

Health Consultation

Assessment of Radionuclides in Groundwater

TUCK POINT CONDOMINIUM COMPLEX
109 – 123 WATER STREET
BEVERLY, ESSEX COUNTY, MASSACHUSETTS

MADEP RTN 3-0234

**Prepared by the
Massachusetts Department of Public Health**

December 18, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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SUMMARY

Introduction: This Health Consultation was conducted in response to exposure and health concerns raised by a resident of Tuck Point Condominium Complex in Beverly, Massachusetts, regarding possible past, present, and future exposure to radioactivity in groundwater associated with the former Ventron site located approximately one half mile west. To investigate these concerns, the MDPH/BEH Environmental Toxicology and Radiation Control Programs (ETP and RCP) developed a groundwater sampling protocol, collected samples, and evaluated groundwater sample results analyzed by the RCP Massachusetts Environmental Radiation Laboratory (MERL).

Conclusion: MDPH/BEH concludes that exposure to the levels of radioactivity detected in groundwater while living and visiting the Tuck Point Condominium Complex is not expected to result in health concerns.

Basis for Decision: The levels of radioactivity measured in groundwater samples collected at Tuck Point Condominium Complex were all

comparable to levels of naturally occurring radionuclides in groundwater in Essex County, Massachusetts where Beverly is located. The groundwater is not a source of drinking water but the resident's concern related to the possibility that if elevated levels are present, some exposure may result through volatilization of radionuclides into indoor air. However, because the levels detected in groundwater samples were at or below background levels, opportunities for exposure to radionuclides are unlikely. Thus, opportunities for exposure are unlikely to result in health effects at Tuck Point in the past, present, and future.

Next Steps: No additional evaluations of exposure or other actions associated with this site are recommended.

For More Information: If you have concerns about your health, you should contact your health care provider. You may also call MDPH at 617-624-5757 and ask for information on the Tuck Point Condominiums Complex site.

INTRODUCTION

In response to a request by a resident of the Tuck Point Condominiums Complex located on 109-123 Water Street in Beverly, Massachusetts, the Radiation Control and Environmental Toxicology Programs (RCP and ETP) of the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted an investigation of radioactivity in groundwater on the condominium property. The request originated from exposure and health concerns specifically related to the possible migration of radioactive contamination associated with the former Ventron site located about one half mile from the Tuck Point Condominiums on Congress Street (Figure 1). The former Ventron site has had several other names including the Metal Hydrides plant, Morton International, and Thiokol Corporation. From 1942 to 1948, uranium was processed at the former Metal Hydrides plant. Work with radioactive material continued at the plant until 1986 (Foley and Johnson 1992).

Contaminants of concern associated with historical operations at the former Ventron site include uranium-238, thorium-232, and to a lesser extent radium-226. The site was investigated and remediated by an MDEP Licensed Site Professional who reported the clean-up was completed in accordance with the Massachusetts Contingency Plan, Chapter 21E. Remediation at the former Ventron site was initiated in the mid-1990s and the U.S. Department of Energy (US DOE) certified clean-up as complete in 2003 (US DOE 2008). This health consultation evaluates the results of groundwater testing for radioactivity and opportunities for past, present, and future exposure to residents of the Tuck Point Condominium Complex.

BACKGROUND

The Tuck Point Condominiums Complex consists of residential condominiums built in the early 1980s at the location of a former chemical storage facility. The condominium buildings are of slab-on-grade construction (i.e. no basements) and are serviced by the

municipal drinking water supply. Common areas between the buildings are paved, except for several small landscaped areas. The Tuck Point Condominium Complex itself has been listed as a disposal site with the Massachusetts Department of Environmental Protection (MDEP) since 1981 related to clean-up of petroleum-related compounds in the groundwater. Groundwater is believed to flow in a southeasterly direction toward Beverly Harbor (ocean) and is influenced by tidal fluctuation (Lessard Environmental, Inc. 2004). Floating product (petroleum) is present on the water table, approximately fifteen feet below grade. The condominium association has engaged a Licensed Site Professional, Lessard Environmental, Inc., and is addressing the site under the MDEP Massachusetts Contingency Plan 21E program. An active pump-and-treat recovery system, designed to collect both free product and groundwater, is currently in operation. Based on site investigations conducted at the condominium complex, MDEP and the U.S. Environmental Protection Agency have determined that hazardous substances related to the petroleum contamination are not present at the surface and residents are not being exposed (US EPA 2005, MDEP 2005).

In January 2005, a resident of the condominiums requested a meeting with MDPH/BEH to discuss his health and exposure concerns about radioactivity at the condominium complex that could have potentially migrated from the nearby Ventron site. Specifically, although remediation at the former Ventron site had been certified as complete by the US DOE, the resident expressed concern about possible migration of radioactive material in groundwater reaching the condominium complex and potentially contributing to indoor air levels of health concern.

In response, since groundwater at the condominium complex is shallow (i.e. approximately 15 feet below grade), MDPH/BEH suggested that if the levels of radioactivity measured in groundwater were determined to be at background levels, then past, present, and future exposure to radioactivity via indoor air would be unlikely. Based on this discussion, the resident expressed interest in having MDPH/BEH sample the groundwater for radioactivity underneath the condominium property to address his exposure concerns.

After receiving signed permission and consent from the Tuck Point Condominium Association, the MDPH/BEH ETP and RCP developed a groundwater sampling protocol (Appendix A). Groundwater samples were collected from existing monitoring wells located on the condominium property on March 14, 2006, by an MDPH consultant, EnviroScience Consultants, Inc. Samples were analyzed for radionuclides at the RCP's Massachusetts Environmental Radiation Laboratory (MERL).

GROUNDWATER SAMPLING

Twelve existing groundwater monitoring wells on the Tuck Point Condominiums Complex property were selected for sampling for radioactivity analysis. Monitoring wells were selected for groundwater sampling based on the following considerations:

- Wells located farthest from the harbor were included because they were least likely to have salt water intrusion that could possibly cause a dilution effect.
- Wells located near all residences throughout the condominium property were included to capture groundwater conditions representative of the entire complex.
- Wells located on the west side of the property and closest to the Ventron site were selected to evaluate the possible influence of radionuclides in groundwater originating from that site.

In addition to these well selection criteria, the data analysis protocol that was developed summarized available background data on radionuclides reported in groundwater in Essex County, Massachusetts (Beverly is located in Essex County). Based on these data, it was determined that if the results of the analyses were less than the maximum background values reported (i.e., 8.6 pCi/L for gross alpha, and 54 pCi/L for gross beta), then past, present, and future indoor air exposures to radioactivity would be unlikely and no further testing or follow-up would be recommended.

Figure 2 shows the site layout and the location of the monitoring wells from which the groundwater samples were collected. A total of 26 groundwater samples were collected on March 14, 2006, and submitted to the MERL for analysis. Two sets of samples were collected from each of the twelve groundwater wells, one during low tide and the other during high tide. For quality assurance purposes, one duplicate sample was also collected during each sampling round (e.g. two duplicates).

Gamma spectroscopy analyses were performed on all groundwater samples using U.S. EPA Prescribed Procedure Drinking Water for Measurement of Radioactivity in Drinking Water for Gamma Emitting Radionuclides, Method 901.1. Results for this analysis were reported in picocuries per liter (pCi/L). Additionally, it was possible to analyze nine of the 24 collected samples for gross alpha and gross beta activity using a method consistent with EPA Method 900.0 for analyzing water samples for the presence of radionuclides (refer to Appendix A). Gross alpha/beta testing requires that total dissolved solids (TDS) not exceed 100 mg/planchet (weighing pan). Nine of the 24 samples collected met the TDS requirement (five of the 12 high tide samples and 4 of the 12 low tide samples). The fact that the groundwater in the Tucks Point area has high TDS likely reflects the tidal influence on groundwater, as salinity is defined by the concentration of TDS in water (Poehls and Smith 2009). Gross alpha and gross beta results reflect the presence of the most common naturally occurring radionuclides (e.g. uranium, radium, and thorium). Sampling results for this analysis were also expressed as pCi/L.

RESULTS AND DISCUSSION

Based on the results of laboratory analyses using both methodologies, no radioactivity above what would occur naturally as background was found in any of the groundwater samples collected from wells located on the Tuck Point Condominium property.

Gamma Spectroscopy Analysis Results

Results of the gamma spectroscopy analysis are presented in Table 1. All 24 groundwater samples had levels of activity comparable to naturally-occurring gamma emitting radionuclides. Specifically, five samples had no detectable activity. Three other samples had potassium-40 (K-40) activity calculated as below minimum detectable activity and had no other gamma activity. The 16 remaining samples had activity contributed by radionuclides other than K-40 and most levels detected barely exceeded the extremely low minimum detectable activity that was achieved for these radionuclides in this analysis.

All of the radionuclides detected in the groundwater samples can be attributed to naturally-occurring radioactivity in the earth's crust. All rocks and soil contain some amount of potassium, thorium, and uranium. Potassium (K-40) is the most soluble and can easily leach from the rocks and soil into the groundwater. Rocks like granite (and New England soils which are largely derived from granite) tend to have higher amounts of potassium than soils that are silica based. Similarly, granite tends to have higher levels of uranium and thorium than other rocks. Four of the samples had detectable thorium (Th-234) and two had detectable uranium (U-235) while another two samples were below the level of minimum detectable activity.

Gross Alpha/Beta Analysis Results

Results of the Gross Alpha/Beta analysis were also at or below background levels. Table 2 shows the analytical results for the nine groundwater samples that were able to be analyzed using this method (i.e. samples for which the total dissolved solids did not exceed 100 mg/planchet). Specifically, the maximum gross alpha result, 3.6 ± 2.2 pCi/L, was detected in the groundwater sample collected from MW-2 during high tide and is less than the maximum value reported in the available data for Essex County, 8.6 pCi/L. The maximum gross beta result, $21.3 \pm$ pCi/L, was also detected in groundwater collected from MW-2 during high tide and is less than the maximum value reported for Essex County, 54 pCi/L. Results of Gross Alpha/Beta analysis for MW-2 during low tide were

lower than at high tide. Although groundwater at the Tuck Point Condominium Complex is not a source of drinking water, it is also important to note that the maximum gross alpha and beta results were also less than federal drinking water standards, 15 pCi/L and 50 pCi/L, respectively.

CONCLUSIONS

Based on an analysis of groundwater samples collected at Tuck Point and a determination that the levels of radioactivity measured in groundwater are at or below background levels, opportunities for past, present, and future indoor air exposures to radiation are unlikely. Thus, MDPH/BEH concludes that exposure to levels of radionuclides detected in groundwater while living and visiting the Tuck Point Condominium property is not expected to result in health concerns.

RECOMMENDATIONS

Based on the results of this groundwater investigation, no further investigation of radioactivity in groundwater at Tuck Point Condominium Complex is recommended at this time. However, MDPH/BEH is available to evaluate additional environmental data and exposure concerns upon request.

Individuals with additional information or questions regarding this health consultation should contact the Bureau of Environmental Health, MDPH, Environmental Toxicology Program, at (617) 624-5757.

PUBLIC HEALTH ACTION PLAN

The purpose of the Public Health Action Plan is to ensure that this health consultation not only identifies potential public health hazards, but also provides a plan of action designed

to mitigate and prevent adverse health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR/MDPH to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR/MDPH are as follows:

- Upon request, MDPH will review any additional environmental data and exposure concerns about Tuck Point Condominium Complex.

REFERENCES

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<http://nwis.waterdata.usgs.gov>.

PREPARER

This document was prepared by the Bureau of Environmental Health of the Massachusetts Department of Public Health. If you have any questions about this document, please contact Suzanne K. Condon, Director of BEH/MDPH at 250 Washington Street, 7th Floor, Boston, MA 02108.

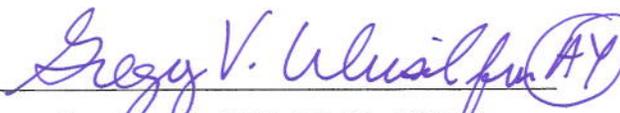
CERTIFICATION

The Health Consultation, *Assessment of Radionuclides in Groundwater, Tuck Point Condominium Complex, Beverly, Essex County, Massachusetts*, was prepared by the Massachusetts Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Health Consultation was initiated. Editorial review was completed by the cooperative agreement partner.



Technical Project Officer, CAT, SPAB, DHAC, ATSDR

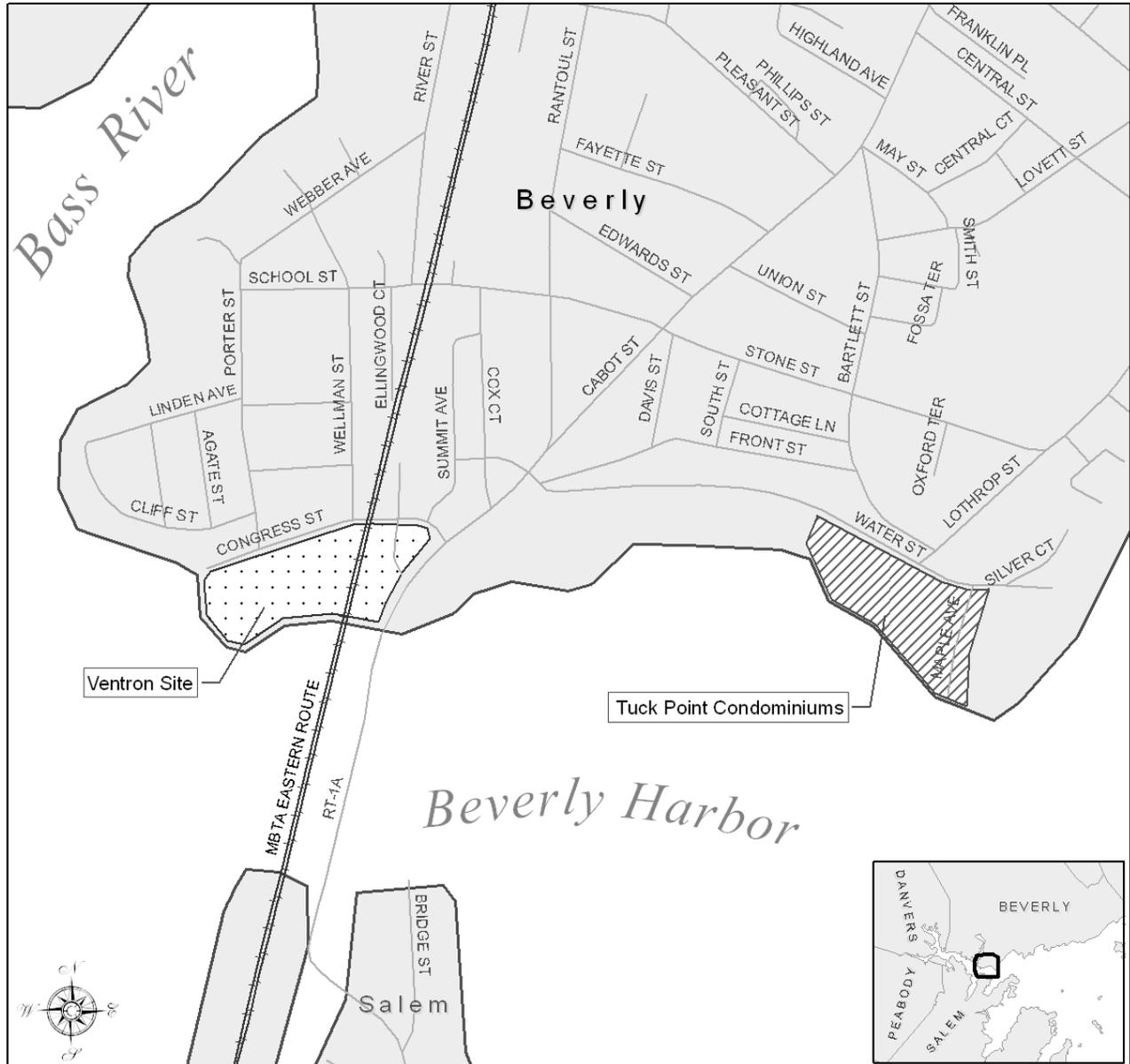
The Division of Health Assessment and Consultation, ATSDR, has reviewed this Health Consultation and concurs with its findings.



Team Lead, CAT, SPAB, DHAC

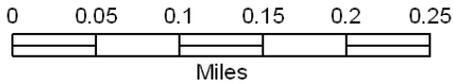
FIGURES

Figure 1
Tuck Point Condominiums, Beverly MA.



Legend

-  Town Boundary
-  Tuck Point Condominiums
-  Ventron Site
-  Active Rail Service
-  Road



Geographic data supplied by:
Massachusetts Executive Office of Environmental Affairs, MassGIS;
Map Created by BEH-GIS, MDPH

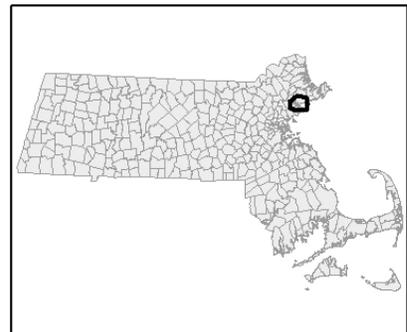
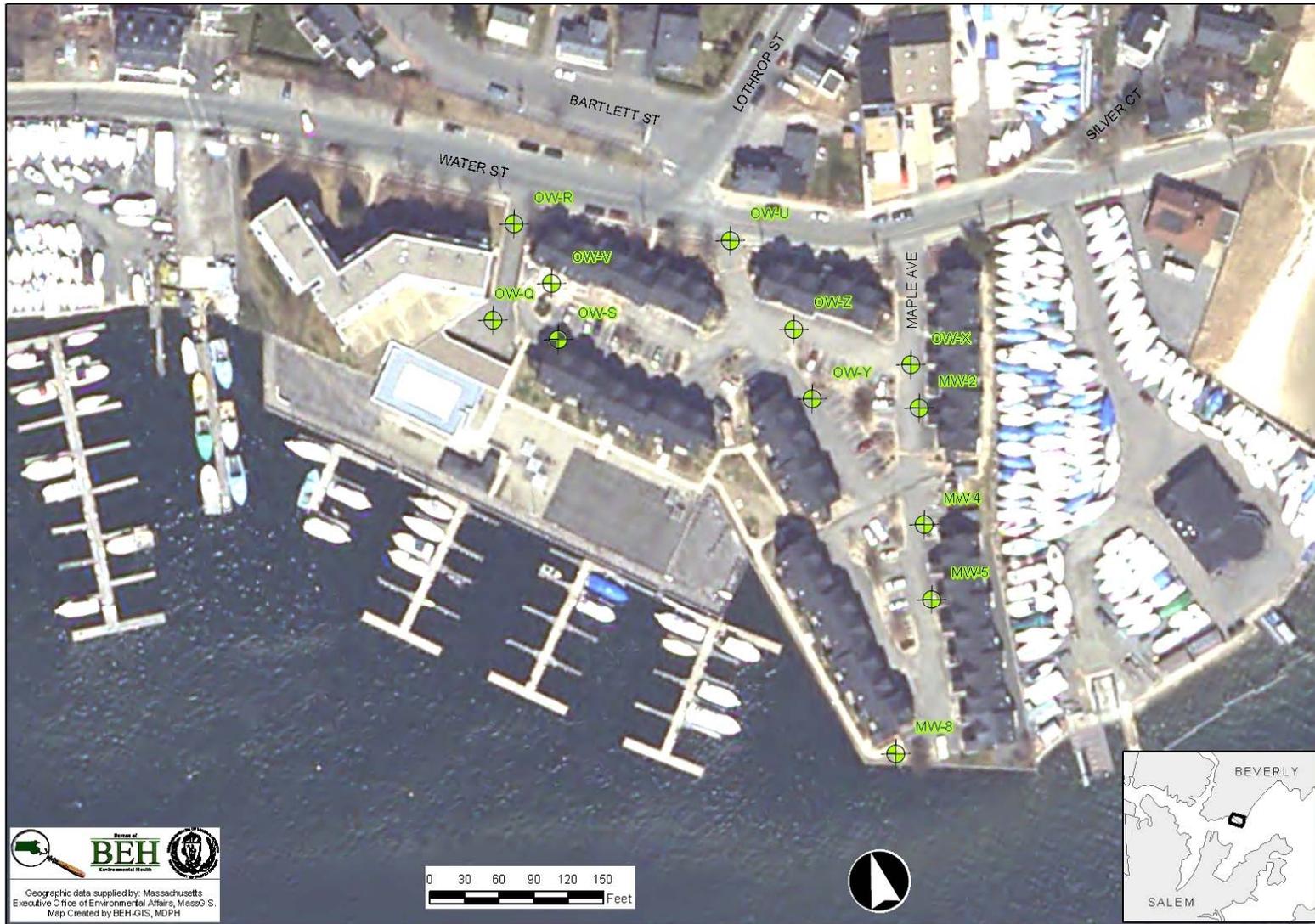


Figure 2
Tuck Point Condominiums Complex, Beverly, MA
Approximate Locations of Sampled Ground Water Monitoring Wells



TABLES

Table 1
Massachusetts Environmental Radiation Laboratory (MERL)
Gamma Spectroscopy Analysis Results for
Groundwater Samples Collected at Tuck Point Condominiums 3/14/2006

MERL ID	Sample ID	Sample Date	Analysis Date	Analysis Results $\pm 1 \sigma$ pCi per liter	MDA
06E0127	MW-2-High	03/14/2006	07/07/2006	*K-40 1.15E3 \pm 6.90E1	7.34E1
				*Bi-214 8.32E1 \pm 5.29E0	1.70E1
				*Pb-214 5.51E1 \pm 3.90E0	1.80E1
				*Th-234 2.31E2 \pm 1.32E1	1.26E2
				*U-235 1.99E1 \pm 4.53E0	1.35E1
06E0128	MW-4-High	03/14/2006	07/10/2006	*K-40 1.15E3 \pm 3.98E1	7.67E1
				*Bi-214 7.71E1 \pm 7.38E0	1.69E1
				*Pb-214 4.57E1 \pm 2.63E0	2.06E1
				*Th-234 3.61E2 \pm 2.29E1	1.36E2
06E0129	MW-5-High	03/14/2006	07/10/2006	*K-40 1.68E2 \pm 6.25E1	1.52E2
06E0130	MW-8-High	03/14/2006	07/11/2006	*K-40 1.33E3 \pm 4.34E1	5.94E1
				*Bi-214 8.36E1 \pm 2.62E0	1.86E1
				*Pb-214 6.57E1 \pm 2.88E0	1.79E1
				*Th-234 2.60E2 \pm 1.36E1	1.37E2
				*U-235 1.84E1 \pm 3.91E0	1.17E1

MERL ID	Sample ID	Sample Date	Analysis Date	Analysis Results $\pm 1 \sigma$ pCi per wipe	MDA
06E0131	OW-R-High	03/14/2006	07/11/2006	*K-40 2.32E2 \pm 7.31E1	1.52E2
06E0132	OW-R-High Dup	03/14/2006	07/17/2006	*Pb-212 3.01E1 \pm 3.48E0	1.16E1
06E0133	OW-Q-High	03/14/2006	07/17/2006	*K-40 2.48E2 \pm 7.28E1	1.51E2
06E0134	OW-S-High	03/14/2006	07/21/2006	*Pb-212 1.35E1 \pm 2.81E0	1.32E1
06E0135	OW-U-High	03/14/2006	07/21/2006	NDA	<MDA
06E0136	OW-X-High	03/14/2006	07/22/2006	NDA	<MDA
06E0137	OW-Y-High	03/14/2006	07/24/2006	*Pb-212 3.04E1 \pm 3.89E0	1.06E1
06E0138	OW-Z-High	03/14/2006	07/26/2006	K-40 9.46E1 \pm 6.94E1 (<MDA)	1.53E2
06E0139	MW-2-Low	03/14/2006	07/27/2006	K-40 1.60E2 \pm 8.08E1 (<MDA)	3.80E2
06E0140	MW-4-Low	03/14/2006	07/27/2006	K-40 1.84E2 \pm 7.57E1 (<MDA)	1.52E2
06E0141	MW-5-Low	03/14/2006	08/08/2006	*Pb 212 2.06E1 \pm 3.54E0	1.19E1
06E0142	MW-8-Low	03/14/2006	08/08/2006	*K-40 2.04E2 \pm 4.50E1 U-235 6.69E0 \pm 2.81E0 (<MDA)	1.52E2 1.14E1
06E0143	OW-Q-Low	03/14/2006	08/01/2006	*K-40 1.27E3 \pm 4.25E1 *Bi-214 2.22E1 \pm 6.26E0 *Th-234 2.42E2 \pm 3.96E1 U-235 1.03E1 \pm 1.28E0	8.83E1 1.88E1 1.23E2 1.40E1
06E0144	OW-R-Low	03/14/2006	08/01/2006	NDA	<MDA
06E0145	OW-R-Low Dup	03/14/2006	08/02/2006	NDA	<MDA
06E0146	OW-S-Low	03/14/2006	08/02/2006	K-40 2.86E2 \pm 1.02E2 Bi-212 6.12E1 \pm 1.26E1 *Pb-212 3.07E1 \pm 2.03E0	3.81E2 1.13E2 1.00E1

MERL ID	Sample ID	Sample Date	Analysis Date	Analysis Results $\pm 1 \sigma$ pCi per wipe	MDA
06E0147	OW-U-Low	03/14/2006	08/03/2006	*K-40 1.60E2 \pm 7.48E1 *Bi-214 3.85E1 \pm 6.46E0	1.51E2 1.77E1
06E0148	OW-X-Low	03/14/2006	08/03/2006	K-40 2.41E2 \pm 1.01E2 *Pb-212 1.90E1 \pm 1.66E0	3.82E2 1.12E1
06E0149	OW-Y-Low	03/14/2006	08/04/2006	Bi-212 5.08E1 \pm 1.27E1 *Pb-212 4.47E1 \pm 4.17E0	1.04E2 1.09E1
06E0150	OW-Z-Low	03/14/2006	08/04/2006	NDA	<MDA

* Asterisk denotes radioactivity detected in the sample. Statistically, if the concentration of the radionuclide is greater than three times the standard deviation (1 sigma) of the radionuclide of interest present in the sample and the analysis result is greater than the minimum detectable activity then the radionuclide is present in the sample.

Analysis Notes:

The samples were analyzed with a high purity germanium gamma spectroscopy system utilizing Canberra Genie 2000 software. The detector was calibrated for energy and efficiency for the geometry of the samples. The groundwater were transferred to 1 Liter Marinelli beakers and counted for 55,000 seconds. Only normal levels of naturally occurring radionuclides were detected. Results are reported in picocuries (pCi) per liter.

All of the analysis results reported reflect the concentration of the radionuclides at the time of sample collection.

The sample analysis results have had background subtracted from the sample plus background counts.

A NDA value reported by MERL can be interpreted to mean that no detectable activity of a radionuclide of interest was found in the sample at the time of analysis.

The following evaluation criteria is used by MERL to report a positive analysis result:

- An analysis result must be three times greater than the one-sigma error value for the radionuclide of interest.

And

- An analysis result must be greater than the detection limit for the radionuclide of interest.

In general, the laboratory's overall uncertainty is ± 15 percent.

Table 2
Massachusetts Environmental Radiation Laboratory (MERL)
Results of Gross Alpha/Beta Analysis for Groundwater Samples
Collected at Tuck Point Condominiums 3/14/2006

Sample ID	Gross Alpha pCi/L		Maximum Reported Background Essex County	Gross Beta pCi/L		Maximum Reported Background Essex County
	High Tide	Low Tide	Gross Alpha*	High Tide	Low Tide	Gross Beta*
MW-2	3.6±2.2	2.6±2.0	8.6 pCi/L	21.3±4.1	7.6±3.6	54 pCi/L
MW-5	2.6±2.0	2.1±2.0		8.9±3.7	9.6±3.7	
OW-X	1.0±2.0	1.2±2.0		9.2±3.8	8.8±3.8	
OW-Y	2.8±2.2	NA		6.4±3.7	NA	
OW-Z	0.4±2.1	0.6±2.1		8.0±3.7	8.6±3.8	

* Background data back to 1999 were obtained from the Massachusetts Department of Environmental Protection's (MDEP) database of regulatory monitoring data for radionuclides in public drinking water supplies in Essex County that are served by groundwater wells.

Analysis Notes:

Nine of the 24 samples were analyzed on a gas-flow proportional counter for gross alpha and gross beta measurement. Gross alpha/beta testing requires that total dissolved solids (TDS) not exceed 100mg/planchet (weighing pan). This is due to the self-absorption effect of the total dissolved solids preventing the alpha radiation from reaching the detector. Thus, only 9 of 24 samples were able to be tested.

Screening of all 24 samples using a volume of 100 ml produced TDS values of 30-1128mg/planchet. The TDS values were randomly distributed and did not seem to correlate with high or low tide. TDS screening resulted in the acceptability of nine samples to be tested for gross alpha and beta along with a lab reagent blank. Five of 12 high tide samples were tested and 4 of 12 low tide samples were tested. TDS values of the nine samples were 89.6, 50.6, 79.7, 94.3, 95.4, 53.8, 64.2, 81.8 and 94.8 mg/100 ml/planchet.

Count times per sample were gross alpha/775 minutes and gross beta/365 minutes. Results are reported in pCi/Liter.

APPENDIX A

Protocol for Testing of Groundwater for Radionuclides at Tuck Point Condominiums, Beverly, MA

**Protocol for Testing of Groundwater for Radionuclides at Tuck Point
Condominiums, Beverly, MA
February 2006**

Objective: To collect samples of groundwater from existing monitoring wells on the property of Tuck Point Condominiums on Water Street in Beverly and to analyze those samples for radionuclides.

Locations of sampling for radionuclides:

Decision: Samples of groundwater will be collected from the following twelve monitoring wells: OW-R, OW-V, OW-Q, OW-S, OW-U, OW-Z, OW-Y, OW-X, MW-2, MW-4, MW-5, MW-8 (refer to figure attached).

Rationale:

(1) Groundwater from wells located farthest from the harbor (e.g., OW-R and OW-U) is relatively less influenced by tidal water than groundwater in wells closest to the ocean (e.g., MW-5 and MW-8). For example, intrusion of salt water can possibly increase the dissolution of any radioactive contaminants present in the geological layers and/or cause a dilution effect.

(2) Groundwater samples will be collected from wells located near all residences in order to determine levels of radionuclides in groundwater from throughout the condominium association property, not just in one particular area.

(3) Groundwater samples will be collected from wells on the association property closest to the Ventron site (the west side of the condominium property) in the event that there is any influence from that site.

How samples will be collected for radionuclide analysis:

Decision: For each sample, approximately 1 gallon of groundwater will be collected according to standard operating protocols used by USGS and the Massachusetts Department of Environmental Protection (USGS 1999; MDEP 1991). The water level in each well will be measured and each well will then be purged about 3 well volumes before the sample is collected. The wells will then be purged a second time before the second round of sampling. The purged water will be disposed of at the disposal well located on the Tuck Point property. Unless there is dedicated purging equipment at each well, the purging equipment will be decontaminated before use at each well. The water samples collected will be field screened for turbidity. For quality assurance purposes, one duplicate sample will be collected per sampling round (2 duplicates total). The samples will be delivered on the day of collection or the next morning to the MDPH/CEH Radiation Control Program Environmental Radiation Laboratory in Jamaica Plain.

Rationale: Although one liter is needed for analysis, extra sample can be used to do additional testing for more specific radionuclides if necessary. Permissible holding time for water samples for this analysis is 6 months (EPA 1980).

When samples will be collected:

Decision: Two sets of samples (one for low tide and the other for high tide on the same day) will be taken on a day that is not preceded by rainfall.

Rationale: Samples will not be collected on a day after rainfall because rainfall may cause temporary dilution of contaminants.

Number of samples to be collected:

Decision: A total of 26 samples will be collected (i.e., high and low tide samples for 12 locations plus two duplicates).

Rationale: Data for the 26 samples at 12 locations should be representative of what radionuclides may be present across the condominium association property, including in relation to residential buildings on the property.

Analysis of Samples

Decision: Samples will be analyzed by the MDPH/CEH Radiation Control Program Environmental Radiation Laboratory for gross alpha and gross beta activity using a method consistent with EPA Method 900.0 (Appendix A) (MDPH 2005). According to this method, results are expressed as pCi/L \pm error at 95% confidence.

Rationale: This method is an EPA-approved method for analyzing water samples for the presence of radionuclides. Gross alpha and gross beta results reflect the presence of the most common naturally occurring radionuclides (e.g., uranium, radium, thorium). It will also reflect possible contribution, if any, from the Ventron site, where the primary radionuclide of concern was uranium.

Interpretation of Results:

MDPH/CEH will interpret the results of the laboratory analyses and formulate any recommendations for possible follow-up activities. The results will be compared to available data on radionuclides in groundwater in Essex County, Massachusetts. Radionuclides data dating back to 1999 from the Massachusetts Department of Environmental Protection's (MDEP) database of regulatory monitoring data for public drinking water supplies in Essex County that are served by groundwater wells indicate that gross alpha ranged from 0 – 8.6 pCi/L (average 1.4 pCi/L) and gross beta ranged from 0 – 54 pCi/L (average 8.7 pCi/L). Data from 2000 and 2001 were also available from the U.S. Geological Survey (USGS) for 9 public drinking water wells in Essex County (USGS 2001). Eight wells were screened in sand and gravel and one well was screened in bedrock. The data indicated that gross alpha ranged from 1.3 – 3.6 pCi/L (average 2 pCi/L) and gross beta ranged from 3.2 – 10.6 pCi/L (average 5.8 pCi/L). The maximum values for gross alpha and gross beta were found in samples taken from the one bedrock well. If the results are less than the maximum values for the reported data above (8.6 pCi/L for gross alpha and 54 pCi/L for gross beta), no further testing or follow-up will be recommended.

References:

MDEP 1991. Standard References for Monitoring Wells, Section 6.2 Sampling Techniques.

MDPH 2005. Radiation Control Program, Environmental Radiation Laboratory, Quality Assurance Manual, Method 5.2.

USGS 2001. Water Quality in the New England Coastal Basins, Maine, New Hampshire, Massachusetts, and Rhode Island, 1999-2001,
<http://nh.water.usgs.gov/projects/nawqa/nawqaweb.htm> and <http://nwis.waterdata.usgs.gov>.

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