scientists, engineers, and managers, will contain essential scientific information on the change in the occurrence of MTBE contamination during the past decade in private water supplies derived from ground-water sources in New Hampshire that can be used in risk assessment and mitigation. This information will help the State assess the status of drinking water contamination by MTBE and to evaluate the factors related to its occurrence. Specifically, results from this study can be used in assessment of vulnerability or risk of contamination of private supplies. Also, results may help to target future monitoring and to make decisions regarding future remedial action. This information will assist the State in evaluating the costs remediation of contamination from MTBE use in the past.

Task and Time Line

Task	FY 15						FY 16												FY 17					
	F	M	A	M	J	J	A	S	O	N	D	J	J	M	A	M	J	J	A	S	O	N	D	
Review recent literature	X																							
Finalize sampling design		X																						
Select private systems for sampling			X	X	X																			
Contact private well owners				X	X	X	X	X	X	X														
Collect samples & deliver to NHDES Lab					X	X	X	X	X	X														
Explanatory data compilation and preliminary analysis				X	X	X	X	X	X	X														
Finalize statistical analyses											X	X	X	X										
Report writing														X	X	X	X							
Review/Publication																	X	X	X	X	X	X	X	X
Quarterly reviews with NHDES			X								X				X						X			

Preliminary Budget:

A joint USGS and NHDES funded project is proposed. USGS Cooperative Water Program Funds will be used to fund the USGS contribution. The budget is preliminary and subject to the final USGS appropriations of Cooperative Water Program funds and NHDES approval. The funds would be used over a two-year period as indicated below:

Agency	Federal Fiscal Year 15	Federal Fiscal Year 16	Total
U.S. Geological Survey	\$55,000	\$55,000	\$110,000
NH DES	\$70,000	\$70,000	\$140,000
Total Project Cost	\$125,000	\$125,000	\$250,000

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