Surveillance*2008*

Vermont Yankee Nuclear Power Station

Report on Public Health Monitoring
August 7, 2009

VERMONT
DEPARTMENT OF HEALTH
Agency of Human Services

108 Cherry Street, PO Box 70
Burlington, VT 05402
1.802.863.7341
healthvermont.gov

Table of Contents

VERMONT
DEPARTMENT OF HEALTH
Agency of Human Services

Report on Public Health Monitoring
August 7, 2009

Executive Summary

The Vermont Department of Health has been monitoring and reporting on radiation emissions from the Vermont Yankee Nuclear Power Station since 1971. The purpose of this environmental surveillance effort is to assure that Vermont Yankee is operating within the limits of the state's radiological health rule to protect the health and safety of Vermonters. This *2008 Surveillance Report* details approximately 1,300 separate measurements of air, water, milk, soil, vegetation, sediment and fish samples taken during the year at the site boundary, from the Connecticut River, and the six towns surrounding the Power Station and other sites. This year's report also describes improvements to our environmental and health surveillance around Vermont Yankee, including analyses of more soil, vegetation, water and milk samples taken elsewhere in Vermont for comparison purposes and, for the first time, results from water samples taken from wells on site at Vermont Yankee.

Overall, the Department of Health found no instances of non-compliance in its environmental surveillance of Vermont Yankee. Direct gamma radiation measurements did not increase during this first year of dry cask spent nuclear fuel storage at Vermont Yankee. Also during 2008, Entergy purchased additional properties and expanded the land boundary around the plant, further distancing the public from Station sources of radiation. In this report direct gamma radiation is presented both as raw data (the exposure measurements) and with the dose conversion factor of 0.6 millirem per milliroentgen applied (the calculated dose) that was recommended by Oak Ridge Associated Universities in 2007. The Vermont Department of Health's regulatory limit is 20 millirem per year at the site boundary, a limit that is more protective than that of any other state or federal agency. The Nuclear Regulatory Commission limits radiation doses to the general public at the site boundary to 100 millirem per year.

None of the calculated doses using the dose conversion factor exceeded the department's quarterly or annual dose limits in 2008. In addition, the measured exposure values did not exceed 10 milliroentgen per quarter nor 20 milliroentgen for the year at any location on the site boundary bordered by land. Compared to 2007, radiation measurements at the site boundary were generally the same or slightly lower in 2008.

The many samples and measurements of the environment around Vermont Yankee are evidence that no significant adverse health effects from radiological exposures are likely from the operation of the Station. A further analysis of health statistics for people who live in towns surrounding Vermont Yankee shows that cancer incidence and mortality rates in the communities around Vermont Yankee do not differ significantly from those in the rest of Windham County, elsewhere in Vermont, or the U.S. as a whole. A summary table of environmental surveillance results is found in the Introduction, and detailed presentations of sampling methods and data are included in the report. The information is sometimes complex, and we invite anyone who reads the report to contact the radiological staff at the Vermont Department of Health with any questions.

It is important to note that as this 2008 report is published, a revision to the Vermont Department of Health's radiological health rule is in progress. While this year's report reflects surveillance measurements and analyses in relationship to the current rule, it is possible that future surveillance reports will be structured differently to reflect any changes made to the rule.

Introduction

This 2008 public health surveillance report for Vermont Yankee Nuclear Power Station profiles the radiological conditions around Vermont Yankee using samples and measurements in the communities surrounding the station. In reviewing the data tabulated here, you will find comparisons of some 2008 results to long-term historical trends. ***These comparisons show no significant increased radiological exposures due to Vermont Yankee Nuclear Power Station operations. One comparison of particular concern is for direct gamma radiation. The 2008 measurements of exposure and calculated doses are generally less than those for 2007.*** This is particularly important because 2008 is the first year where spent nuclear fuel was moved from within the reactor building for storage on the Independent Spent Fuel Storage Installation (ISFSI).

In one area of the Vermont Yankee site boundary, the 2007 data reflected the measured exposures and calculated doses at the then-current site boundary location. The 2008 data reflect the measured exposures and calculated doses at the now-current site boundary, following Entergy's purchase on August 1, 2008 of additional property near the Governor Hunt Road area of the plant.

The report marks the second year that the Health Department applied a 0.6 millirem per millroentgen dose conversion factor recommended in the independent 2007 report by Oak Ridge Associated Universities.

This report also contains results that are compared to background levels. Background levels, in this case, are the levels of radioactivity in the air, water and earthen materials not attributable to Vermont Yankee Nuclear Power Station. Some background measurements were obtained in Windham County, while others were obtained in other parts of Vermont. Measurements around Vermont Yankee that are significantly above the normal range of background may generally be attributed to the station, other uses of radioactivity in the measurement area, and/or changing meteorological conditions.

The report also includes maps that show the locations where samples are collected or where measurements are made.

All of the measurements in this report are presented at the 95 percent confidence level. This means we are 95 percent certain (not due to chance alone) that the results lie within two standard deviations on either side of the mean. The mean is the reported result, usually found in the tables next to the location identifier, and the uncertainty, often called the error, is the plus or minus factor associated with that result. The error is usually found in the column immediately next to the mean result in the tables. The Department regulates on the basis of the mean result. The uncertainty only demonstrates how confident we are that the mean result reported is accurate.

Some samples and measurements are being collected or made continuously. Other samples are taken periodically. With one exception, all of the samples are analyzed by the Vermont Department of Health Laboratory in Burlington, Vermont. Measurements of direct gamma radiation exposures using thermoluminescent dosimeters are analyzed by a National Voluntary Laboratory Accreditation Program vendor of dosimetry. You will find the results of all of these samples and measurements in this report:

- The direct gamma radiation emanations as measured continuously at dozens of thermoluminescent dosimeter (TLD) sites.
- The amount and identity of radioactive particulates and radioactive iodine that may be found in the air as collected with numerous continuous air samplers.
- Water from wells and waterways surrounding the plant and milk from local dairy farms that are sampled every month to determine the amount and identity of natural and man-made radioactivity within them.
- Various wild and cultivated vegetation, river bed sediments, fish and soils that are sampled at least twice annually, and analyzed for man-made and naturally occurring radioactivity.

As with 2007, this report presents the direct gamma radiation results in both the measured exposure levels and in the calculated doses. The dose calculations use the previously recognized dose conversion factor of 0.6 millirem per milliroentgen. In 2008, the exposure values at all site boundary locations bordered by land were below 20 milliroentgen and the calculated dose values for those same locations were all below the regulatory standard of 20 millirem.

This report also describes valuable expertise and capabilities of the Vermont Department of Health Laboratory and its scientific staff. Vermonters are served well by the staff and other resources there that allow the Health Department to conduct rigorous testing. All radiological analyses of the laboratory are subject to high levels of quality control.

The entire report is published at the Vermont Department of Health web site www.healthvermont.gov. Should you have questions about the content, please call the Vermont Department of Health Radiological Health Program at 802-865-7730.

Program Results Summary

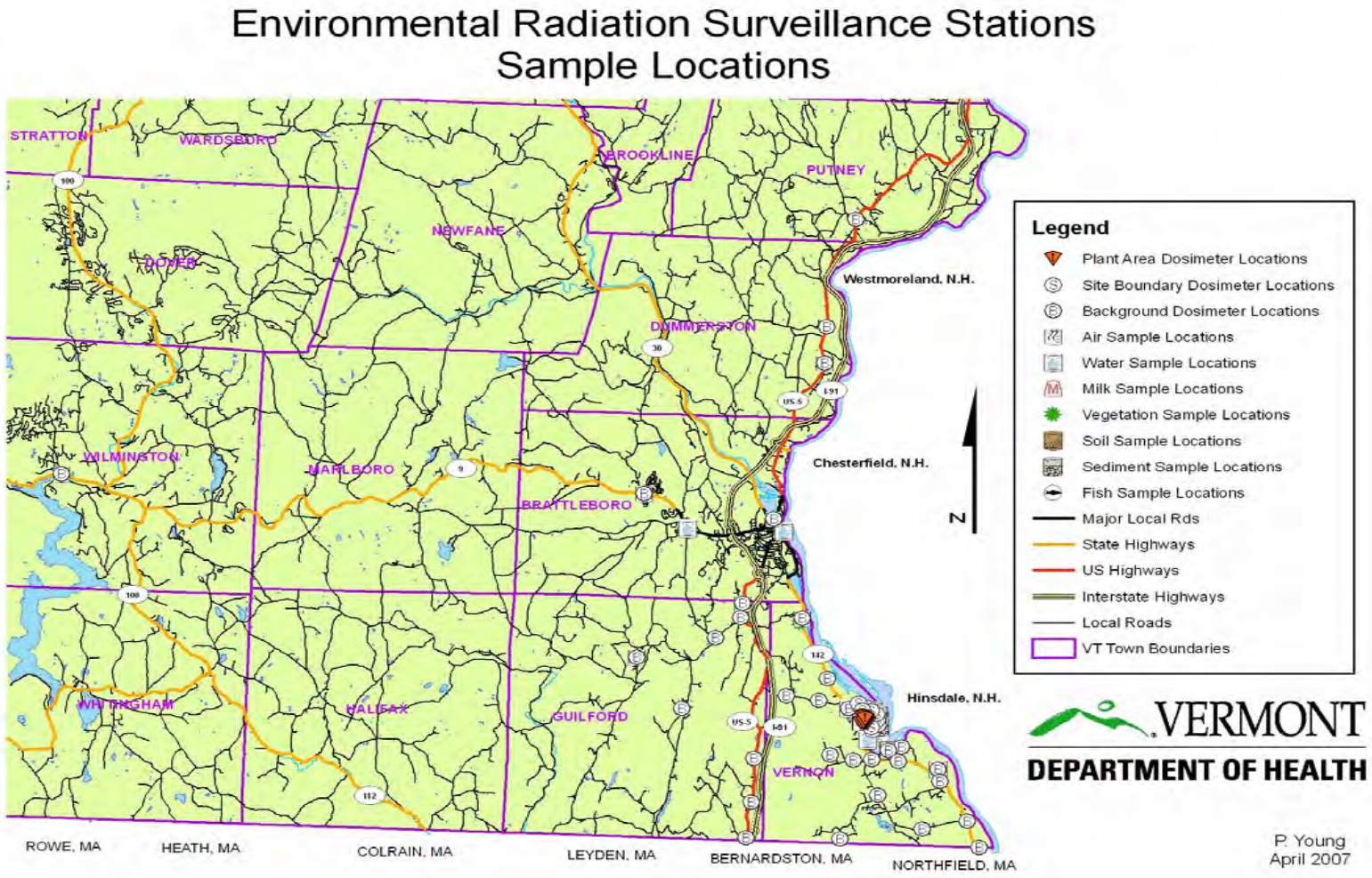
The number of samples and analyses in the Vermont Department of Health environmental surveillance program for the Vermont Yankee Nuclear Power Station is indicative of a significant commitment to evaluating compliance with Department of Health regulations and protecting public health. Table 1 indicates the number of sample types, the number of measurements or sample collection locations, the total number of samples collected, the analysis types and the overall results for each sample type. Maps 1 and 2 display the specific locations of the sampling. More detailed discussion about the sample results comprises the bulk of this report.

With each discussion are tables that show the results and map location identification numbers. Some maps are more easily viewed on the Vermont Department of Health web site, where they can be enlarged. This is especially true of Map 1, where all the sample locations and types are depicted. The printed version does not show them as clearly as the individual maps for the different sample types later in the report. You can view this report and all of the maps at http://healthvermont.gov/.

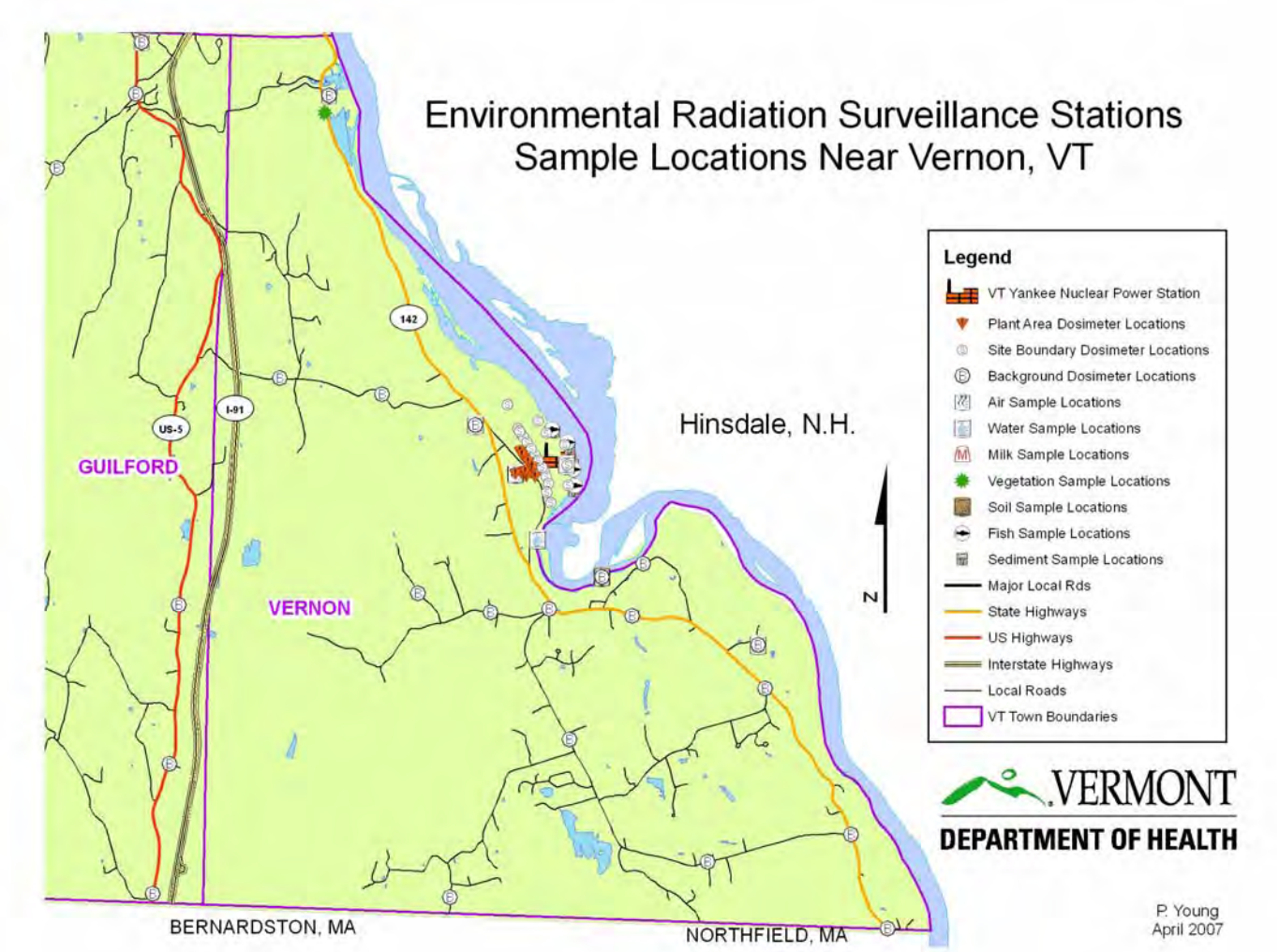
Table 1. Summary of 2008 Samples, Analyses and Results

Sample Type	Locations	Samples	Analysis Type	Results
Direct Gamma Radiation	71	284	Thermoluminescent Dosimeter	Less than 20 milliroentgen per year at the site boundary
Air Particulates, Gases, Vapors	9	108	Total Alpha Radioactivity	Within historical range; mean results near VYNPS similar to those further from VYNPS
		108	Total Beta Radioactivity	Within historical range; mean results near VYNPS similar to those further from VYNPS
		108	Iodine-131 Radioactivity	All samples less than calculated limit of detection of 0.0038 pCi/m^3
		108	Total Gamma Radioactivity	All detected gamma radioactivity of natural origin
		4	Total Particulate Gamma Radioactivity	All detected gamma radioactivity of natural origin
Water	13	120	Total Alpha Radioactivity	Within historical range; mean results near VYNPS similar to those further from VYNPS
		120	Total Beta Radioactivity	Within historical range; mean results near VYNPS similar to those further from VYNPS
		120	Tritium Radioactivity	All samples less than the lcalculated limit of detection of 300 pCi/l or well below the limit for liquid effluents
		120	Total Gamma Radioactivity	All detected gamma radioactivity of natural origin
		3	Radium-226 Radioactivity	All samples well below EPA action levels of 5 pCi/l (total Ra-226 and Ra-228)
		3	Radium-228 Radioactivity	All samples well below EPA action levels of 5 pCi/l (total Ra-226 and Ra-228)
		3	Uranium Radioactivity	All samples well below EPA action levels of 30 µg/l and VT limit of 20 µg/l
Milk	3	12	Iodine-131 Radioactivity	All samples less than the calculated limit of detection of 2.53 pCi/l
		12	Total Gamma Radioactivity	All detected gamma radioactivity of natural origin
Groundwater	7	7	Total Gamma Radioactivity	All detected gamma radioactivity of natural origin
		7	Tritium Radioactivity	No significant results greater than 95% uncertainty confidence level
Vegetation	4	4	Total Gamma Radioactivity	All detected gamma radioactivity of natural, Chernobyl or nuclear weapons testing origin
Soil	4	4	Total Gamma Radioactivity	All detected gamma radioactivity of natural, Chernobyl or nuclear weapons testing origin
River Sediments	19	38	Total Gamma Radioactivity	All detected gamma radioactivity of natural, Chernobyl or nuclear weapons testing origin
Fish	4	4	Total Gamma Radioactivity	All detected gamma radioactivity of natural origin
Totals	134	1297		

Map 1. All Samples, All Locations



Map 2. All Samples in Vernon, Vermont



Ionizing Radiation Risks

The radiations to which people may be exposed as a result of Vermont Yankee Nuclear Power Station operations are called ionizing radiations. According to the International Agency for Research on Cancer, ionizing radiation is a known human carcinogen. Cancer may result from exposure to ionizing radiation because the energy absorbed may directly or indirectly damage the DNA of human cells. DNA damage is a general requirement of carcinogenesis.

It has been clearly demonstrated that at high doses, generally in excess of 10 rem or 10,000 millirem (1 rem = 1,000 millirem), people exposed have a statistically higher risk of cancer as compared to people incurring lower doses. As with other carcinogens, it is impossible to prove that low doses are without risk. With radiation exposure, it is assumed that no dose is without risk. Still, at very low doses such as those reported here, the risk of developing cancer is considered very low, if it exists at all.

The risk management approach used for public health protection with carcinogenic agents is precautionary. In the field of radiation protection, this precautionary approach is called the ALARA principle. Every reasonable effort must be made to maintain exposures and doses *As Low As Reasonably Achievable*. The Vermont Department of Health regulations not only require that exposures to ionizing radiation be less than specific limits, but also that users of ionizing radiation - in all forms of industry, medicine and education - maintain exposures as low as reasonably achievable. More about ionizing radiation risk may be found at these websites:

The National Academies of Science:
http://books.nap.edu/openbook.php?isbn=030909156X.

The Health Physics Society: http://hps.org/documents/risk_ps010-1.pdf

The International Agency for Research on Cancer, their complete series of monographs on carcinogenic agents: http://monographs.iarc.fr/ENG/Monographs/allmonos90.php

With the Surveillance 2006 Report on Public Health Monitoring published in 2007, the Vermont Department of Health began presenting information about certain health outcomes in the vicinity of Vermont Yankee. Environmental sampling is important in determining compliance with regulations and verifying that radioactivity and radiation exposures remain at or near background levels. Assessments of the health of people living near the power station helps us understand the whether there are any adverse health events in the area.

The primary concern about chronic low level exposure to ionizing radiation is its potential to increase people's risk of developing cancer. Therefore, data from the Department's Public Health Statistics Section for cancer incidence (new cancer cases diagnosed) and cancer mortality (people dying from cancer) data are provided for Windham County and the six towns nearest Vermont Yankee Nuclear Power Station (the Emergency Planning Zone).

Cancer is, unfortunately, very common. Roughly one out of every two men and one out of every three women will develop cancer in their lifetime. Cancer "prevalence" is the number of people alive today who have ever been diagnosed with cancer. Approximately 29,000 Vermonters (four to six percent of Vermont adults age 18+) have ever been told by doctor they had cancer (Behavioral Risk Factor Surveillance System (BRFSS), 2007). This includes individuals who are newly diagnosed, in active treatment, have completed active treatment, and those living with progressive symptoms of their disease.

With nine percent of people age 50 and over living with cancer in the U.S., it is not unusual to know several people who have cancer. As a population ages, the occurrence of new cancer cases is expected to increase. With treatment advances, people are living

longer with a cancer diagnosis; the number of cancer survivors has doubled in the past 20 years.

The source of the information in Table 2 is the Vermont Department of Health Cancer Registry. It was updated as of June 15, 2009. The incidence rates are for all cancers, for invasive thyroid cancers, for leukemia and for childhood (pediatric) cancers for the years 1997 - 2006. More information about cancer rates in Vermont may be found at: http://healthvermont.gov/prevent/cancer/cancer_programs.aspx#stats.

The data in Table 2 indicate that, for all cancer types combined, the rate of cancer incidence in the six towns near Vermont Yankee Nuclear Power Station (Brattleboro, Dummerston, Guilford, Halifax, Marlboro and Vernon) is lower than rates in Windham County, the State of Vermont, and the United States white population as a whole. The incidence rates for invasive thyroid cancer and leukemia is not different from Vermont, Windham County, or the U.S. white population. The incidence rates for pediatric cancers in the six towns could not be calculated as there were too few cases (fewer than six) over the time period studied. The pediatric cancer incidence rate in Windham County, however, was calculated and is not different from Vermont and the United States white population as a whole. Similar results were seen in the incidence rates in last year's report.

Thyroid cancers and leukemia are of particular interest because increased risk may be associated with excess radiation exposure. There is no evidence of excessive radiation exposure in these geographic areas, but the focus on these kinds of cancers remains useful. Pediatric cancers are important because radiation health effects are generally more likely when individuals are exposed prenatally or at an early age. The embryo or fetus is most radiosensitive.

Table 2. Cancer Incidence Rates Near VYNPS, in Vermont and in U.S.

Vermont and U.S. Cancer Incidence, All Sites, Males and Females, 1997-2006 (Urinary Bladder includes malignant and in situ)

	Rate	Lower CI	Upper CI	Avg. cases per year
U.S. White	489.6	488.6	490.5	104,178
Vermont	500.3	494.9	505.8	3,241
Windham County	485.5	466.3	505.4	244
Emergency Zone	437.6	410.8	466.0	101

Vermont and U.S. Cancer Incidence, Invasive Thyroid Cancer, Males and Females, 1997-2006

	Rate	Lower CI	Upper CI	Avg. cases per year
U.S. White	9.2	9.1	9.4	1,970
Vermont	8.8	8.1	9.6	56
Windham County	6.5	4.4	9.3	3
Emergency Zone	6.0	3.2	10.7	1

Vermont and U.S. Cancer Incidence, Leukemia, Males and Females, 1997-2006

	Rate	Lower CI	Upper CI	Avg. cases per year
U.S. White	13.6	13.5	13.8	2,882
Vermont	13.8	12.9	14.7	87
Windham County	14.5	11.4	18.4	7
Emergency Zone	10.0	6.3	15.5	2

Vermont and U.S. Cancer Incidence, Pediatric Cancers (< Age 20), Males and Females, 1997-2006 (Urinary Bladder includes malignant and in situ)

	Rate	Lower CI	Upper CI	Avg. cases per year
U.S. White	17.7	17.4	18.1	989
Vermont	18.6	16.6	20.8	30
Windham County	17.0	10.2	26.8	2
Emergency Zone	--	--	--	--

-- Cancer incidence rates are only presented when the number of cases is greater than 5.
Emergency Zone towns include: Brattleboro, Dummerston, Guilford, Halifax, Marlboro, and Vernon.
All rates are age adjusted to the 2000 U.S. standard population.

In Table 3, mortality rates from cancer in the United States (U.S. white rate), Vermont, Windham County and the six towns near Vermont Yankee Nuclear Power Station are presented for the ten years 1997 - 2006. The Vermont data are from the Vermont Department of Health's Vital Statistics System, last updated in June 2009, and the U.S. data were taken from the Surveillance, Epidemiology, and End Results (SEER) Program at the National Cancer Institute at www.seer.cancer.gov .

The data in this table indicate that, for the years 1997 – 2006, cancer mortality rates in the Emergency Planning Zone are not different than those for Windham County, Vermont, or the U.S. white population as a whole. So characterizations that one population is at more risk or at less risk of dying from cancer as compared to another are not valid.

The method used to determine whether one rate is different than another is as follows: (1) compute an age-adjusted cancer incidence or mortality rate; (2) compute the confidence interval, which is a range of values within which the true rate is expected to fall; (3) compare the confidence intervals (ranges) of the two rates. If the confidence intervals of two rates overlap, then any difference between the two rates is not statistically significant. If the confidence intervals do not overlap, then the rates are considered different.

The rates in this document are calculated at a 95 percent confidence level. For example, we are 95 percent confident (not due to chance alone) that the true 1997-2006 U.S. white cancer incidence rate of 489.6 per 100,000 population is in the range of 488.6 to 490.5 per 100,000. In the six towns near Vermont Yankee, the cancer incidence rate for all types of cancer combined is 437.6 cases per 100,000 persons. Statistically, speaking, we are 95 percent confident that the actual rate is between 410.8 cases and 466.0 cases per 100,000 persons. Since the confidence intervals do not overlap, a statistical difference exists between the two rates. After adjusting for age and population size, people in the six towns near Vermont Yankee Nuclear Power Station were diagnosed with fewer cancers between 1997 and 2006 than Vermont and the U.S.

In Table 3, it initially appears that deaths from malignant neoplasms (all sites, all ages) in the six towns near Vermont Yankee may be higher than Windham County. In Windham County, the death rate from malignant neoplasms was 196.2 deaths per 100,000 persons, while the death rate from malignant neoplasms in the six towns near Vermont Yankee was 202.4 deaths per 100,000 persons. However, this difference is not statistically significant. We are 95 percent confident that these rates fall between 184.1 and 208.8 deaths per 100,000 persons in Windham County, and between 184.5 and 222.0 deaths per 100,000 persons in the six towns. Because these confidence intervals overlap, the two cancer mortality rates are not statistically different. The same conclusion is drawn relative to Vermont as a whole – the all sites, all ages cancer mortality rates are not significantly different. Also, the same is true relative to the U.S. white population – the all sites, all ages cancer mortality rates are not significantly different since the confidence intervals overlap.

One limitation about the use of these data is that the numbers of cancer cases and the number of cancer deaths in the six towns near Vermont Yankee are small. There are challenges associated with computing rates for relatively small geographical areas, such as the Vermont Yankee Emergency Planning Zone, with an estimated population of 19,800. When the rates are based on a small number of cases, it is almost impossible to distinguish random fluctuation from true changes in the underlying risk of disease. This is particularly an issue within Vermont where we have a number of rural communities with relatively small populations. To improve rate stability, the cases have been combined for the ten years from 1997 through 2006.

Cancer develops gradually as a result of a complex mix of factors related to lifestyle choices, environment and genetics. Each type of cancer is caused by a different set of factors, some well established, some uncertain, and some unknown. The exact causes of most cancers are unknown, and research continues to examine how and why normal cellular growth becomes uncontrolled. The Vermont Department of Health annually

updates these cancer statistics in the geographical area near the Vermont Yankee Nuclear Power Plant to help reconcile the differences between perceived risks for developing cancer and the actual experience of cancer diagnoses in the community.

Table 3. Cancer Mortality Rates Near VYNPS, in Vermont and in U.S.

Vermont and U.S. Cancer Mortality, Malignant Neoplasms (all sites), Males and Females, 1997-2006

	Rate	Lower CI	Upper CI	# of deaths
U.S. White	190.9	190.8	191.1	4,782,451
Vermont	190.1	186.7	193.5	12,231
Windham County	196.2	184.1	208.8	994
Emergency Zone	202.4	184.5	222.0	483

Vermont and U.S. Cancer Mortality, Thyroid Cancer, Males and Females, 1997- 2006

	Rate	Lower CI	Upper CI	# of deaths
U.S. White	0.5	0.5	0.5	11,678
Vermont	0.3	0.2	0.5	22
Windham County	0.2	0.0	1.3	1
Emergency Zone	0.4	0.0	3.2	1

Vermont and U.S. Cancer Mortality, Leukemia, Males and Females, 1997-2006

	Rate	Lower CI	Upper CI	# of deaths
U.S. White	7.7	7.6	7.7	191,365
Vermont	7.8	7.2	8.5	496
Windham County	7.2	5.1	10.1	36
Emergency Zone	7.5	4.3	12.5	17

Vermont and U.S. Cancer Mortality, Pediatric Cancers (Malignant Neoplasms (all sites) for Males and Females < Age 20), 1997-2006

	Rate	Lower CI	Upper CI	# of deaths
U.S. White	2.8	2.7	2.8	17,526
Vermont	2.6	1.9	3.5	42
Windham County	1.8	0.2	6.7	2
Emergency Zone	2.3	0.0	16.5	1

Emergency Zone towns include: Brattleboro, Dummerston, Guilford, Halifax, Marlboro, and Vernon.
All rates are age adjusted to the 2000 U.S. standard population.

Surveillance Methods

The types of surveys and analyses performed by the Department of Health deserve some description relative to their role in protecting public health.

Direct Gamma Radiation

The Vermont Department of Health uses thermoluminescent dosimeters (TLDs) to monitor direct gamma radiation. Direct gamma radiation is the energy emanating from the Vermont Yankee Nuclear Power Station systems and components. Direct gamma radiation is not a contaminant that collects on surfaces like particles, gases or vapors released from a facility might. Direct gamma radiation is energy that the body is affected by only when a person is located in an area where gamma radiation exists. Everyone is continuously exposed to direct gamma radiation from natural and human-made sources.

Department of Health thermoluminescent dosimeters are installed all the way around the Vermont Yankee site fence line, along its site boundary and in the publicly occupied spaces around the station to identify the amount of public exposure that may be associated with operations at the Station. Additional Department of Health thermoluminescent dosimeters are installed throughout the towns of Vernon and Guilford, and in locations in Brattleboro, Dummerston, Putney and Wilmington to establish what the background levels of direct gamma radiation are, in the absence of radiation from the Vermont Yankee Nuclear Power Station.

The gamma radiation measured by the Department of Health thermoluminescent dosimeters is an electromagnetic wave similar to X-rays. Gamma radiation passes through your skin and may pass through your entire body. As it does pass through your body, the radiation energy delivers ionizing radiation dose to the tissues with which it interacts.

With a thermoluminescent dosimeter, the gamma radiation interacts with and changes the physical composition of the materials in the thermoluminescent dosimeter. When the

thermoluminescent dosimeter is removed from its monitoring location and sent to a laboratory for analysis, the physical changes in the thermoluminescent dosimeter are reversed. When this occurs, light is emitted, and the amount of light measured in the process is directly proportional to the amount of ionizing radiation energy to which the thermoluminescent dosimeter was exposed.

While the dosimeter's radiation exposure is directly proportional to the wearer's radiation exposure, the Oak Ridge Report made it clear that the radiation dose the wearer absorbs from this exposure is not equal to the dosimeter exposure. According to the Oak Ridge Report, the human body absorbs about 60 percent of the radiation energy to which it is exposed at the energy levels found near the nuclear power station. As described earlier, the thermoluminescent dosimeter exposure results are converted to human dose prior to being compared to the regulatory dose limits. Because this is still a new process, we will show both the exposure values from the thermoluminescent dosimeters and the converted biological dose equivalent.

Typical gamma radiation emitting radioactive materials include the potassium-40 inside our own bodies, the beryllium-7 in most earthen materials and the nitrogen-16 in neutron-activated reactor coolant water at a nuclear power plant. Other important reactor-generated gamma radiation emitters include the particulate solids cobalt-60 and cesium-137, vaporous iodine-131 and gaseous krypton-88 and xenon-133.

Personnel thermoluminescent dosimeters, like those worn by workers in nuclear power plants and in medical and research facilities, are calibrated to provide a measure of biological dose for the wearer. Dose is the amount of an agent to which you are exposed that actually affects you. The dose of ionizing radiation is recorded in units called millirem.

On the other hand, environmental thermoluminescent dosimeters, including those reported on in this document, are not calibrated to provide direct measures of dose in

millirem. Environmental thermoluminescent dosimeters are only calibrated to provide a measure of exposure. These thermoluminescent dosimeter exposures are recorded in milliroentgen. Historically, the Vermont Department of Health has considered the amount of radiation exposure measured in milliroentgen to be equal to the amount of biological dose equivalent in millirem. The Oak Ridge Report documented that this assumption results in overstating the biological dose equivalent. Following the recommendation of the Oak Ridge Report, the Department of Health now converts the exposures measured by the dosimeters in milliroentgen to biological dose equivalent in millirems using the guidance of nationally recognized standards, in particular, the 0.6 millirem per milliroentgen dose conversion factor of *American National Standards Institute Standard ANSI/ANS-6.1.1-1991, Neutron and Gamma-ray Fluence-to-dose Factors.* ***In 2008, no thermoluminescent dosimeter exposures at the site boundary bordered by land exceeded measured values of 20 millroentgen and no calculated doses exceeded the 20 millirem annual site boundary limit.***

Both personnel and environmental thermoluminescent dosimeters are used to measure beta and gamma radiation exposure. The Vermont Department of Health accounts for exposures from beta radiation with our analyses of beta radiation in water and air samples. This is appropriate because beta radiation, like alpha radiation, contributes to whole body dose essentially only through internal contamination by radioactive materials inhaled or ingested into the body. It is to these kinds of samples we turn next.

The remaining sample types are used to determine the amount of radioactivity, or radioactive contamination, in the media being sampled. Identifying the quantities and types of radioactive materials in the environment helps us predict how much may end up in our bodies from the air we breathe and in the water and food we eat.

Air Monitoring

The Vermont Department of Health uses continuously operating air samplers to monitor the air near Vermont Yankee Nuclear Power Station in Vernon, as well as air in the

nearby towns of Guilford, Brattleboro, Dummerston and Wilmington. The air samples allow us to evaluate the amount of three different kinds of radiation to which people may be exposed in the air they breathe. These are alpha, beta and gamma radiation.

Alpha and beta radiation are similar to gamma radiation in that the health risk associated with each is carcinogenesis from damage to DNA. Alpha and beta radiation differ from gamma radiation because they are particle forms of radiation energy, and gamma radiation is an electromagnetic wave of energy. While electromagnetic waves like gamma radiation travel great distances and through most materials, particle radiations like alpha and beta radiation travel relatively short distances and are completely stopped by simple materials.

Alpha particle radiation is the most biologically hazardous form of ionizing radiation. For equal amounts of alpha, beta and gamma radiation energy, alpha particle radiation may cause roughly 20 times more tissue damage. Radon gas and its radioactive decay daughter products emit alpha, beta and gamma radiation. It is the alpha radiation that leads to so much concern about lung cancer.

Fortunately, alpha radiation cannot penetrate the simplest of materials. For example, a sheet of paper can completely stop an alpha particle, as can the dead layer of skin that covers the outer surface of the skin of our bodies. Thus, the only way alpha particles may actually harm us is if radioactive material that emits alpha radiation is inhaled, ingested or otherwise taken into the body.

Most alpha-emitting radioactive materials are heavy metals like human-made americium-241 and plutonium-239 or naturally-occurring uranium-238 or thorium-232. Radon-222 is unusual because it is a radioactive gas. It is this characteristic that also adds to our exposures to, and risks from, radon. Radon gas seeps from the earth’s crust and accumulates in buildings and other structures, unlike solids like uranium and thorium that are trapped in soil and rock.

Beta particle radiations also have predictable ranges through materials and are stopped by simple materials. Most beta particle radiations are stopped by plastics and simple construction materials. The dead layer of skin on the outside of our bodies is not always capable of protecting the living skin beneath it. Most beta particle radiation can also cause skin dose. Risks from beta radiation exposure of the skin are low, on the order of ten times lower than whole body irradiation by gamma rays.

Still, beta particles do not penetrate the living skin more than a few millimeters, so our internal organs are only affected by beta particle radiation if we inhale or ingest beta particle emitting radioactive materials. Once taken into the body, like alpha particle radiation, the beta particle radiation may damage the tissues of our internal organs. This is why monitoring of the air, water and food chain is so important in an environmental surveillance program.

Materials that emit beta particle radiation include the naturally-occurring carbon-14 in all living things, as well as hydrogen-3 (also known as tritium), which may be both human-made or of natural origin. Strontium-90 is a beta radiation emitting radioactive material. It is a product of the fission process that may be found in nuclear reactor coolant water.

Radioactive materials that emit alpha, beta or gamma radiation behave chemically just like non-radioactive materials. For example, radioactive hydrogen in water goes everywhere water (a compound of two atoms of hydrogen and one atom of oxygen) goes in our bodies; radioactive iodine goes to the thyroid gland like non-radioactive iodine does; and, radioactive strontium goes to the bone just like non-radioactive strontium does. Obviously, our concern is that radioactive materials in these parts of our bodies may subject our bodies to unnecessary risk. Thus far, in the history of Vermont Yankee surveillance, the Vermont Department of Health has found no significant reactor-produced radioactive contaminants in the environment near the station. Department records indicate that those contaminants that have been identified in past years were

small amounts unlikely to be associated with any adverse public health effects. ***Results this year do not indicate any additional VYNPS-related radioactive contaminants in the environment.***

Alpha and beta particle radiation in radioactive materials in the air is determined by drawing air through a glass fiber filter. Radioactive materials are trapped on the filter and the filter is counted on a gas flow proportional counter in the Vermont Department of Health Laboratory. All radiological analyses of the laboratory are subject to high levels of quality control.

Radioactive materials that emit gamma radiation are also monitored in the air samples the Vermont Department of Health takes each month. Specifically, a charcoal cartridge is positioned in the air sampler immediately downstream from the glass fiber filter described above. While the glass fiber filter traps particulate materials, the charcoal cartridge traps molecules of gas and vapors. One particular radioactive material of interest existing in a vaporous form especially likely to be trapped by the charcoal cartridge is iodine-131.

Iodine-131 is a vapor at temperatures above room temperature. It is created during the fission of nuclear reactor fuel. Leaks in fuel rod cladding, the tubes in reactor fuel that contain the fuel pellets, allow the iodine-131 to leak into the reactor coolant, the water that runs through the reactor core, and other plant components and systems. The iodine-131 vapor may be trapped by plant ventilation system charcoal beds, but some may also be released from the plant stack. Iodine-131 is not generally found in the environment except where used in medicine and produced by nuclear facilities.

Iodine-131 that is inhaled, like other isotopes of iodine that may also be released, travels through the bloodstream to the thyroid gland in a person's neck. That which is not taken up by the thyroid gland is soon excreted from the body with other waste fluids. If a person's thyroid gland is saturated with iodine, most of the iodine-131 taken into the

body passes straight from the bloodstream to the urine for elimination. This is the benefit afforded to those who take potassium iodide. If one takes a sufficient dose of potassium iodide, about 130 milligrams (mg) for an adult and 65 mg for children between the ages of 3 and 18, radioactive iodine-131 will not be taken up into the thyroid, and risks of thyroid cancer or other thyroid disease will be reduced significantly.

More about potassium iodide availability and use around the Vermont Yankee Nuclear Power Station may be found at: http://healthvermont.gov/enviro/rad/KI_program.aspx.

In addition to analyzing the charcoal cartridges for radioactive iodine-131, both the charcoal cartridges and the air filters are analyzed for most other gamma radiation emitting radioactive materials. Gamma radiation is analyzed by gamma spectroscopy. Gamma spectroscopy relies on the unique energy signatures of radioactive materials that emit gamma radiation. These unique gamma radiation energies are analyzed to identify the specific radioactive materials in the sample. Gamma spectroscopy can also determine the amount of radioactivity in the sample by measuring the number of gamma radiation photons emitted by the sample over a given counting time. Gamma spectroscopy is performed by the Vermont Department of Health Laboratory under relatively ideal conditions.

Hence, the Vermont Department of Health looks for nearly every radioactive material that may be emitted from the Vermont Yankee Nuclear Power Station and found in air. ***No alpha, beta or gamma radioactivity related to the operations of Vermont Yankee Nuclear Power Station was identified in the Vermont Department of Health air samples in 2008.***

Water Monitoring

Groundwater and surface water around the Vermont Yankee Nuclear Power Station is monitored with methods similar to those for air. Water is collected from separate wells that supply water to two Vernon farms and to the Vernon Elementary School. Samples

are also taken from the Brattleboro municipal water supply. Surface water is sampled from the Connecticut River near the plant discharge, downstream of Vernon Dam and in Brattleboro.

Water samples are collected monthly by the Vermont Department of Health and by an environmental monitoring contractor. All of the samples are analyzed by the Vermont Department of Health Laboratory through various methods. The Vermont Department of Health Laboratory analyzes all water samples for total alpha radioactivity and total beta radioactivity. It also analyzes for gamma radiation-emitting radioactive materials through gamma spectroscopy. All of these water samples are analyzed specifically for tritium (hydrogen-3).

Beginning in 2007, the Vermont Department of Health Laboratory analyzed samples from each of the ground water locations for naturally occurring uranium and radium. These radioactive materials emit alpha, beta and gamma radiation, and have contributed to elevated radiation levels in water samples for decades. The Vermont Department of Health will periodically test these water sources for uranium and radium to keep track of their possible impact on other water sample results.

Beginning in 2008, the Department of Health incorporated monitoring of the on-site wells at Vermont Yankee. These seven wells are only accessed on the station property. These groundwater samples were analyzed for gamma radioactivity and tritium in a fashion similar to the other groundwater samples taken from outside the station. ***Neither the on-site groundwater, nor the off-site groundwater, surface water or drinking water samples obtained in 2008 were found to contain radioactive materials attributable to the operations of Vermont Yankee Nuclear Power Station.***

Monitoring of the Inputs to the Food Chain

Given that direct gamma radiation that may contribute to public ionizing radiation dose is monitored, and that radioactive materials in the air we breathe and in the water we drink

are measured, the remaining pathway for public exposure from Vermont Yankee Nuclear Power Station is the food we consume. To evaluate the food chain and inputs to it, the Vermont Department of Health takes samples from the soil within which plants grow and obtain nutrients and water, from sediments that support fish and other aquatic species in waterways, from wild and cultivated vegetation, from fish, and from cow's raw milk.

Every soil, sediment, vegetation, fish and milk sample is evaluated for gamma radiation emitting radioactive materials, while raw cow's milk is also specifically analyzed for iodine-131. These analyses are via gamma spectroscopy at the Vermont Department of Health Laboratory. ***For 2008, no radioactive materials related to the operations of Vermont Yankee were found in samples of inputs into the food chain.***

Direct Gamma Radiation Results

Direct gamma radiation is what we call the electromagnetic energy that is emitted from the reactor and turbine systems at Vermont Yankee Nuclear Power Station. Like light from a bulb, this energy is emitted in all directions from certain station components and operations. Like light, this direct gamma radiation is reduced in intensity with increasing distance. Also like light, it scatters and reflects off of nearby materials. Some direct gamma radiation actually reflects from the atmosphere above the station back to earth. This is called skyshine.

The Vermont Department of Health direct gamma radiation measurements also account for any gamma radiation exposures from gases, vapors and particles in the air. This includes gamma radiation exposures from gases like krypton-88 and xenon-133 that might be released from the Vermont Yankee Nuclear Power Station plant stack, as well as particulates and vapors, including radioactive iodine. These exposures are very small, especially as compared to the direct gamma radiation and scattered and skyshine radiation from plant components, systems and operations.

Direct gamma radiation can contribute to public exposures outside the site boundary of the station. The Vermont Department of Health limits direct gamma radiation doses for members of the public. The limit is expressed in millirem, a unit that accounts for both the amount of radiation energy absorbed and the potential biological effects of that radiation energy absorption. The unit millirem quantifies what is called the biological dose equivalent. The Vermont Department of Health regulations for radiological health can be found at http://healthvermont.gov/regs/radio_health.pdf.

The biological dose equivalent allowed annually for a member of the general public from direct gamma radiation emitted from Vermont Yankee Nuclear Power Station is limited to 5 millirem. Because it is impossible to verify that the biological dose equivalent to every single person exposed throughout the year is less than 5 millirem, the regulations provide for measurements of the site boundary dose as an acceptable alternative for

verifying compliance. This makes sense, since measurements of the actual dose at a location along the site boundary may be readily obtained. Specifically, the regulations limit the calculated biological dose equivalent at the site boundary to 20 millirem per year. There is a further, separate limit of no more than 10 millirem per calendar quarter.

It is important to note that the Vermont Department of Health regulations for site boundary direct gamma radiation dose pertain only to that portion of the site boundary bordered by land. Thermoluminescent dosimeter locations DR42, DR43, DR44, DR45, DR46 and DR47 in Tables 5a and 5b below are on the site boundary along the Connecticut River.

Also note that the thermoluminescent dosimeter exposure results in Tables 5a and 6a below are in units of milliroentgen. The unit milliroentgen (mR) is a unit of exposure, and environmental thermoluminescent dosimeters only record exposure. The calculated dose equivalents are shown in units of millirem in Tables 5b and 6b. These dose equivalents were calculated using the 0.60 millirem per milliroentgen conversion factor.

When evaluating compliance with Vermont Department of Health regulations, measurements of exposure are taken. These measurements record exposures in units of milliroentgen (mR). The regulations are in units of dose equivalent in millirem. Obtaining dose equivalents in millirem from exposures in milliroentgen requires use of nationally recognized dose conversion factors in accordance with Vermont Department of Health Regulations for Radiation Protection, specifically Section 5-305, Standards. The Department of Health uses the dose conversion factors found in *American National Standards Institute Standard ANSI/ANS-6.1.1-1991, Neutron and Gamma-ray Fluence-to-dose Factors* as recommended in the Oak Ridge Report. The use of such dose conversion factors is done whether we are evaluating compliance for the use of medical X-rays or whether we are evaluating compliance at Vermont Yankee Nuclear Power Station. After calculating the dose equivalents, they are compared to the Vermont Department of Health limits. ***There are two relevant limits: no more than 10 millirem***

per calendar quarter and no more than 20 millirem per calendar year. For 2008, neither any quarterly limit nor the annual limit was exceeded.

Background Gamma Radiation

To determine the direct gamma radiation exposure attributable only to Vermont Yankee Nuclear Power Station, background radiation must be subtracted from measurements. The 71 thermoluminescent dosimeters the Vermont Department of Health deploys in its environmental surveillance program record what are called gross measurements. Gross measurements of gamma radiation include exposures from all natural and man-made sources of radiation where the thermoluminescent dosimeter is physically located, including the background radiation not attributable to Vermont Yankee Nuclear Power Station Operations.

Gross gamma radiation measurements include exposures from radon gas in the air; from naturally-occurring radioactive materials in the soil, water and vegetation; from radioactive materials in building materials; from contaminants deposited as a result of above-ground nuclear weapons testing; from passing vehicles containing radioactive materials; from people who have varying amounts of natural and human-made radioactive materials within their bodies, and from the direct and scattered gamma radiation from the systems, components and operations at Vermont Yankee Nuclear Power Station.

For thermoluminescent dosimeter measurements, the Vermont Department of Health uses the results of measurements at 34 locations unlikely to be affected by Vermont Yankee Nuclear Power Station to establish what the background exposure levels are. These 34 thermoluminescent dosimeters are located as far west as Wilmington, as far north as Putney, and as far south as the Vermont/Massachusetts state line in Guilford and Vernon.

Each quarter's average (or mean) dose to these 34 thermoluminescent dosimeters is calculated to estimate background radiation. Past determinations of background gamma

radiation were from the mean of two thermoluminescent dosimeter stations, one in Putney and one Wilmington. This change from the past was implemented because the calculated mean background is more accurate when 34 measurements are used than when only two measurements are used to calculate the mean. The mean background exposures are reported in Table 4.

The exposures and dose equivalents reported in Tables 5a , 5b, 6a and 6b for comparison to the annual limit are the net thermoluminescent dosimeter results – the gross thermoluminescent dosimeter reading minus the mean background radiation.

Background gamma radiation levels for the four quarters of 2008 are presented in summary in Table 4 at the 95 percent confidence level. This summary table presents the mean background as calculated using the 34 dosimeter sites in Tables 6a and 6b. These results, as well as the complete results in Tables 5a, 5b, 6a and 6b, are provided in units of both gamma radiation exposure, milliroentgen (mR), and in units of biological dose equivalent, millirem (mrem) as converted using the Oak Ridge dose conversion factor, for completeness and for technical accuracy.

Note also that, as opposed to 2007, the Department is using just one dosimeter vendor now. The vendor was chosen after testing two different dosimeter vendors for 23 months and verifying that the quality controls for the second vendor, AREVA NP, were satisfactory or better than those of the other comparison vendor. AREVA NP was selected as the single vendor going forward.

Interestingly, the background exposures and calculated doses from 2007 and 2008 are very similar. In particular, the 2007 background was 56.2 $\pm$ 5.2 milliroentgen and 33.7 + 3.1 millirem, while the 2008 background was 56.4 $\pm$ 4.6 milliroentgen and 33.8 $\pm$ 2.8 millirem. These comparisons help us feel confident that our methods of determining background, taking the mean of 34 different distant site measurements of exposure, and choice of dosimeter vendor were appropriate.

Table 4. Mean Direct Gamma Radiation Background for 2008

Calendar Quarter of 2008	Mean Background Exposure and Error (mR) at the 95% Confidence Level	Mean Background Dose Equivalent and Error (mrem) at the 95% Confidence Level
January 1 to March 31	11.6 ± 2.3	7.0 ± 1.4
April 1 to June 30	15.2 ± 2.4	9.1 ± 1.4
July 1 to September 30	14.9 ± 2.4	8.9 ± 1.4
October 1 to December 31	14.7 ± 2.1	8.8 ± 1.3
	Mean Background Exposure and Error (mR) at the 95% Confidence Level	Mean Background Dose Equivalent and Error (mrem) at the 95% Confidence Level
Calendar Year 2008	56.4 ± 4.6	33.8 ± 2.8
Calendar Year 2007 For Comparison	56.2 ± 5.2	33.7 ± 3.1

Uncertainty of Dosimeter Measurements

All dosimeter measurements over time are estimates. They are best estimates, but these measurements are subject to error or uncertainty. It is appropriate when reporting measurements, then, to also report the amount of uncertainty. Uncertainty results from variability in what is being measured, in the measurement devices, and in the persons doing the measurements. The uncertainty in what is being measured – radioactivity - may be accounted for statistically; the uncertainty in measurement instruments can be determined readily in a laboratory; and, the uncertainty in human performance during measurement can be reasonably estimated.

Uncertainty can be minimized, too. For example, the amount of uncertainty in the background measurements the Vermont Department of Health uses was greater when only two dosimeters were used to calculate the mean background, as compared to when the mean background is calculated from 34 background thermoluminescent dosimeter measurements, as was begun in 2006. Generally, the greater the number in the sample

size, the more accurate statistics like the mean and standard deviation will be. The same is true of time. The longer you collect measurements, the more likely it is that the measurement accurately characterizes the condition. For example, it may be better to characterize background radiation using 10 years worth of measurements than to use the measurements for a three-month calendar quarter.

2008 Direct Gamma Radiation Exposures and Calculated Dose Equivalents

In the four tables below are the results of Vermont Department of Health thermoluminescent dosimeter measurements of direct gamma radiation at the Vermont Yankee Nuclear Power Station site boundary and in the immediate area around the station (Tables 5a and 5b) and, to establish a background radiation level, in parts of Windham County distant from the station (Tables 6a and 6b).

Tables 5a and 5b list the results for 2008 for what we call the site boundary and plant area. As noted earlier, all of the dosimeters on the site boundary recorded measurements of less than 20 milliroentgen and calculated dose conversion values are less than the regulatory standard of 20 millirems.

Dosimeter locations on the site boundary bordered by land, and reflecting the Entergy purchases that closed on or before August 1, 2008, are highlighted in pink in Tables 5a and 5b. As a result, there are twelve Department of Health dosimeter locations that are on the site boundary. They are called VY SW Fence, VY SW Fence #2, VDH DR48, VY North Fence, VY North Fence #2, VDH T07A, VDH TO7B, VDH DR51A, VY Parking Lot A, VDH DR53A, Gov Hunt Road # 39 and VDH DR52A. Dosimeters that were presented on two sets of tables in 2007 have been presented in just one table this year to allow highlighting of these twelve dosimeter locations together.

All the exposure and calculated dose equivalent results in Tables 5a and 5b were arrived at by subtracting the mean exposure from the 34 background dosimeters from the net exposure results for each of the site boundary dosimeters. The physical locations of these

34 background dosimeters, and the net results for each of them, are found in Tables 6a and 6b.

The actual biological dose equivalent results in Tables 5b and 6b were arrived at by multiplying the exposure results in Tables 5a and 6a by the 0.60 millirem per milliroentgen dose conversion factor appropriate for gamma radiation energies at the site boundary from *American National Standards Institute Standard ANSI/ANS-6.1.1-1991, Neutron and Gamma-ray Fluence-to-dose Factors*. The error for the annual results is the total propagated error at the 95 percent confidence level. The formula for the propagation of error is a root-mean-square formula of the form:

$$[(\sigma_1^2) + (\sigma_2^2) + (\sigma_3^2) + (\sigma_4^2)]^{1/2}$$

Where (σ_1^2) is the error for quarter 1, (σ_2^2) is the error for quarter 2, (σ_3^2) is the error for quarter 3 and (σ_4^2) is the error for quarter 4 of 2008.

Note that the exposure and dose equivalent results for the Vernon Elementary School are much less than the exposure and dose equivalent values for the plant's western site boundary. The Vernon Elementary School measurement locations are listed as Vernon School Nurse, VDH DR06, Vernon School A/S and Vernon School Pole. The Vernon School Nurse measurement site is inside the school, while the other locations are outside the building. The location called Governor Hunt Road #39 is a telephone pole immediately between the plant site boundary and the school.

The net background exposure and dose equivalent results are displayed in Tables 6a and 6b, respectively. Like the results in Tables 5a and 5b, these results are net measurements, meaning that the mean of the 34 background dosimeter exposures was subtracted from each of the individual measurements. That is why some of the measurements are close to zero.

Maps 4, 5, 6 and 7 depict the physical locations of the site boundary, plant area and background dosimeters, respectively. The ID numbers on the maps may be matched to the locations in Tables 5 and 6.

Table 5a. Net VYNPS Site Boundary and Plant Area TLD Exposure Results for 2008 in Milliroentgen

Results	Qtr 1	Mean	Net	2 SD	Qrtr 2	Mean	Net	2 SD	Qrtr 3	Mean	Net	2 SD	Qrtr 4	Mean	Net	2 SD	2008	2 SD
Location	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Net	Error
Site Boundary																		
VDH T01	11.3	11.6	0.0	1.2	15.5	15.2	0.3	1.3	15.2	14.9	0.3	1.0	15.0	14.7	0.3	1.9	0.8	2.7
VDH T02	11.2	11.6	0.0	1.5	15.9	15.2	0.7	1.4	15.1	14.9	0.2	1.3	15.1	14.7	0.4	2.0	1.3	3.2
VDH T03	11.6	11.6	0.0	1.3	16.3	15.2	1.1	1.3	15.2	14.9	0.3	1.7	15.4	14.7	0.7	1.3	2.0	2.8
VDH T04	11.2	11.6	0.0	1.2	16.3	15.2	1.1	1.7	16.6	14.9	1.7	1.4	15.7	14.7	1.0	1.2	3.8	2.8
VDH T05	12.9	11.6	1.3	1.5	17.5	15.2	2.3	1.9	16.5	14.9	1.6	1.8	16.3	14.7	1.6	1.9	6.7	3.5
VDH T06	12.8	11.6	1.2	1.5	18.6	15.2	3.4	1.8	17.8	14.9	2.9	1.5	16.9	14.7	2.2	1.3	9.7	3.0
VDH DR07	13.6	11.6	2.0	1.8	20.2	15.2	5.0	1.9	19.4	14.9	4.5	1.5	18.0	14.7	3.3	1.4	14.8	3.4
VDH DR08	17.1	11.6	5.5	3.0	21.6	15.2	6.4	2.0	20.6	14.9	5.7	1.5	19.3	14.7	4.6	1.3	22.2	4.1
VDH DR41	12.9	11.6	1.3	1.8	17.3	15.2	2.1	2.2	16.8	14.9	1.9	2.3	16.3	14.7	1.6	1.7	6.9	4.0
VY SW Fence	11.4	11.6	0.0	1.4	15.3	15.2	0.1	1.4	14.6	14.9	0.0	1.2	14.4	14.7	0.0	1.1	0.1	2.5
VY SW Fence #2	10.9	11.6	0.0	1.1	15.3	15.2	0.2	1.5	15.0	14.9	0.1	1.1	14.9	14.7	0.1	1.4	0.4	2.6
VDH DR42	10.8	11.6	0.0	1.6	16.4	15.2	1.2	1.7	15.9	14.9	1.0	1.2	15.4	14.7	0.7	1.3	2.9	3.0
VDH DR43	12.6	11.6	1.0	1.4	18.6	15.2	3.4	1.4	17.6	14.9	2.7	1.5	16.6	14.7	1.9	1.4	8.9	2.9
VDH DR44	20.6	11.6	9.0	3.6	22.3	15.2	7.2	2.7	20.9	14.9	6.0	1.4	20.1	14.7	5.3	2.3	27.6	5.3
VDH DR45	33.1	11.6	21.5	4.9	36.1	15.2	20.9	5.5	31.9	14.9	17.0	3.8	37.3	14.7	22.6	4.0	81.9	9.2
VDH DR46	18.0	11.6	6.4	1.8	21.0	15.2	5.8	1.6	20.2	14.9	5.3	1.7	19.6	14.7	4.9	2.0	22.4	3.5
VDH DR47	13.3	11.6	1.8	1.3	18.4	15.2	3.3	1.5	17.5	14.9	2.6	1.5	17.0	14.7	2.3	1.5	10.0	2.9
VDH DR48	11.5	11.6	0.0	1.9	17.1	15.2	1.9	1.6	16.3	14.9	1.4	1.5	16.0	14.7	1.3	1.3	4.6	3.1
VY North Fence	11.6	11.6	0.0	1.4	16.5	15.2	1.3	1.5	16.0	14.9	1.1	1.8	15.6	14.7	0.9	1.0	3.3	2.9
VY North Fence #2	11.3	11.6	0.0	1.3	16.3	15.2	1.2	2.3	15.9	14.9	1.0	1.3	15.8	14.7	1.1	0.9	3.2	3.0
VDH DR49	10.9	11.6	0.0	1.6	15.6	15.2	0.4	1.3	14.4	14.9	0.0	1.7	14.4	14.7	0.0	1.2	0.4	2.9
VDH DR51	13.5	11.6	1.9	1.7	20.8	15.2	5.6	2.5	20.3	14.9	5.4	1.7	18.7	14.7	4.0	2.1	16.9	4.1
VDH DR52	18.2	11.6	6.6	1.7	22.5	15.2	7.3	1.7	21.4	14.9	6.5	1.6	19.7	14.7	5.0	1.5	25.3	3.2
VY Parking Lot	17.3	11.6	5.7	2.4	23.1	15.2	7.9	1.9	22.4	14.9	7.5	1.8	20.7	14.7	6.0	2.2	27.0	4.1
VY Parking Lot #2	17.5	11.6	5.9	2.0	23.4	15.2	8.2	1.6	22.8	14.9	7.9	1.5	20.4	14.7	5.6	1.1	27.7	3.2
VDH DR53	16.3	11.6	4.7	2.3	24.0	15.2	8.8	1.8	22.0	14.9	7.1	1.9	21.1	14.7	6.4	2.0	27.0	4.0

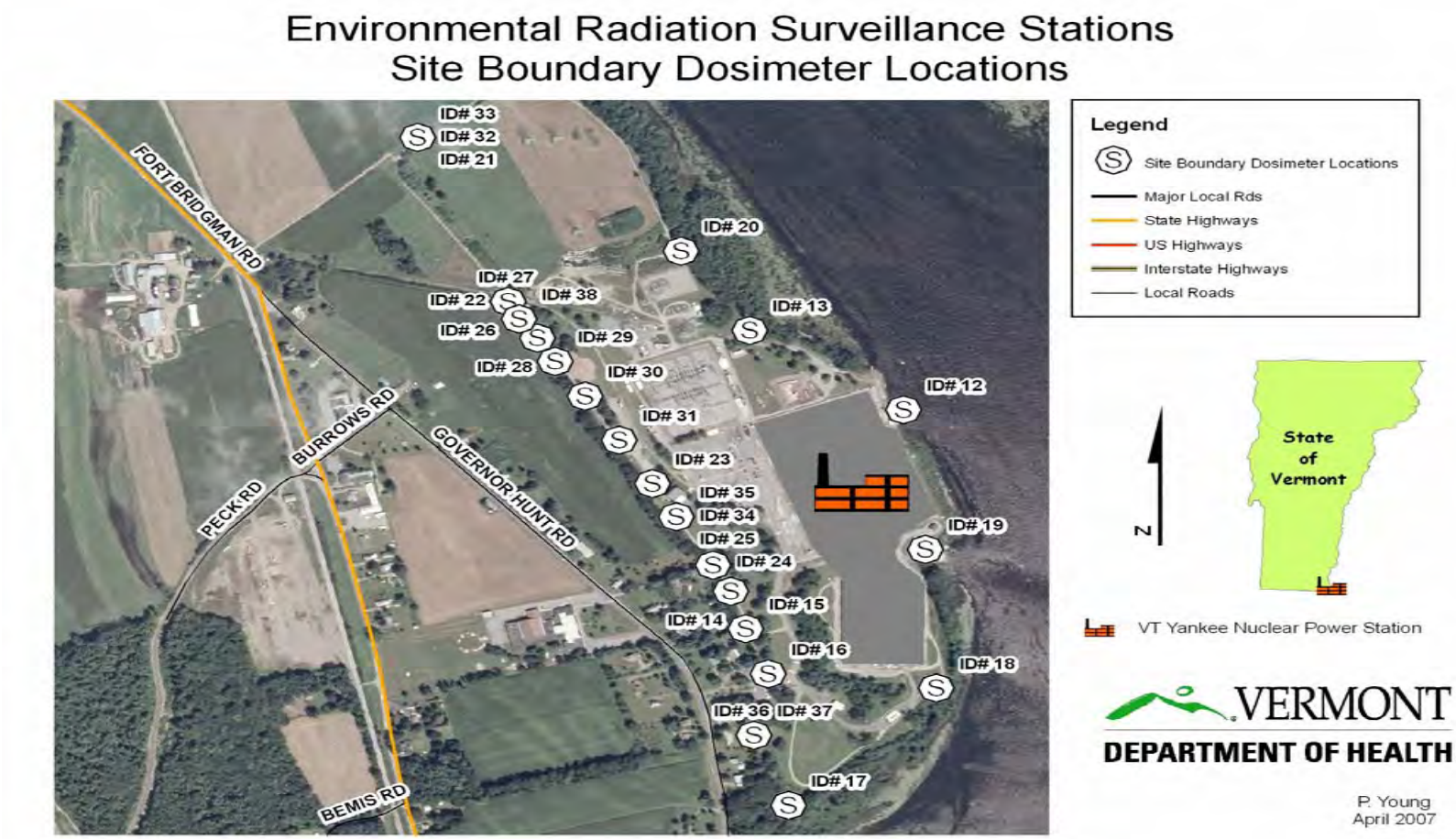
Plant Area																		
VDH T07A	12.0	11.6	0.4	1.3	16.8	15.2	1.6	1.6	16.5	14.9	1.6	1.2	16.0	14.7	1.2	1.4	4.9	2.8
VDH T07B	12.0	11.6	0.4	2.2	17.1	15.2	2.0	1.6	16.5	14.9	1.6	1.6	16.0	14.7	1.3	1.6	5.3	3.5
VDH DR51A	12.3	11.6	0.7	1.5	18.0	15.2	2.8	3.3	17.0	14.9	2.1	1.6	16.6	14.7	1.8	1.4	7.6	4.1
VY PARKING LOT A	13.8	11.6	2.2	2.2	18.7	15.2	3.5	1.5	17.7	14.9	2.8	2.2	17.9	14.7	3.2	1.6	11.7	3.8
VDH DR53A	14.1	11.6	2.6	2.1	19.7	15.2	4.6	1.5	19.3	14.9	4.4	1.9	18.4	14.7	3.7	1.4	15.2	3.5
Gov Hunt Road # 39	13.6	11.6	2.0	1.7	18.1	15.2	2.9	1.5	17.1	14.9	2.2	1.7	17.0	14.7	2.2	3.1	9.3	4.2
Vernon School Nurse	17.0	11.6	5.4	1.8	18.6	15.2	3.5	2.3	17.8	14.9	2.9	1.8	18.1	14.7	3.4	1.3	15.1	3.7
VDH DR06	12.4	11.6	0.9	1.8	16.6	15.2	1.4	1.5	15.6	14.9	0.7	0.9	15.1	14.7	0.4	0.9	3.4	2.7
Vernon Elem School A/S	12.2	11.6	0.6	1.6	16.6	15.2	1.4	1.3	15.2	14.9	0.3	1.4	15.5	14.7	0.7	1.2	2.9	2.8
VDH DR52A	14.1	11.6	2.5	1.6	17.7	15.2	2.5	1.9	17.3	14.9	2.4	1.7	16.7	14.7	2.0	1.7	9.3	3.5
Vernon School Pole	12.0	11.6	0.4	1.2	16.2	15.2	1.0	1.5	15.0	14.9	0.1	2.2	15.0	14.7	0.3	1.5	1.8	3.3
Site Boundary Dosimeters Regulated by the Vermont Department of Health																		

Table 5b. Net VYNPS Site Boundary and Plant Area Dose Equivalent Results for 2008 in Millirem

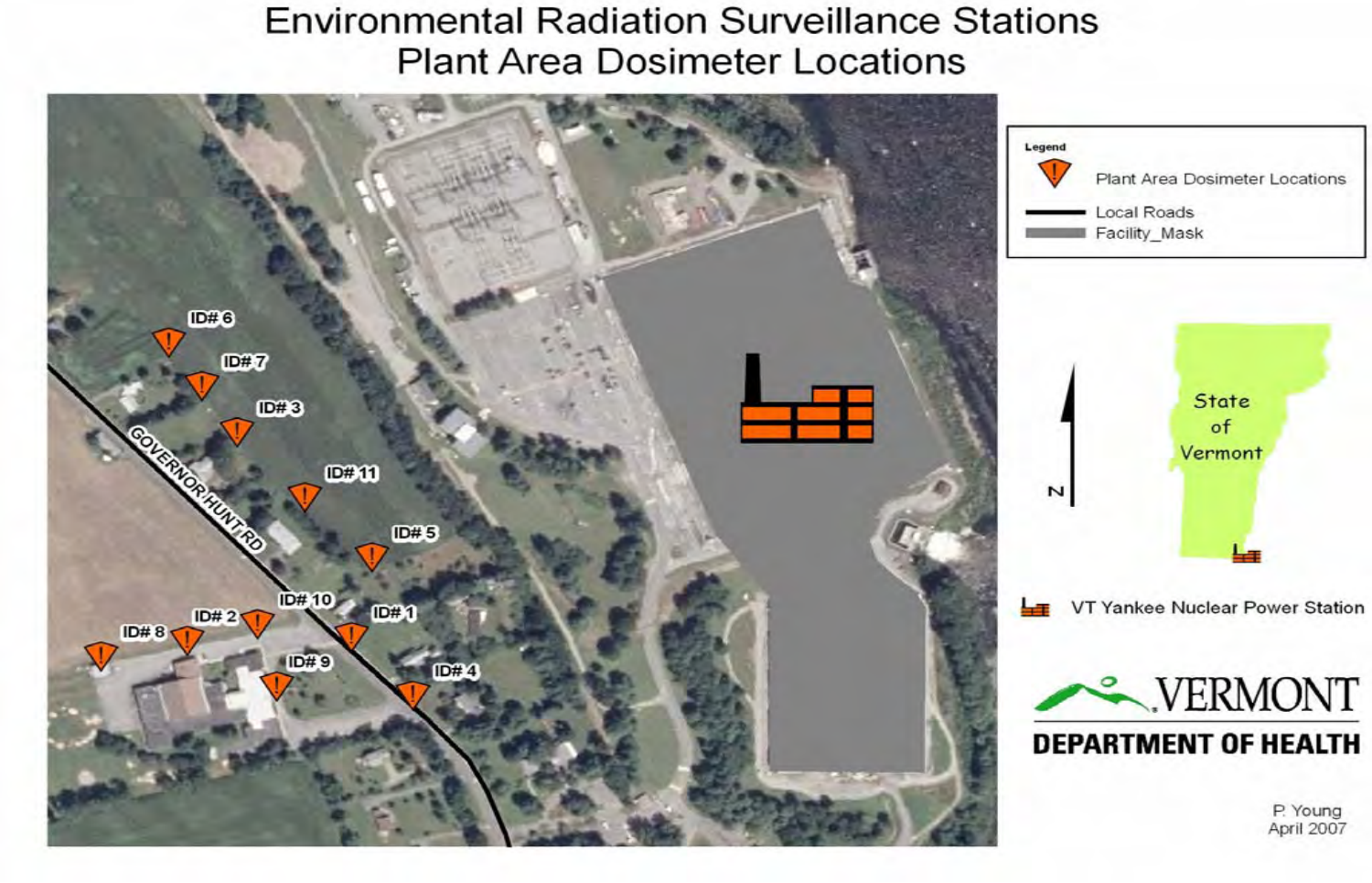
Results	Qtr 1	Mean	Net	2 SD	Qrtr 2	Mean	Net	2 SD	Qrtr 3	Mean	Net	2 SD	Qrtr 4	Mean	Net	2 SD	2008	2 SD
Location	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Net	Error
Site Boundary																		
VDH T01	6.8	6.9	0.0	0.7	9.3	9.1	0.2	0.8	9.1	8.9	0.2	0.6	9.0	8.8	0.2	1.1	0.5	1.6
VDH T02	6.7	6.9	0.0	0.9	9.5	9.1	0.4	0.8	9.1	8.9	0.1	0.8	9.1	8.8	0.2	1.2	0.8	1.9
VDH T03	7.0	6.9	0.0	0.8	9.8	9.1	0.6	0.8	9.1	8.9	0.2	1.0	9.2	8.8	0.4	0.8	1.2	1.7
VDH T04	6.7	6.9	0.0	0.7	9.8	9.1	0.7	1.0	9.9	8.9	1.0	0.8	9.4	8.8	0.6	0.7	2.3	1.7
VDH T05	7.7	6.9	0.8	0.9	10.5	9.1	1.4	1.1	9.9	8.9	0.9	1.1	9.8	8.8	1.0	1.1	4.0	2.1
VDH T06	7.7	6.9	0.7	0.9	11.2	9.1	2.0	1.1	10.7	8.9	1.7	0.9	10.2	8.8	1.3	0.8	5.8	1.8
VDH DR07	8.2	6.9	1.2	1.1	12.1	9.1	3.0	1.2	11.6	8.9	2.7	0.9	10.8	8.8	2.0	0.9	8.9	2.0
VDH DR08	10.2	6.9	3.3	1.8	13.0	9.1	3.9	1.2	12.4	8.9	3.4	0.9	11.6	8.8	2.7	0.8	13.3	2.5
VDH DR41	7.7	6.9	0.8	1.1	10.4	9.1	1.3	1.3	10.1	8.9	1.1	1.4	9.8	8.8	0.9	1.0	4.1	2.4
VY SW Fence	6.8	6.9	0.0	0.8	9.2	9.1	0.0	0.8	8.8	8.9	0.0	0.7	8.6	8.8	0.0	0.6	0.0	1.5
VY SW Fence #2	6.5	6.9	0.0	0.7	9.2	9.1	0.1	0.9	9.0	8.9	0.1	0.7	8.9	8.8	0.1	0.8	0.2	1.6
VDH DR42	6.5	6.9	0.0	1.0	9.8	9.1	0.7	1.0	9.6	8.9	0.6	0.7	9.2	8.8	0.4	0.8	1.7	1.8
VDH DR43	7.6	6.9	0.6	0.8	11.1	9.1	2.0	0.8	10.5	8.9	1.6	0.9	10.0	8.8	1.1	0.8	5.4	1.7
VDH DR44	12.4	6.9	5.4	2.2	13.4	9.1	4.3	1.6	12.6	8.9	3.6	0.8	12.0	8.8	3.2	1.4	16.5	3.2
VDH DR45	19.9	6.9	12.9	2.9	21.6	9.1	12.5	3.3	19.1	8.9	10.2	2.3	22.4	8.8	13.5	2.4	49.2	5.5
VDH DR46	10.8	6.9	3.9	1.1	12.6	9.1	3.5	1.0	12.1	8.9	3.2	1.0	11.8	8.8	2.9	1.2	13.4	2.1
VDH DR47	8.0	6.9	1.1	0.8	11.1	9.1	2.0	0.9	10.5	8.9	1.6	0.9	10.2	8.8	1.4	0.9	6.0	1.7
VDH DR48	6.9	6.9	0.0	1.1	10.3	9.1	1.1	1.0	9.8	8.9	0.9	0.9	9.6	8.8	0.8	0.8	2.8	1.9
VY North Fence	6.9	6.9	0.0	0.8	9.9	9.1	0.8	0.9	9.6	8.9	0.7	1.1	9.4	8.8	0.5	0.6	2.0	1.8
VY North Fence #2	6.8	6.9	0.0	0.8	9.8	9.1	0.7	1.4	9.5	8.9	0.6	0.8	9.5	8.8	0.6	0.6	1.9	1.8
VDH DR49	6.6	6.9	0.0	0.9	9.4	9.1	0.3	0.8	8.7	8.9	0.0	1.0	8.6	8.8	0.0	0.7	0.3	1.8
VDH DR51	8.1	6.9	1.2	1.0	12.5	9.1	3.4	1.5	12.2	8.9	3.2	1.0	11.2	8.8	2.4	1.3	10.2	2.4
VDH DR52	10.9	6.9	4.0	1.0	13.5	9.1	4.4	1.0	12.8	8.9	3.9	1.0	11.8	8.8	3.0	0.9	15.2	1.9
VY Parking Lot	10.4	6.9	3.4	1.4	13.8	9.1	4.7	1.2	13.4	8.9	4.5	1.1	12.4	8.8	3.6	1.3	16.2	2.5
VY Parking Lot #2	10.5	6.9	3.6	1.2	14.1	9.1	4.9	1.0	13.7	8.9	4.7	0.9	12.2	8.8	3.4	0.7	16.6	1.9
VDH DR53	9.8	6.9	2.8	1.4	14.4	9.1	5.3	1.1	13.2	8.9	4.3	1.1	12.7	8.8	3.8	1.2	16.2	2.4

Plant Area																		
VDH T07A	7.2	6.9	0.2	0.8	10.1	9.1	1.0	1.0	9.9	8.9	1.0	0.7	9.6	8.8	0.7	0.8	2.9	1.7
VDH T07B	7.2	6.9	0.3	1.3	10.3	9.1	1.2	0.9	9.9	8.9	1.0	1.0	9.6	8.8	0.8	0.9	3.2	2.1
VDH DR51A	7.4	6.9	0.4	0.9	10.8	9.1	1.7	2.0	10.2	8.9	1.3	1.0	9.9	8.8	1.1	0.8	4.5	2.5
VY PARKING LOT A	8.3	6.9	1.3	1.3	11.2	9.1	2.1	0.9	10.6	8.9	1.7	1.3	10.7	8.8	1.9	0.9	7.0	2.3
VDH DR53A	8.5	6.9	1.5	1.3	11.8	9.1	2.7	0.9	11.6	8.9	2.7	1.1	11.0	8.8	2.2	0.8	9.1	2.1
Gov Hunt Road # 39	8.1	6.9	1.2	1.0	10.9	9.1	1.7	0.9	10.3	8.9	1.3	1.0	10.2	8.8	1.3	1.9	5.6	2.5
Vernon School Nurse	10.2	6.9	3.3	1.1	11.2	9.1	2.1	1.4	10.7	8.9	1.7	1.1	10.8	8.8	2.0	0.8	9.1	2.2
VDH DR06	7.5	6.9	0.5	1.1	10.0	9.1	0.9	0.9	9.4	8.9	0.4	0.6	9.1	8.8	0.2	0.6	2.0	1.6
Vernon Elem School A/S	7.3	6.9	0.3	1.0	9.9	9.1	0.8	0.8	9.1	8.9	0.2	0.9	9.3	8.8	0.4	0.7	1.8	1.7
VDH DR52A	8.5	6.9	1.5	1.0	10.6	9.1	1.5	1.1	10.4	8.9	1.4	1.0	10.0	8.8	1.2	1.0	5.6	2.1
Vernon School Pole	7.2	6.9	0.2	0.7	9.7	9.1	0.6	0.9	9.0	8.9	0.1	1.3	9.0	8.8	0.2	0.9	1.1	2.0
Site Boundary Dosimeters Regulated by the Vermont Department of Health																		

Map 3


Environmental Radiation Surveillance Stations
Site Boundary Dosimeter Locations
ID# 33
ID# 32
ID# 21
ID# 20
ID# 27
ID# 22
ID# 38
ID# 26
ID# 29
ID# 28
ID# 30
ID# 13
ID# 12
ID# 31
ID# 23
ID# 35
ID# 34
ID# 25
ID# 24
ID# 19
ID# 15
ID# 14
ID# 16
ID# 18
ID# 36
ID# 37
ID# 17
FORT BRIDGMAN RD
BURROWS RD
GOVERNOR HUNT RD
PECK RD
BEMIS RD
Legend
Site Boundary Dosimeter Locations
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
N
State of Vermont
VT Yankee Nuclear Power Station
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Map 4


Environmental Radiation Surveillance Stations
Plant Area Dosimeter Locations
ID# 6
ID# 7
ID# 3
ID# 11
ID# 5
ID# 10
ID# 1
ID# 2
ID# 8
ID# 9
ID# 4
GOVERNOR HUNT RD
Legend
Plant Area Dosimeter Locations
Local Roads
Facility_Mask
N
State of Vermont
VT Yankee Nuclear Power Station
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Map 5

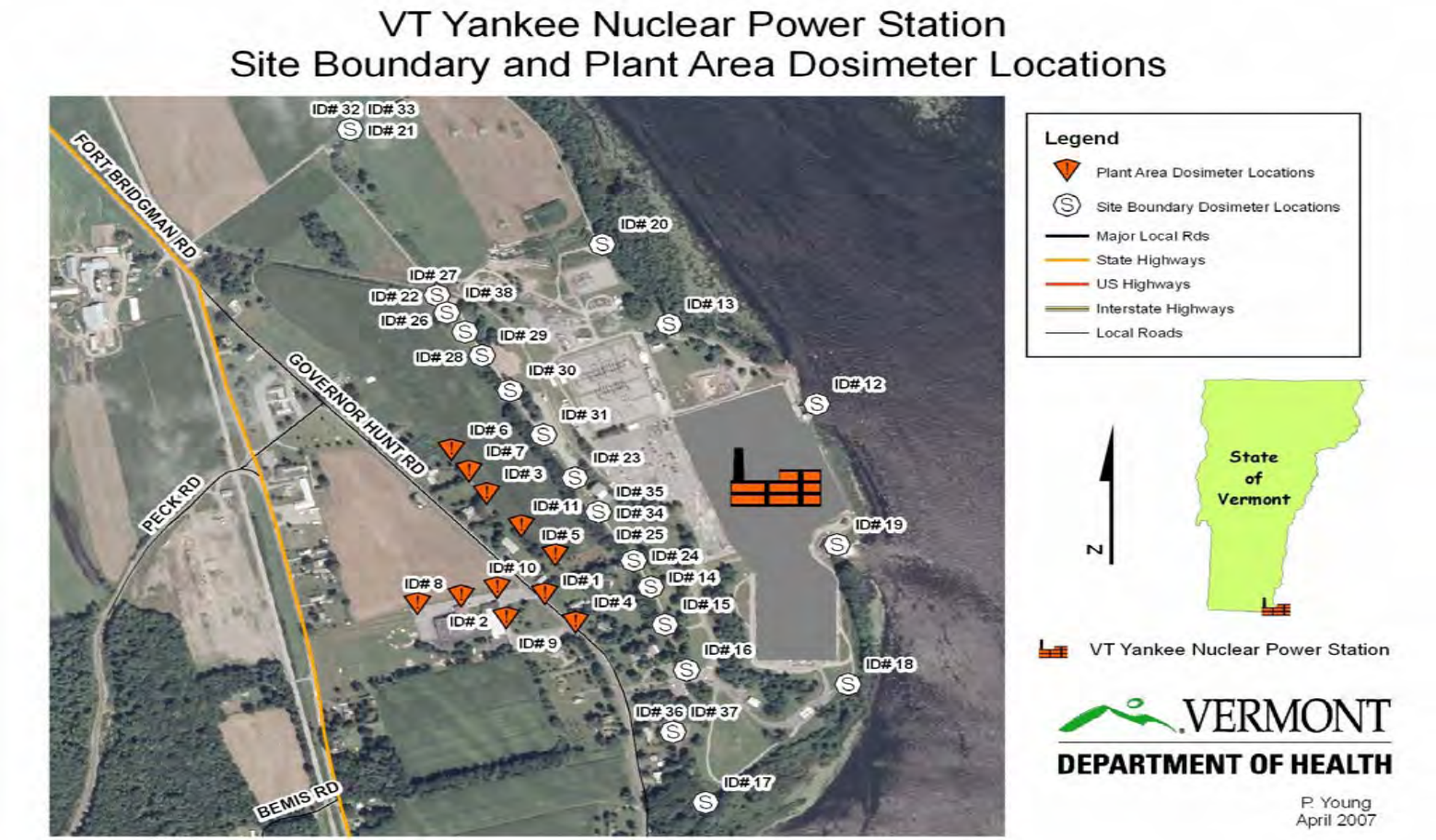

VT Yankee Nuclear Power Station
Site Boundary and Plant Area Dosimeter Locations
FORT BRIDGMAN RD
GOVERNOR HUNT RD
PECK RD
BEMIS RD
ID# 32
ID# 33
ID# 21
ID# 20
ID# 27
ID# 22
ID# 38
ID# 26
ID# 29
ID# 28
ID# 30
ID# 13
ID# 12
ID# 31
ID# 6
ID# 7
ID# 23
ID# 3
ID# 35
ID# 11
ID# 34
ID# 5
ID# 25
ID# 19
ID# 24
ID# 10
ID# 14
ID# 8
ID# 1
ID# 4
ID# 15
ID# 2
ID# 9
ID# 16
ID# 18
ID# 36
ID# 37
ID# 17
Legend
Plant Area Dosimeter Locations
Site Boundary Dosimeter Locations
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
N
State of Vermont
VT Yankee Nuclear Power Station
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Table 6a Net VYNPS Background TLD Exposure Results for 2008 in Milliroentgen

Results	Qtr 1	Mean	Net	2 SD	Qrtr 2	Mean	Net	2 SD	Qrtr 3	Mean	Net	2 SD	Qrtr 4	Mean	Net	2 SD	2008	2 SD
Location	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Net	Error
Putney Town Clerk	12.0	11.6	0.4	1.3	13.8	15.2	0.0	1.1	13.7	14.9	0.0	1.3	13.7	14.7	0.0	1.0	0.4	2.3
Putney Pole	12.4	11.6	0.8	1.7	15.6	15.2	0.4	1.8	15.4	14.9	0.5	1.2	15.8	14.7	1.1	2.0	2.8	3.4
Dummerston School	10.5	11.6	0.0	1.2	15.6	15.2	0.5	1.6	15.3	14.9	0.4	1.3	15.1	14.7	0.3	2.0	1.2	3.1
Dummerston IFO	12.3	11.6	0.7	1.4	15.9	15.2	0.7	1.4	15.7	14.9	0.8	1.4	15.0	14.7	0.3	1.0	2.5	2.6
Windham County Court	10.5	11.6	0.0	1.6	14.4	15.2	0.0	1.5	15.9	14.9	1.0	1.5	15.6	14.7	0.9	1.5	1.9	3.0
Renaud Brothers	15.3	11.6	3.7	1.5	17.2	15.2	2.0	1.3	17.3	14.9	2.4	1.4	16.7	14.7	1.9	1.3	10.0	2.8
Rt 142 North Trans Lines	10.3	11.6	0.0	2.0	15.4	15.2	0.2	1.4	15.1	14.9	0.2	1.6	14.0	14.7	0.0	1.5	0.4	3.3
Tyler Hill Road	11.2	11.6	0.0	2.7	15.7	15.2	0.5	1.4	15.8	14.9	0.9	1.7	15.0	14.7	0.2	1.4	1.6	3.7
Miller Farm	11.9	11.6	0.3	1.4	13.4	15.2	0.0	1.2	13.5	14.9	0.0	1.9	13.1	14.7	0.0	1.0	0.3	2.9
142 & Pond Road North	11.5	11.6	0.0	1.5	14.1	15.2	0.0	0.9	13.7	14.9	0.0	1.2	13.9	14.7	0.0	1.4	0.0	2.5
Fairman Road	10.5	11.6	0.0	1.4	15.1	15.2	0.0	1.2	14.6	14.9	0.0	1.4	14.1	14.7	0.0	1.2	0.0	2.6
West Road & Edgewood	9.9	11.6	0.0	1.4	14.8	15.2	0.0	1.6	14.5	14.9	0.0	1.3	14.3	14.7	0.0	1.1	0.0	2.7
Vernon Fire Station	11.8	11.6	0.2	1.5	15.0	15.2	0.0	1.6	14.2	14.9	0.0	1.4	14.0	14.7	0.0	1.1	0.2	2.8
Power Line Rvr Crsng	12.2	11.6	0.6	1.2	14.7	15.2	0.0	1.1	14.9	14.9	0.0	1.4	14.3	14.7	0.0	1.0	0.6	2.4
A&M Auto/Smead	11.0	11.6	0.0	1.2	14.7	15.2	0.0	1.1	14.1	14.9	0.0	1.5	14.7	14.7	0.0	1.0	0.0	2.4
Blodgett Farm	13.2	11.6	1.6	1.4	15.0	15.2	0.0	1.1	14.4	14.9	0.0	1.2	15.2	14.7	0.5	1.2	2.1	2.4
Rt 142 & Newtron Rd	10.8	11.6	0.0	1.2	13.2	15.2	0.0	1.7	12.9	14.9	0.0	1.0	12.9	14.7	0.0	1.5	0.0	2.8
Rt 142 & Pond Rd South	11.7	11.6	0.1	1.5	15.2	15.2	0.0	1.4	14.4	14.9	0.0	1.3	14.7	14.7	0.0	1.2	0.1	2.7
Rt 142 & Depot Street	11.4	11.6	0.0	1.2	15.3	15.2	0.1	1.7	15.2	14.9	0.3	1.3	14.7	14.7	0.0	1.0	0.4	2.7
Pond Rd & Houghton	10.1	11.6	0.0	1.3	14.8	15.2	0.0	1.5	14.2	14.9	0.0	1.6	13.9	14.7	0.0	0.9	0.0	2.7
Pond Rd/Vernon Rec	10.8	11.6	0.0	1.1	13.4	15.2	0.0	1.3	13.2	14.9	0.0	0.8	13.0	14.7	0.0	1.4	0.0	2.4
Huckle Hill Rd.VT Line	12.0	11.6	0.4	1.4	17.8	15.2	2.6	1.6	17.3	14.9	2.4	1.8	16.8	14.7	2.1	1.7	7.5	3.2
Route 5 & Wolosko	12.5	11.6	0.9	1.6	17.4	15.2	2.2	1.9	17.4	14.9	2.5	2.2	16.0	14.7	1.3	1.1	6.8	3.5
Rt 5/Andrews Cemetary	11.4	11.6	0.0	1.6	16.0	15.2	0.8	1.9	14.9	14.9	0.0	1.2	14.6	14.7	0.0	1.1	0.8	3.0
Rt 5/Tkaczyk Farm Rd	10.8	11.6	0.0	2.2	15.8	15.2	0.6	1.3	15.2	14.9	0.3	1.7	15.9	14.7	1.1	2.1	2.0	3.7
Tyler Rd/Franklin Rd	11.5	11.6	0.0	1.5	16.2	15.2	1.0	2.4	16.5	14.9	1.6	2.1	15.2	14.7	0.5	1.3	3.1	3.8
D&E Tree, Rt 5, Guilford	9.8	11.6	0.0	1.1	14.6	15.2	0.0	1.4	14.1	14.9	0.0	0.9	14.3	14.7	0.0	1.3	0.0	2.4
Rt 5 & Guilford Ctr Rd	12.6	11.6	1.0	1.3	14.5	15.2	0.0	1.2	14.2	14.9	0.0	1.3	14.3	14.7	0.0	1.4	1.0	2.6
Guilford Ctr Rd/Tater Rd	11.4	11.6	0.0	1.2	14.6	15.2	0.0	1.5	14.7	14.9	0.0	2.1	14.8	14.7	0.1	1.0	0.1	3.0

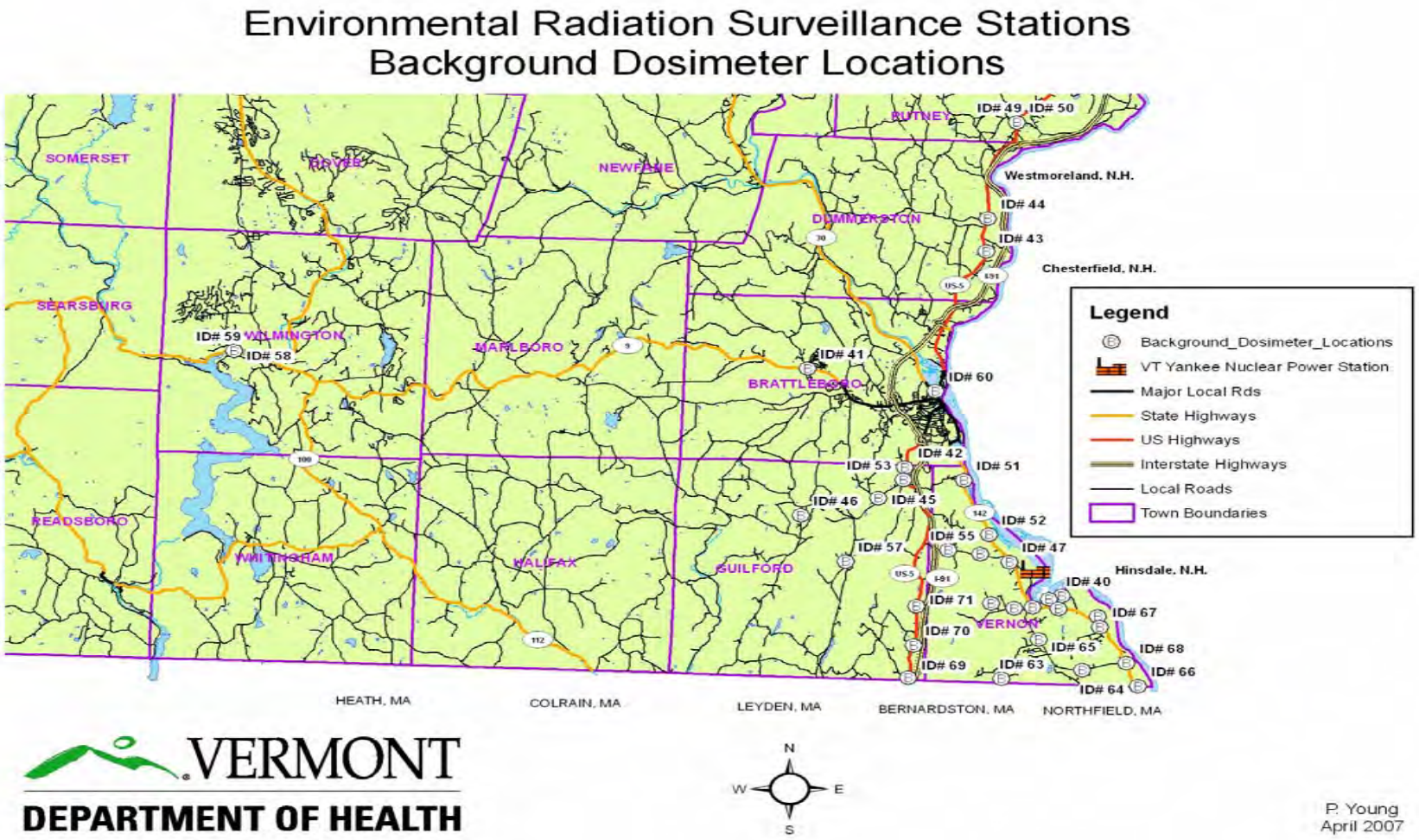
Weatherhead Hollow Rd		11.6	0.0	0.0		15.2	0.0	0.0	13.3	14.9	0.0	1.5	13.3	14.7	0.0	1.5	0.0	2.1
Guilford Town Garage	13.4	11.6	1.9	1.6	15.9	15.2	0.7	1.7	15.0	14.9	0.1	1.0	15.6	14.7	0.9	1.5	3.5	3.0
West Brattleboro SP	10.6	11.6	0.0	1.2	13.3	15.2	0.0	1.0	13.2	14.9	0.0	1.8	13.5	14.7	0.0	1.1	0.0	2.6
Wilmington AOT Pole	11.9	11.6	0.3	2.1	15.3	15.2	0.1	1.1	15.5	14.9	0.6	1.5	15.4	14.7	0.6	1.1	1.7	3.1
Wilmington AOT A/S	13.1	11.6	1.5	1.4	17.9	15.2	2.7	1.5	17.4	14.9	2.5	1.5	17.5	14.7	2.7	1.4	9.5	2.9

Table 6b. VYNPS Net Background Dose Equivalent Results for 2008 in Millirem

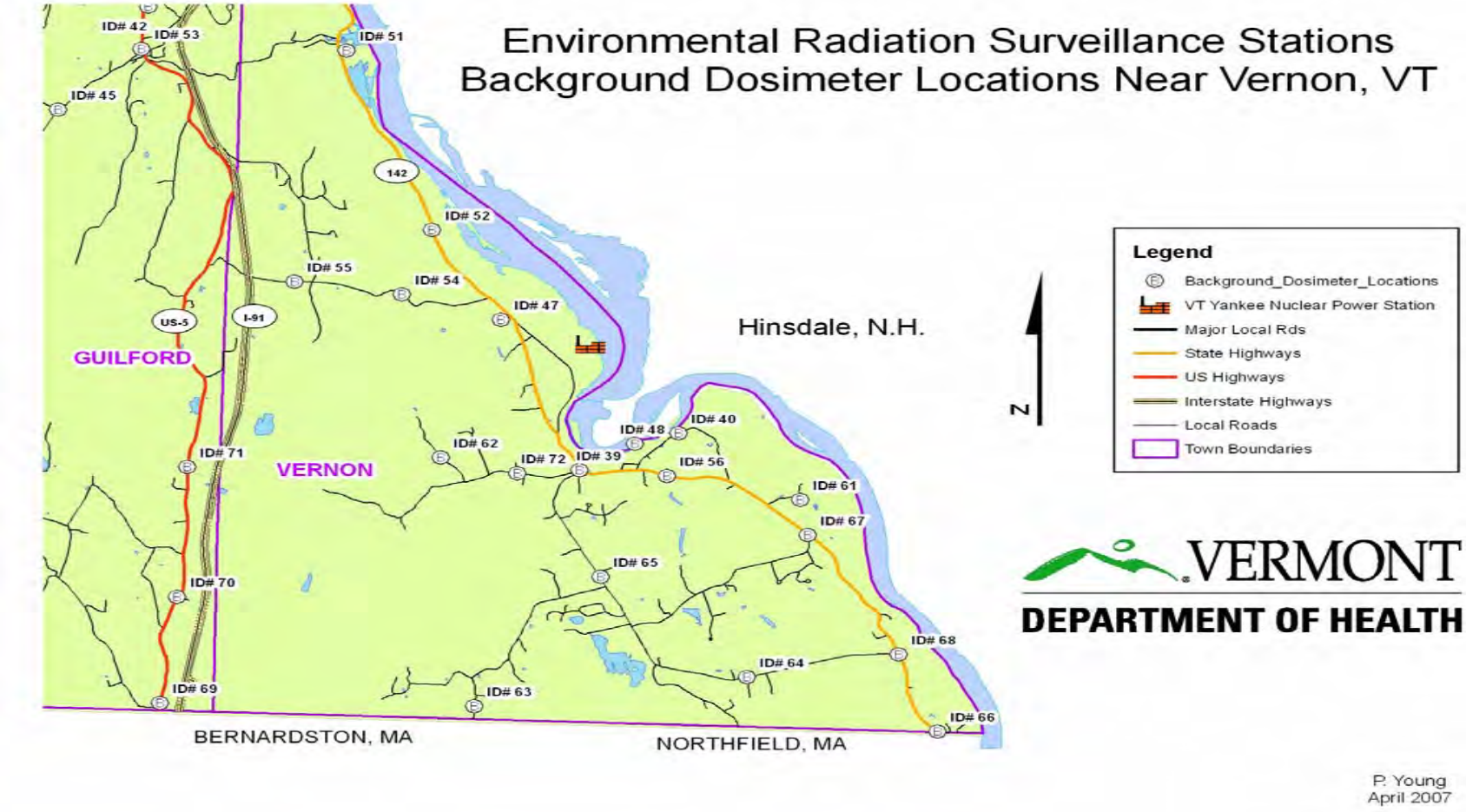
Results	Qtr 1	Mean	Net	2 SD	Qrtr 2	Mean	Net	2 SD	Qrtr 3	Mean	Net	2 SD	Qrtr 4	Mean	Net	2 SD	2008	2 SD
Location	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Gross	BKGD	>=0	Error	Net	Error
Putney Town Clerk	7.2	6.9	0.2	0.8	8.3	9.1	0.0	0.6	8.2	8.9	0.0	0.8	8.2	8.8	0.0	0.6	0.2	1.4
Putney Pole	7.4	6.9	0.5	1.0	9.3	9.1	0.2	1.1	9.2	8.9	0.3	0.7	9.5	8.8	0.6	1.2	1.7	2.0
Dummerston School	6.3	6.9	0.0	0.7	9.4	9.1	0.3	1.0	9.2	8.9	0.2	0.8	9.0	8.8	0.2	1.2	0.7	1.9
Dummerston IFO	7.4	6.9	0.4	0.9	9.6	9.1	0.4	0.8	9.4	8.9	0.5	0.8	9.0	8.8	0.2	0.6	1.5	1.6
Windham County Court	6.3	6.9	0.0	1.0	8.7	9.1	0.0	0.9	9.5	8.9	0.6	0.9	9.4	8.8	0.5	0.9	1.1	1.8
Renaud Brothers	9.2	6.9	2.2	0.9	10.3	9.1	1.2	0.8	10.4	8.9	1.5	0.8	10.0	8.8	1.2	0.8	6.0	1.7
Rt 142 North Trans Lines	6.2	6.9	0.0	1.2	9.2	9.1	0.1	0.8	9.0	8.9	0.1	1.0	8.4	8.8	0.0	0.9	0.2	2.0
Tyler Hill Road	6.7	6.9	0.0	1.6	9.4	9.1	0.3	0.8	9.5	8.9	0.5	1.0	9.0	8.8	0.1	0.8	1.0	2.2
Miller Farm	7.1	6.9	0.2	0.9	8.0	9.1	0.0	0.7	8.1	8.9	0.0	1.1	7.9	8.8	0.0	0.6	0.2	1.7
142 & Pond Road North	6.9	6.9	0.0	0.9	8.5	9.1	0.0	0.6	8.2	8.9	0.0	0.7	8.3	8.8	0.0	0.8	0.0	1.5
Fairman Road	6.3	6.9	0.0	0.8	9.0	9.1	0.0	0.7	8.8	8.9	0.0	0.8	8.5	8.8	0.0	0.7	0.0	1.6
West Road & Edgewood	6.0	6.9	0.0	0.9	8.9	9.1	0.0	1.0	8.7	8.9	0.0	0.8	8.6	8.8	0.0	0.6	0.0	1.6
Vernon Fire Station	7.1	6.9	0.1	0.9	9.0	9.1	0.0	1.0	8.5	8.9	0.0	0.8	8.4	8.8	0.0	0.7	0.1	1.7
Power Line Rvr Crsng	7.3	6.9	0.4	0.7	8.8	9.1	0.0	0.6	8.9	8.9	0.0	0.8	8.6	8.8	0.0	0.6	0.4	1.4
A&M Auto/Smead	6.6	6.9	0.0	0.7	8.8	9.1	0.0	0.6	8.5	8.9	0.0	0.9	8.8	8.8	0.0	0.6	0.0	1.5
Blodgett Farm	7.9	6.9	1.0	0.8	9.0	9.1	0.0	0.6	8.7	8.9	0.0	0.7	9.1	8.8	0.3	0.7	1.3	1.5
Rt 142 & Newtron Rd	6.5	6.9	0.0	0.7	7.9	9.1	0.0	1.0	7.7	8.9	0.0	0.6	7.7	8.8	0.0	0.9	0.0	1.7
Rt 142 & Pond Rd South	7.0	6.9	0.1	0.9	9.1	9.1	0.0	0.8	8.6	8.9	0.0	0.8	8.8	8.8	0.0	0.7	0.1	1.6
Rt 142 & Depot Street	6.8	6.9	0.0	0.7	9.2	9.1	0.0	1.0	9.1	8.9	0.2	0.8	8.8	8.8	0.0	0.6	0.2	1.6
Pond Rd & Houghton	6.1	6.9	0.0	0.8	8.9	9.1	0.0	0.9	8.5	8.9	0.0	1.0	8.4	8.8	0.0	0.6	0.0	1.6
Pond Rd/Vernon Rec	6.5	6.9	0.0	0.7	8.0	9.1	0.0	0.8	7.9	8.9	0.0	0.5	7.8	8.8	0.0	0.8	0.0	1.4
Huckle Hill Rd.VT Line	7.2	6.9	0.3	0.9	10.7	9.1	1.6	0.9	10.4	8.9	1.4	1.1	10.1	8.8	1.3	1.0	4.5	1.9
Route 5 & Wolosko	7.5	6.9	0.6	0.9	10.4	9.1	1.3	1.2	10.4	8.9	1.5	1.3	9.6	8.8	0.8	0.7	4.1	2.1
Rt 5/Andrews Cemetary	6.8	6.9	0.0	1.0	9.6	9.1	0.5	1.2	8.9	8.9	0.0	0.7	8.8	8.8	0.0	0.7	0.5	1.8
Rt 5/Tkaczyk Farm Rd	6.5	6.9	0.0	1.3	9.5	9.1	0.3	0.8	9.1	8.9	0.2	1.0	9.5	8.8	0.7	1.3	1.2	2.2
Tyler Rd/Franklin Rd	6.9	6.9	0.0	0.9	9.7	9.1	0.6	1.5	9.9	8.9	0.9	1.3	9.1	8.8	0.3	0.8	1.9	2.3
D&E Tree, Rt 5, Guilford	5.9	6.9	0.0	0.7	8.8	9.1	0.0	0.8	8.4	8.9	0.0	0.6	8.6	8.8	0.0	0.8	0.0	1.4
Rt 5 & Guilford Ctr Rd	7.6	6.9	0.6	0.8	8.7	9.1	0.0	0.7	8.5	8.9	0.0	0.8	8.6	8.8	0.0	0.8	0.6	1.5
Guilford Ctr Rd/Tater Rd	6.9	6.9	0.0	0.7	8.7	9.1	0.0	0.9	8.8	8.9	0.0	1.3	8.9	8.8	0.0	0.6	0.0	1.8
Weatherhead Hollow Rd	0.0	6.9	0.0	0.0	0.0	9.1	0.0	0.0	8.0	8.9	0.0	0.9	8.0	8.8	0.0	0.9	0.0	1.2

Guilford Town Garage	8.1	6.9	1.1	1.0	9.5	9.1	0.4	1.0	9.0	8.9	0.0	0.6	9.4	8.8	0.5	0.9	2.1	1.8
West Brattleboro SP	6.3	6.9	0.0	0.7	8.0	9.1	0.0	0.6	7.9	8.9	0.0	1.1	8.1	8.8	0.0	0.7	0.0	1.6
Wilmington AOT Pole	7.1	6.9	0.2	1.3	9.2	9.1	0.1	0.7	9.3	8.9	0.4	0.9	9.2	8.8	0.4	0.6	1.0	1.8
Wilmington AOT A/S	7.9	6.9	0.9	0.8	10.7	9.1	1.6	0.9	10.5	8.9	1.5	0.9	10.5	8.8	1.6	0.8	5.7	1.7

Map 6


Environmental Radiation Surveillance Stations
Background Dosimeter Locations
SOMERSET
NEWFANE
RUTNEY
Westmoreland, N.H.
DUMMERSTON
Chesterfield, N.H.
SEARSBURG
WILMINGTON
MARLBORO
BRATTLEBORO
READSBORO
WHITINGHAM
HALIFAX
GUILFORD
VERNON
Hinsdale, N.H.
ID# 49
ID# 50
ID# 44
ID# 43
ID# 59
ID# 58
ID# 41
ID# 60
ID# 42
ID# 53
ID# 51
ID# 46
ID# 45
ID# 52
ID# 55
ID# 57
ID# 47
ID# 40
ID# 71
ID# 67
ID# 70
ID# 65
ID# 68
ID# 69
ID# 63
ID# 66
ID# 64
Legend
Background_Dosimeter_Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
Town Boundaries
HEATH, MA
COLRAIN, MA
LEYDEN, MA
BERNARDSTON, MA
NORTHFIELD, MA
VERMONT
DEPARTMENT OF HEALTH
N
W
E
S
P. Young
April 2007

Map 7


Environmental Radiation Surveillance Stations
Background Dosimeter Locations Near Vernon, VT
ID# 42
ID# 53
ID# 51
ID# 45
142
ID# 52
ID# 55
ID# 54
ID# 47
US-5
I-91
GUILFORD
Hinsdale, N.H.
ID# 48
ID# 40
ID# 62
ID# 72
ID# 39
ID# 56
ID# 71
VERNON
ID# 61
ID# 67
ID# 65
ID# 70
ID# 68
ID# 64
ID# 69
ID# 63
ID# 66
BERNARDSTON, MA
NORTHFIELD, MA
N
Legend
Background_Dosimeter_Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
Town Boundaries
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Air Sampling Results

Using nine air sampling stations, the Vermont Department of Health assesses radioactivity in the air around Vermont Yankee. The locations of the air samplers are shown on Map 8 below. The ID numbers on the map may be matched with those on Tables 8, 9, 10 and 11. The sampling apparatus uses a mechanical pump to pull environmental air through sample media. Between the pump and sample media is positioned an in-line flow meter. The flow meter tracks the volume of air drawn through the sample media. The air samplers run continuously, and the air samples collected there are retrieved and analyzed at least monthly.

The air samplers use two different sample media to capture airborne radioactivity. One is a glass fiber filter. This filter collects particulate material. The air filter is analyzed by the Vermont Department of Health Laboratory in Burlington, which reports the results numerically (as calculated) as total alpha radioactivity and total beta radioactivity. Alpha radioactivity is a measure of radioactive materials that emit alpha radiation, while beta radioactivity is a measure of radioactive materials that emit beta radiation. The air filters are also counted for gamma radioactivity in what are called the quarterly composites. An example of a natural radioactive particulate is beryllium-7. A radioactive particulate only associated with human activity is cesium-137.

The second media is a charcoal cartridge treated with triethylenediamine (TEDA). This cartridge has an affinity for radioactive iodine. As air passes through the cartridge, radioactive iodine gets trapped in the charcoal cartridge. The radioactive iodine is measured at the Vermont Department of Health Laboratory. In addition, other radioactive gases and vapors may be trapped in the charcoal cartridge. These, too, are analyzed by the laboratory. A radioactive iodine of particular interest is iodine-131. The lab reports the iodine-131 radioactivity, and identifies any other radioactive gases or vapors that were collected on the cartridge.

Alpha and beta radioactivity on the glass fiber filters is measured using a gas flow proportional counter. This analysis is particularly useful with environmental levels of radioactivity, and allows easy discrimination between alpha and beta radioactivity. Glass fiber filter results are presented numerically with error. The charcoal cartridges are analyzed for radioactive iodine and other gamma radiation emitting radioactive materials with a gamma spectrometer system using a reverse electrode germanium detector. This instrument can detect hundreds of different radioisotopes and identify them individually by their unique gamma radiation energy signatures. The instruments used at the Vermont Department of Health Laboratory are very sensitive and subject to significant quality controls. Still, each instrument has a limit of detection. When a sample is analyzed and no radioactivity is detected, the result is not recorded as zero, but it is recorded as less than the limit of detection. Limits of detection (LOD) are calculated periodically and represent an activity value that can be distinguished from the absence of that activity, LODs are calculated for gamma instruments taking into consideration instrument and sample characteristics such as sample type, count times, sample sizes. The calculated limit of detection for iodine-131, for example is 0.0038 pCi/m^3.

Total alpha, total beta, and iodine-131 radioactivity is reported in picocuries per cubic meter. A picocurie (pCi) is a measure of radioactivity. One pCi is one trillionth of a curie, and one curie is the amount of radioactivity in one gram of radium-226. A cubic meter (m^3) is a measure of volume, so the number of pCi/m^3 in these air samples is a measure of the airborne radioactivity concentration. Table 7 presents the total alpha radioactivity results from the 2008 air sample filters. Table 8 presents the total beta radioactivity from these filters. Table 9 presents the radioactive iodine-131 results following analysis of the charcoal cartridge samples, while Table 10 presents the gamma spectrometry results for the analysis of these charcoal cartridges.

Results for 2008 are that 1) alpha radioactivity is within the historical range of less than the calculated limits of detection to 0.0071 pCi/m^3; 2) that beta radioactivity is within eight percent of the maximum in the historical range of less than the calulated limits of

detection to 0.0251 pCi/m^3; 3) that iodine-131 samples were all less than the limit of detection; and 4) that all gamma radioactivity detected was of natural origin. Specific concentrations for alpha radioactivity ranged from 0.0 pCi/m^3 to 0.00483 pCi/m^3 while the specific concentrations for beta radioactivity ranged from 0.00118 pCi/m^3 to 0.0271 pCi/m^3.

Each calendar quarter, the air filter samples from all nine air sample locations are analyzed together in what is called a quarterly composite. The filters are analyzed with the gamma spectrometer system used to evaluate the air cartridges for radioactive materials. Table 11 presents the quarterly composite results. The results show only naturally occurring beryllium-7, and at levels consistent with the historical range.

In the graph in Figure 1, the mean alpha radioactivity for each of the nine Vermont Department of Health air sample stations is plotted. The graph indicates that there is little difference between results at locations close to Vermont Yankee Nuclear Power Station, for example at the Vernon Elementary School, and at locations far from the plant, for example the Windham County Courthouse in Brattleboro. As with alpha radioactivity, a look at the mean air sample total beta radioactivity indicates no significant difference between air sample results for locations near the plant as compared to locations further from the plant. These mean air sample beta radioactivity results from the nine air sample stations are plotted in the graph in Figure 2.

Table 9 presents the monthly results of iodine-131 sample analysis. No iodine-131 above the calculated limit of detection was identified at any of the nine air sampling stations. The calculated limit of detection is 0.0038 picocuries per cubic meter (pCi/m^3).

In Table 10 is presented the gamma spectroscopy results for air sample charcoal cartridges for the nine air samplers in the Vermont Yankee Nuclear Power Station area. All of the results indicate only naturally occurring radioactive materials were detected. Table 12 provides a list of some of the naturally occurring radioactive materials found in gamma spectroscopy at the Vermont Department of Health Laboratory. Table 13 is a list

of radioactive materials that may be identified through gamma spectroscopy that are predominantly associated with nuclear facilities.

Table 11 presents the quarterly air sample composite analysis. The quarterly composites are analyses of all air filters collected from the nine air sampling stations over the three-month calendar quarter. The 27 filters collected over the calendar quarter are analyzed by gamma spectroscopy, which can identify any radioactivity that emits gamma radiation. The analysis of these filters indicated only naturally occurring beryllium-7 present in excess of the calculated limit of detection. Beryllium-7 is a cosmogenic radioactive material. Cosmogenic radioactive materials are created by cosmic radiation interactions in the earth's atmosphere. The beryllium-7 accumulates on the surface of the earth when washed out of the atmosphere by precipitation.

In summary, gamma spectroscopy of air sample cartridges and filters around Vermont Yankee showed no evidence of radioactivity from the station. The alpha and beta radioactivity measurements are within the historical range and are considered most likely only associated with natural radioactive materials in the air.

Map 8

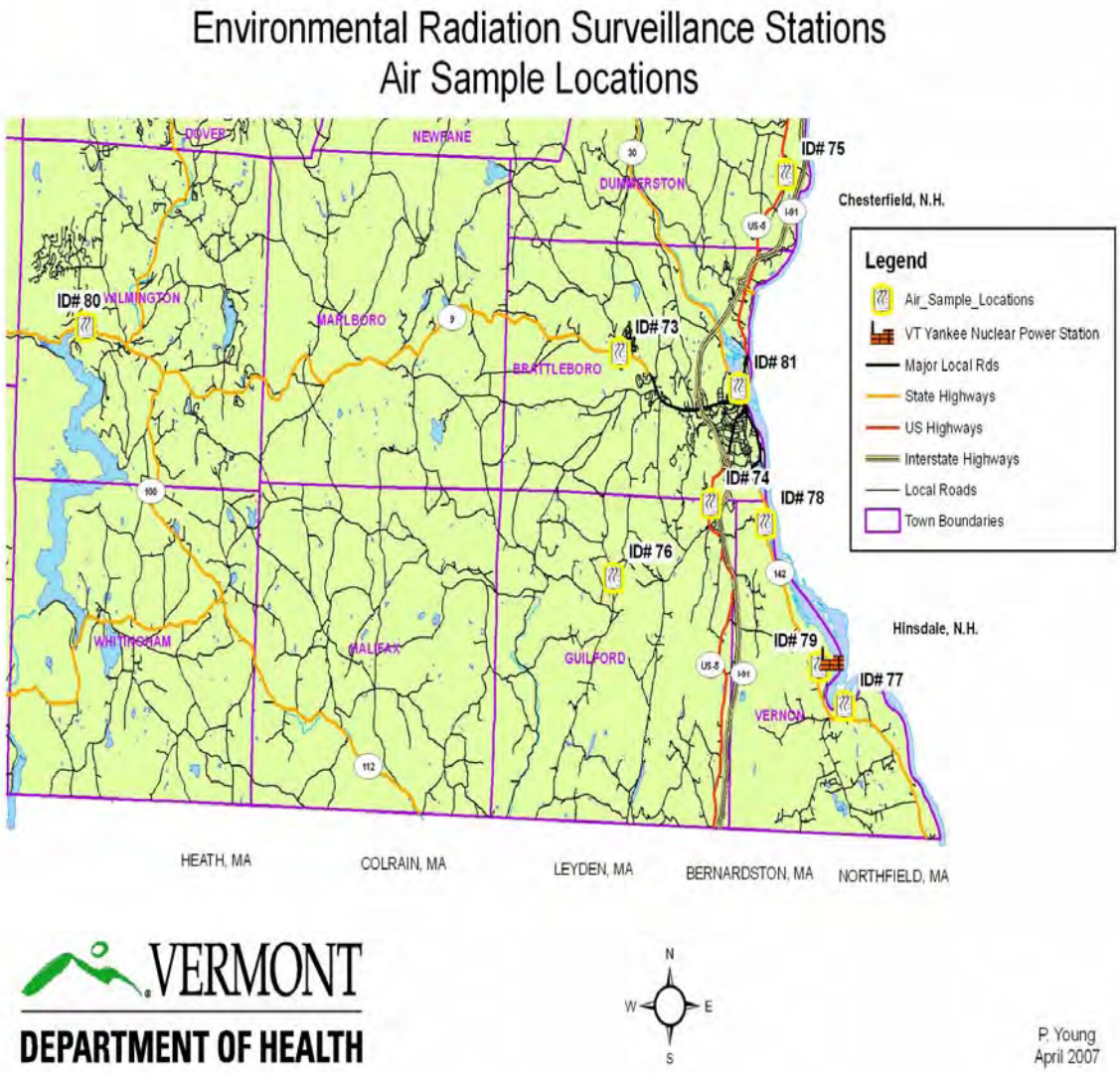

Environmental Radiation Surveillance Stations
Air Sample Locations
ID# 75
Chesterfield, N.H.
ID# 80
WILMINGTON
MARLBORO
ID# 73
BRATTLEBORO
ID# 81
ID# 74
ID# 78
ID# 76
Hinsdale, N.H.
ID# 79
ID# 77
VERNON
WHITINGHAM
MALLEAX
GUILFORD
DOVER
NEWFANE
DUMMERSTON
Legend
Air_Sample_Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
Town Boundaries
HEATH, MA
COLRAIN, MA
LEYDEN, MA
BERNARDSTON, MA
NORTHFIELD, MA
VERMONT
DEPARTMENT OF HEALTH
N
W
E
S
P. Young
April 2007

Table 7. 2008 Air Sample Alpha Radioactivity Results

Sample Date	Sample Location	Map ID No.	Results pCi/m^3	Error pCi/m^3
1/31/2008	Brattleboro State Police	73	0.00366	0.00075
1/31/2008	D & E Tree	74	0.00217	0.00062
1/31/2008	Dummerston State Garage	75	0.00304	0.0007
1/31/2008	Guilford Town Garage	76	0.00366	0.00082
1/31/2008	Power Line River Crossing	77	0.0033	0.00071
1/31/2008	Renauld Brothers	78	0.00378	0.00079
1/31/2008	Vernon Elementary School	79	0.00369	0.00075
1/31/2008	Wilmington State Garage	80	0.00287	0.00063
1/31/2008	Windham County Court	81	0.00483	0.0011
2/25/2008	Brattleboro State Police	73	0.00239	0.00084
2/25/2008	D & E Tree	74	0.00203	0.0008
2/25/2008	Dummerston State Garage	75	0.00263	0.00087
2/25/2008	Guilford Town Garage	76	0.00254	0.00094
2/25/2008	Power Line River Crossing	77	0.0026	0.00086
2/25/2008	Renauld Brothers	78	0.00275	0.0009
2/25/2008	Vernon Elementary School	79	0.00294	0.00089
2/25/2008	Wilmington State Garage	80	0.00253	0.00079
2/25/2008	Windham County Court	81	0.0019	0.00054
3/27/2008	Brattleboro State Police	73	0.00306	0.00079
3/27/2008	D & E Tree	74	0.00249	0.00074
3/27/2008	Dummerston State Garage	75	0.00244	0.00072
3/27/2008	Guilford Town Garage	76	0.00287	0.00084
3/27/2008	Power Line River Crossing	77	0.00303	0.00078
3/27/2008	Renauld Brothers	78	0.00273	0.00077
3/27/2008	Vernon Elementary School	79	0.00317	0.00079
3/27/2008	Wilmington State Garage	80	0.00226	0.00065
3/27/2008	Windham County Court	81	0.00216	0.00066
4/29/2008	Brattleboro State Police	73	0.00355	0.00085
4/29/2008	D & E Tree	74	0.00271	0.00077
4/29/2008	Dummerston State Garage	75	0.00299	0.00078
4/29/2008	Guilford Town Garage	76	0.00366	0.0009
4/29/2008	Power Line River Crossing	77	0.00367	0.00098
4/29/2008	Renauld Brothers	78	0.00292	0.00076
4/29/2008	Vernon Elementary School	79	0.00379	0.00085
4/29/2008	Wilmington State Garage	80	0.00296	0.00071
4/29/2008	Windham County Court	81	0.00263	0.00071

Table 7. 2008 Air Sample Alpha Radioactivity (continued)

Sample Date	Sample Location	Map ID No	Results pCi/m^3	Error pCi/m^3
6/4/2008	Brattleboro State Police	73	0.00191	0.00063
5/29/2008	D & E Tree	74	0.000876	0.000533
5/29/2008	Dummerston State Garage	75	0.00251	0.00078
5/29/2008	Guilford Town Garage	76	0.00115	0.00061
5/29/2008	Power Line River Crossing	77	0.00042	0.000529
5/29/2008	Renauld Brothers	78	0.000347	0.000396
5/29/2008	Vernon Elementary School	79	0.003	0.00082
6/4/2008	Wilmington State Garage	80	0.00242	0.00064
5/29/2008	Windham County Court	81	0.00179	0.00065
6/30/2008	Brattleboro State Police	73	0.00141	0.0007
6/30/2008	D & E Tree	74	0.00196	0.0007
6/30/2008	Dummerston State Garage	75	0.00112	0.00059
6/30/2008	Guilford Town Garage	76	0.00125	0.00061
6/30/2008	Power Line River Crossing	77	0.00413	0.00207
6/30/2008	Renauld Brothers	78	0.00153	0.00059
6/30/2008	Vernon Elementary School	79	0.00217	0.0007
6/30/2008	Wilmington State Garage	80	0.000657	0.000483
6/30/2008	Windham County Court	81	0.00136	0.00058
7/28/2008	Brattleboro State Police	73	0.00268	0.0009
7/28/2008	D & E Tree	74	0.00157	0.00078
7/28/2008	Dummerston State Garage	75	0.0016	0.00078
7/28/2008	Guilford Town Garage	76	0	0.00053
7/28/2008	Power Line River Crossing	77	0.00315	0.0009
7/28/2008	Renauld Brothers	78	0.000088	0.000435
7/28/2008	Vernon Elementary School	79	0.0032	0.00095
7/28/2008	Wilmington State Garage	80	0.00132	0.00215
7/28/2008	Windham County Court	81	0.00233	0.00084
8/21/2008	Brattleboro State Police	73	0.00242	0.00084
8/21/2008	D & E Tree	74	0.000376	0.000466
8/21/2008	Dummerston State Garage	75	0.00167	0.00074
8/21/2008	Guilford Town Garage	76	0.00262	0.00089
8/21/2008	Power Line River Crossing	77	0.00267	0.00091
8/21/2008	Renauld Brothers	78	0.00246	0.0008
8/21/2008	Vernon Elementary School	79	0.0021	0.00079
8/21/2008	Wilmington State Garage	80	0.00249	0.00096
8/21/2008	Windham County Court	81	0.00255	0.00085

Table 7. 2008 Air Sample Alpha Radioactivity (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/m^3	Error pCi/m^3
9/29/2008	Brattleboro State Police	73	0.00229	0.00062
9/29/2008	D & E Tree	74	0.00197	0.0006
9/29/2008	Dummerston State Garage	75	N/A	N/A
9/29/2008	Guilford Town Garage	76	0.00278	0.0007
9/29/2008	Power Line River Crossing	77	0.00256	0.00068
9/29/2008	Renauld Brothers	78	0.00265	0.00064
9/29/2008	Vernon Elementary School	79	0.0026	0.00066
9/29/2008	Wilmington State Garage	80	0.00334	0.00083
9/29/2008	Windham County Court	81	0.00206	0.00059
10/23/2008	Brattleboro State Police	73	0.00219	0.00084
10/23/2008	D & E Tree	74	0.000731	0.0006
10/23/2008	Dummerston State Garage	75	0.00276	0.00092
10/23/2008	Guilford Town Garage	76	0.00214	0.00088
10/23/2008	Power Line River Crossing	77	0.00193	0.00083
10/23/2008	Renauld Brothers	78	0.00186	0.00076
10/23/2008	Vernon Elementary School	79	0.0027	0.0009
10/23/2008	Wilmington State Garage	80	0.00239	0.00091
10/23/2008	Windham County Court	81	0.00222	0.00082
12/1/2008	Brattleboro State Police	73	0.00236	0.00063
12/1/2008	D & E Tree	74	0.000793	0.000418
12/1/2008	Dummerston State Garage	75	0.00313	0.00071
12/1/2008	Guilford Town Garage	76	0.00346	0.0008
12/1/2008	Power Line River Crossing	77	0.00275	0.0007
12/1/2008	Renauld Brothers	78	0.0017	0.00055
12/1/2008	Vernon Elementary School	79	0.0027	0.00066
12/1/2008	Wilmington State Garage	80	0.00323	0.00077
12/1/2008	Windham County Court	81	0.00239	0.00062
12/23/2008	Brattleboro State Police	73	0.00315	0.00101
12/23/2008	D & E Tree	74	0.000748	0.000661
12/23/2008	Dummerston State Garage	75	0.00279	0.00095
12/23/2008	Guilford Town Garage	76	0.00393	0.0012
12/23/2008	Power Line River Crossing	77	0.00385	0.0011
12/23/2008	Renauld Brothers	78	0.00253	0.00094
12/23/2008	Vernon Elementary School	79	0.00257	0.00092
12/23/2008	Wilmington State Garage	80	0.00305	0.00099
12/23/2008	Windham County Court	81	0.0023	0.00086

Figure 1, 2008 Mean Alpha Radioactivity in Air Around VYNPS

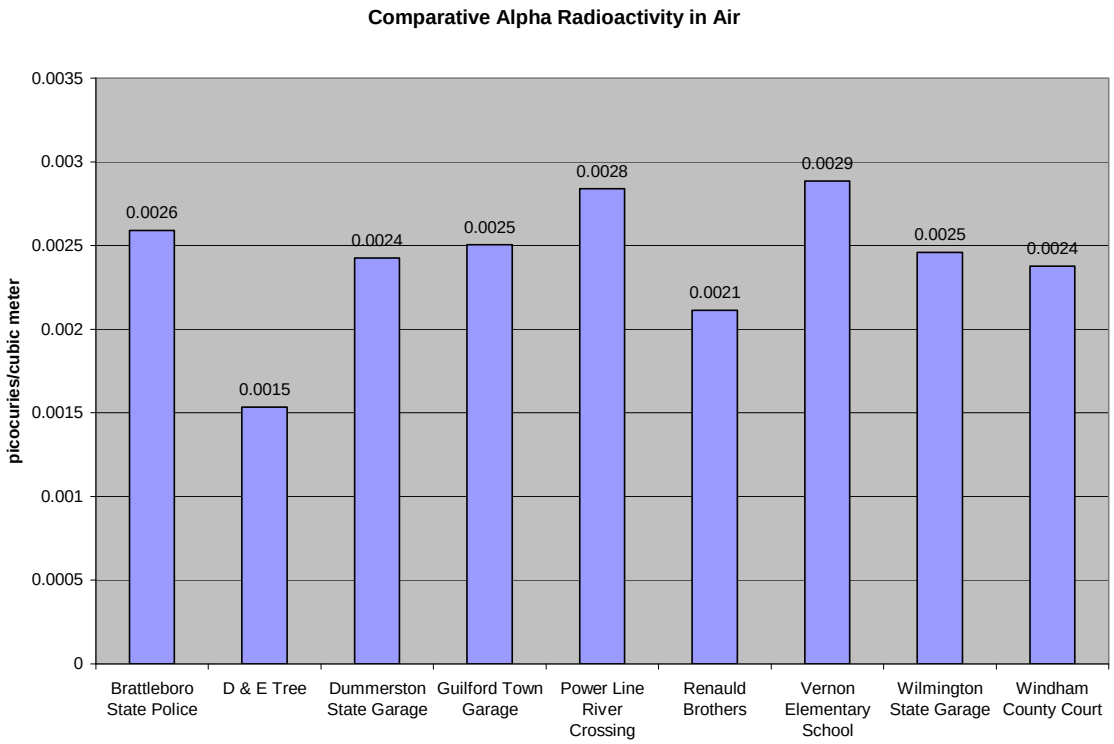


Table 8. 2008 Air Sample Beta Radioactivity Results

Sample Date	Sample Location	Map ID No.	Results pCi/m^3	Error pCi/m^3
1/31/2008	Brattleboro State Police	73	0.0155	0.0012
1/31/2008	D & E Tree	74	0.0137	0.0011
1/31/2008	Dummerston State Garage	75	0.0151	0.0012
1/31/2008	Guilford Town Garage	76	0.0159	0.0013
1/31/2008	Power Line River Crossing	77	0.016	0.0012
1/31/2008	Renauld Brothers	78	0.0193	0.0013
1/31/2008	Vernon Elementary School	79	0.0166	0.0012
1/31/2008	Wilmington State Garage	80	0.0141	0.0011
1/31/2008	Windham County Court	81	0.0254	0.0019
2/25/2008	Brattleboro State Police	73	0.0149	0.0015
2/25/2008	D & E Tree	74	0.015	0.0015
2/25/2008	Dummerston State Garage	75	0.0127	0.0014
2/25/2008	Guilford Town Garage	76	0.015	0.0017
2/25/2008	Power Line River Crossing	77	0.0153	0.0015
2/25/2008	Renauld Brothers	78	0.0165	0.0016
2/25/2008	Vernon Elementary School	79	0.0184	0.0016
2/25/2008	Wilmington State Garage	80	0.0127	0.0013
2/25/2008	Windham County Court	81	0.00863	0.00087
3/27/2008	Brattleboro State Police	73	0.0121	0.0013
3/27/2008	D & E Tree	74	0.0124	0.0013
3/27/2008	Dummerston State Garage	75	0.0104	0.0012
3/27/2008	Guilford Town Garage	76	0.0138	0.0014
3/27/2008	Power Line River Crossing	77	0.0127	0.0013
3/27/2008	Renauld Brothers	78	0.0135	0.0013
3/27/2008	Vernon Elementary School	79	0.0141	0.0013
3/27/2008	Wilmington State Garage	80	0.0106	0.0011
3/27/2008	Windham County Court	81	0.0123	0.0012
4/29/2008	Brattleboro State Police	73	0.0141	0.0013
4/29/2008	D & E Tree	74	0.0119	0.0013
4/29/2008	Dummerston State Garage	75	0.0128	0.0013
4/29/2008	Guilford Town Garage	76	0.0121	0.0012
4/29/2008	Power Line River Crossing	77	0.0148	0.0016
4/29/2008	Renauld Brothers	78	0.0141	0.0013
4/29/2008	Vernon Elementary School	79	0.013	0.0013
4/29/2008	Wilmington State Garage	80	0.011	0.0011
4/29/2008	Windham County Court	81	0.0112	0.0012

Table 8. 2008 Air Sample Beta Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/m^3	Error pCi/m^3
6/4/2008	Brattleboro State Police	73	0.00606	0.0009
5/29/2008	D & E Tree	74	0.00203	0.00074
5/29/2008	Dummerston State Garage	75	0.00826	0.00113
5/29/2008	Guilford Town Garage	76	0.00573	0.00104
5/29/2008	Power Line River Crossing	77	0.00121	0.00082
5/29/2008	Renauld Brothers	78	0.00118	0.00063
5/29/2008	Vernon Elementary School	79	0.00936	0.00116
6/4/2008	Wilmington State Garage	80	0.00643	0.00085
5/29/2008	Windham County Court	81	0.00996	0.00117
6/30/2008	Brattleboro State Police	73	0.00267	0.00092
6/30/2008	D & E Tree	74	0.00782	0.00111
6/30/2008	Dummerston State Garage	75	0.00634	0.00106
6/30/2008	Guilford Town Garage	76	0.00252	0.0008
6/30/2008	Power Line River Crossing	77	0.0271	0.0039
6/30/2008	Renauld Brothers	78	0.0074	0.001
6/30/2008	Vernon Elementary School	79	0.0108	0.0012
6/30/2008	Wilmington State Garage	80	0.00135	0.00068
6/30/2008	Windham County Court	81	0.00859	0.00109
7/28/2008	Brattleboro State Police	73	0.00268	0.0015
7/28/2008	D & E Tree	74	0.00974	0.0013
7/28/2008	Dummerston State Garage	75	0.0106	0.0013
7/28/2008	Guilford Town Garage	76	0.0018	0.00079
7/28/2008	Power Line River Crossing	77	0.0154	0.0016
7/28/2008	Renauld Brothers	78	0.00227	0.0007
7/28/2008	Vernon Elementary School	79	0.0157	0.0015
7/28/2008	Wilmington State Garage	80	0.00491	0.00265
7/28/2008	Windham County Court	81	0.0128	0.0014
8/21/2008	Brattleboro State Police	73	0.0101	0.0014
8/21/2008	D & E Tree	74	0.00183	0.00094
8/21/2008	Dummerston State Garage	75	0.00755	0.00134
8/21/2008	Guilford Town Garage	76	0.0117	0.0016
8/21/2008	Power Line River Crossing	77	0.011	0.0015
8/21/2008	Renauld Brothers	78	0.00907	0.00131
8/21/2008	Vernon Elementary School	79	0.0114	0.0015
8/21/2008	Wilmington State Garage	80	0.0116	0.0017
8/21/2008	Windham County Court	81	0.00968	0.00139

Table 8. 2008 Air Sample Beta Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/m^3	Error pCi/m^3
9/29/2008	Brattleboro State Police	73	0.0112	0.0011
9/29/2008	D & E Tree	74	0.00766	0.001
9/29/2008	Dummerston State Garage	75	N/A	N/A
9/29/2008	Guilford Town Garage	76	0.0129	0.0012
9/29/2008	Power Line River Crossing	77	0.0126	0.0012
9/29/2008	Renauld Brothers	78	0.0112	0.0011
9/29/2008	Vernon Elementary School	79	0.0118	0.0011
9/29/2008	Wilmington State Garage	80	0.0136	0.0014
9/29/2008	Windham County Court	81	0.011	0.0011
10/23/2008	Brattleboro State Police	73	0.0128	0.0015
10/23/2008	D & E Tree	74	0.00179	0.00092
10/23/2008	Dummerston State Garage	75	0.0096	0.00139
10/23/2008	Guilford Town Garage	76	0.0134	0.0017
10/23/2008	Power Line River Crossing	77	0.0128	0.0016
10/23/2008	Renauld Brothers	78	0.0113	0.0014
10/23/2008	Vernon Elementary School	79	0.0119	0.0015
10/23/2008	Wilmington State Garage	80	0.0123	0.0016
10/23/2008	Windham County Court	81	0.0124	0.0015
12/1/2008	Brattleboro State Police	73	0.012	0.0011
12/1/2008	D & E Tree	74	0.0028	0.00067
12/1/2008	Dummerston State Garage	75	0.0116	0.0011
12/1/2008	Guilford Town Garage	76	0.0124	0.0012
12/1/2008	Power Line River Crossing	77	0.0135	0.0012
12/1/2008	Renauld Brothers	78	0.00905	0.001
12/1/2008	Vernon Elementary School	79	0.0123	0.0011
12/1/2008	Wilmington State Garage	80	0.0107	0.0011
12/1/2008	Windham County Court	81	0.0119	0.0011
12/23/2008	Brattleboro State Police	73	0.0153	0.0016
12/23/2008	D & E Tree	74	0.00324	0.00096
12/23/2008	Dummerston State Garage	75	0.0138	0.0015
12/23/2008	Guilford Town Garage	76	0.0185	0.0019
12/23/2008	Power Line River Crossing	77	0.015	0.0016
12/23/2008	Renauld Brothers	78	0.0193	0.0016
12/23/2008	Vernon Elementary School	79	0.0159	0.0016
12/23/2008	Wilmington State Garage	80	0.0154	0.0016
12/23/2008	Windham County Court	81	0.0138	0.0015

Figure 2, 2008 Mean Beta Radioactivity in Air Around VYNPS

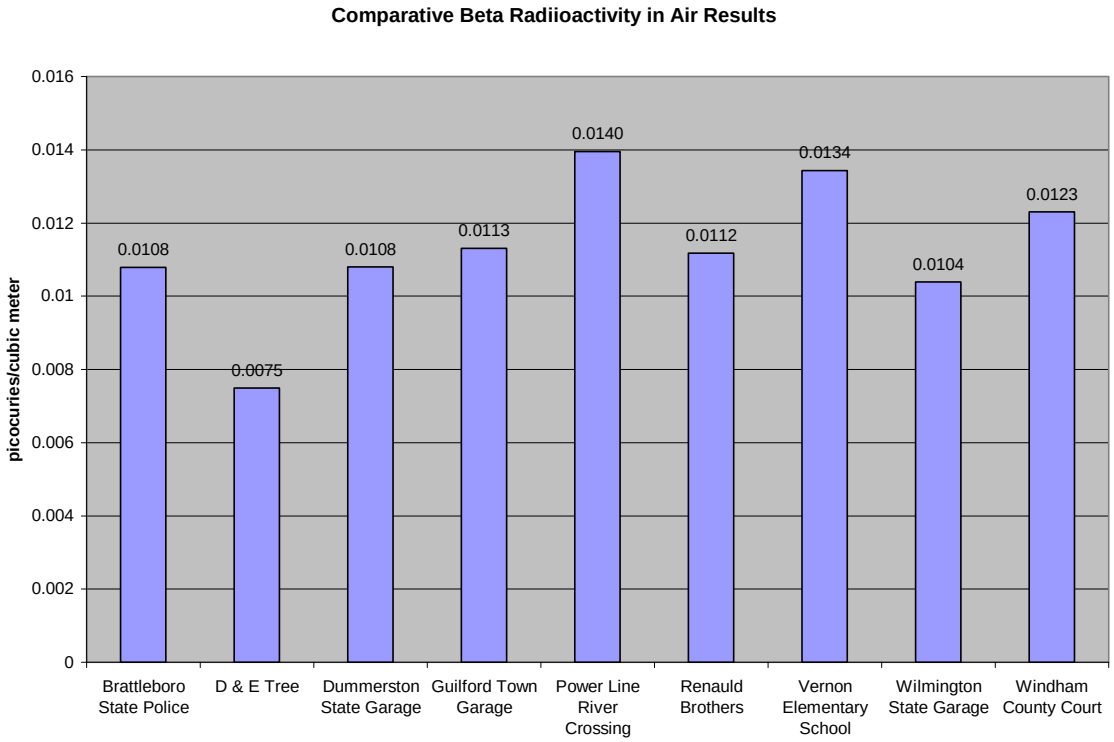


Table 9. 2008 Air Sample Radioactive Iodine-131 Results

Sample Date	Sample Location	Map ID No.	Results pCi/m^3
1/31/2008	Brattleboro State Police	73	< LOD
1/31/2008	D & E Tree	74	< LOD
1/31/2008	Dummerston State Garage	75	< LOD
1/31/2008	Guilford Town Garage	76	< LOD
1/31/2008	Power Line River Crossing	77	< LOD
1/31/2008	Renauld Brothers	78	< LOD
1/31/2008	Vernon Elementary School	79	< LOD
1/31/2008	Wilmington State Garage	80	< LOD
1/31/2008	Windham County Court	81	< LOD
2/25/2008	Brattleboro State Police	73	< LOD
2/25/2008	D & E Tree	74	< LOD
2/25/2008	Dummerston State Garage	75	< LOD
2/25/2008	Guilford Town Garage	76	< LOD
2/25/2008	Power Line River Crossing	77	< LOD
2/25/2008	Renauld Brothers	78	< LOD
2/25/2008	Vernon Elementary School	79	< LOD
2/25/2008	Wilmington State Garage	80	< LOD
2/25/2008	Windham County Court	81	< LOD
3/27/2008	Brattleboro State Police	73	< LOD
3/27/2008	D & E Tree	74	< LOD
3/27/2008	Dummerston State Garage	75	< LOD
3/27/2008	Guilford Town Garage	76	< LOD
3/27/2008	Power Line River Crossing	77	< LOD
3/27/2008	Renauld Brothers	78	< LOD
3/27/2008	Vernon Elementary School	79	< LOD
3/27/2008	Wilmington State Garage	80	< LOD
3/27/2008	Windham County Court	81	< LOD
4/29/2008	Brattleboro State Police	73	< LOD
4/29/2008	D & E Tree	74	< LOD
4/29/2008	Dummerston State Garage	75	< LOD
4/29/2008	Guilford Town Garage	76	< LOD
4/29/2008	Power Line River Crossing	77	< LOD
4/29/2008	Renauld Brothers	78	< LOD
4/29/2008	Vernon Elementary School	79	< LOD
4/29/2008	Wilmington State Garage	80	< LOD
4/29/2008	Windham County Court	81	< LOD

LOD = Limit of Detection

Table 9. 2008 Air Sample Radioactive Iodine-131 Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/m^3
6/4/2008	Brattleboro State Police	73	< LOD
5/29/2008	D & E Tree	74	< LOD
5/29/2008	Dummerston State Garage	75	< LOD
5/29/2008	Guilford Town Garage	76	< LOD
5/29/2008	Power Line River Crossing	77	< LOD
5/29/2008	Renauld Brothers	78	< LOD
5/29/2008	Vernon Elementary School	79	< LOD
6/4/2008	Wilmington State Garage	80	< LOD
5/29/2008	Windham County Court	81	< LOD
6/30/2008	Brattleboro State Police	73	< LOD
6/30/2008	D & E Tree	74	< LOD
6/30/2008	Dummerston State Garage	75	< LOD
6/30/2008	Guilford Town Garage	76	< LOD
6/30/2008	Power Line River Crossing	77	< LOD
6/30/2008	Renauld Brothers	78	< LOD
6/30/2008	Vernon Elementary School	79	< LOD
6/30/2008	Wilmington State Garage	80	< LOD
6/30/2008	Windham County Court	81	< LOD
7/28/2008	Brattleboro State Police	73	< LOD
7/28/2008	D & E Tree	74	< LOD
7/28/2008	Dummerston State Garage	75	< LOD
7/28/2008	Guilford Town Garage	76	< LOD
7/28/2008	Power Line River Crossing	77	< LOD
7/28/2008	Renauld Brothers	78	< LOD
7/28/2008	Vernon Elementary School	79	< LOD
7/28/2008	Wilmington State Garage	80	< LOD
7/28/2008	Windham County Court	81	< LOD
8/21/2008	Brattleboro State Police	73	< LOD
8/21/2008	D & E Tree	74	< LOD
8/21/2008	Dummerston State Garage	75	< LOD
8/21/2008	Guilford Town Garage	76	< LOD
8/21/2008	Power Line River Crossing	77	< LOD
8/21/2008	Renauld Brothers	78	< LOD
8/21/2008	Vernon Elementary School	79	< LOD
8/21/2008	Wilmington State Garage	80	< LOD
8/21/2008	Windham County Court	81	< LOD

LOD = Limit of Detection

Table 9. 2008 Air Sample Radioactive Iodine-131 Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/m^3
9/29/2008	Brattleboro State Police	73	< LOD
9/29/2008	D & E Tree	74	< LOD
9/29/2008	Dummerston State Garage	75	< LOD
9/29/2008	Guilford Town Garage	76	< LOD
9/29/2008	Power Line River Crossing	77	< LOD
9/29/2008	Renauld Brothers	78	< LOD
9/29/2008	Vernon Elementary School	79	< LOD
9/29/2008	Wilmington State Garage	80	< LOD
9/29/2008	Windham County Court	81	< LOD
10/23/2008	Brattleboro State Police	73	< LOD
10/23/2008	D & E Tree	74	< LOD
10/23/2008	Dummerston State Garage	75	< LOD
10/23/2008	Guilford Town Garage	76	< LOD
10/23/2008	Power Line River Crossing	77	< LOD
10/23/2008	Renauld Brothers	78	< LOD
10/23/2008	Vernon Elementary School	79	< LOD
10/23/2008	Wilmington State Garage	80	< LOD
10/23/2008	Windham County Court	81	< LOD
12/1/2008	Brattleboro State Police	73	< LOD
12/1/2008	D & E Tree	74	< LOD
12/1/2008	Dummerston State Garage	75	< LOD
12/1/2008	Guilford Town Garage	76	< LOD
12/1/2008	Power Line River Crossing	77	< LOD
12/1/2008	Renauld Brothers	78	< LOD
12/1/2008	Vernon Elementary School	79	< LOD
12/1/2008	Wilmington State Garage	80	< LOD
12/1/2008	Windham County Court	81	< LOD
12/23/2008	Brattleboro State Police	73	< LOD
12/23/2008	D & E Tree	74	< LOD
12/23/2008	Dummerston State Garage	75	< LOD
12/23/2008	Guilford Town Garage	76	< LOD
12/23/2008	Power Line River Crossing	77	< LOD
12/23/2008	Renauld Brothers	78	< LOD
12/23/2008	Vernon Elementary School	79	< LOD
12/23/2008	Wilmington State Garage	80	< LOD
12/23/2008	Windham County Court	81	< LOD

LOD = Limit of Detection

Table 10. 2008 Air Sample Gamma Radioactivity Results

Sample Date	Sample Location	Map ID No.	Results pCi/m^3
1/31/2008	Brattleboro State Police	73	Natural
1/31/2008	D & E Tree	74	Natural
1/31/2008	Dummerston State Garage	75	Natural
1/31/2008	Guilford Town Garage	76	Natural
1/31/2008	Power Line River Crossing	77	Natural
1/31/2008	Renauld Brothers	78	Natural
1/31/2008	Vernon Elementary School	79	Natural
1/31/2008	Wilmington State Garage	80	Natural
1/31/2008	Windham County Court	81	Natural
2/25/2008	Brattleboro State Police	73	Natural
2/25/2008	D & E Tree	74	Natural
2/25/2008	Dummerston State Garage	75	Natural
2/25/2008	Guilford Town Garage	76	Natural
2/25/2008	Power Line River Crossing	77	Natural
2/25/2008	Renauld Brothers	78	Natural
2/25/2008	Vernon Elementary School	79	Natural
2/25/2008	Wilmington State Garage	80	Natural
2/25/2008	Windham County Court	81	Natural
3/27/2008	Brattleboro State Police	73	Natural
3/27/2008	D & E Tree	74	Natural
3/27/2008	Dummerston State Garage	75	Natural
3/27/2008	Guilford Town Garage	76	Natural
3/27/2008	Power Line River Crossing	77	Natural
3/27/2008	Renauld Brothers	78	Natural
3/27/2008	Vernon Elementary School	79	Natural
3/27/2008	Wilmington State Garage	80	Natural
3/27/2008	Windham County Court	81	Natural
4/29/2008	Brattleboro State Police	73	Natural
4/29/2008	D & E Tree	74	Natural
4/29/2008	Dummerston State Garage	75	Natural
4/29/2008	Guilford Town Garage	76	Natural
4/29/2008	Power Line River Crossing	77	Natural
4/29/2008	Renauld Brothers	78	Natural
4/29/2008	Vernon Elementary School	79	Natural
4/29/2008	Wilmington State Garage	80	Natural
4/29/2008	Windham County Court	81	Natural

Table 10. 2008 Air Sample Gamma Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/m^3
6/4/2008	Brattleboro State Police	73	Natural
5/29/2008	D & E Tree	74	Natural
5/29/2008	Dummerston State Garage	75	Natural
5/29/2008	Guilford Town Garage	76	Natural
5/29/2008	Power Line River Crossing	77	Natural
5/29/2008	Renauld Brothers	78	Natural
5/29/2008	Vernon Elementary School	79	Natural
6/4/2008	Wilmington State Garage	80	Natural
5/29/2008	Windham County Court	81	Natural
6/30/2008	Brattleboro State Police	73	Natural
6/30/2008	D & E Tree	74	Natural
6/30/2008	Dummerston State Garage	75	Natural
6/30/2008	Guilford Town Garage	76	Natural
6/30/2008	Power Line River Crossing	77	Natural
6/30/2008	Renauld Brothers	78	Natural
6/30/2008	Vernon Elementary School	79	Natural
6/30/2008	Wilmington State Garage	80	Natural
6/30/2008	Windham County Court	81	Natural
7/28/2008	Brattleboro State Police	73	Natural
7/28/2008	D & E Tree	74	Natural
7/28/2008	Dummerston State Garage	75	Natural
7/28/2008	Guilford Town Garage	76	Natural
7/28/2008	Power Line River Crossing	77	Natural
7/28/2008	Renauld Brothers	78	Natural
7/28/2008	Vernon Elementary School	79	Natural
7/28/2008	Wilmington State Garage	80	Natural
7/28/2008	Windham County Court	81	Natural
8/21/2008	Brattleboro State Police	73	Natural
8/21/2008	D & E Tree	74	Natural
8/21/2008	Dummerston State Garage	75	Natural
8/21/2008	Guilford Town Garage	76	Natural
8/21/2008	Power Line River Crossing	77	Natural
8/21/2008	Renauld Brothers	78	Natural
8/21/2008	Vernon Elementary School	79	Natural
8/21/2008	Wilmington State Garage	80	Natural
8/21/2008	Windham County Court	81	Natural

Table 10. 2008 Air Sample Gamma Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/m^3
9/29/2008	Brattleboro State Police	73	Natural
9/29/2008	D & E Tree	74	Natural
9/29/2009	Dummerston State Garage	75	Natural
9/29/2008	Guilford Town Garage	76	Natural
9/29/2008	Power Line River Crossing	77	Natural
9/29/2008	Renauld Brothers	78	Natural
9/29/2008	Vernon Elementary School	79	Natural
9/29/2008	Wilmington State Garage	80	Natural
9/29/2008	Windham County Court	81	Natural
10/23/2008	Brattleboro State Police	73	Natural
10/23/2008	D & E Tree	74	Natural
10/23/2008	Dummerston State Garage	75	Natural
10/23/2008	Guilford Town Garage	76	Natural
10/23/2008	Power Line River Crossing	77	Natural
10/23/2008	Renauld Brothers	78	Natural
10/23/2008	Vernon Elementary School	79	Natural
10/23/2008	Wilmington State Garage	80	Natural
10/23/2008	Windham County Court	81	Natural
12/1/2008	Brattleboro State Police	73	Natural
12/1/2008	D & E Tree	74	Natural
12/1/2008	Dummerston State Garage	75	Natural
12/1/2008	Guilford Town Garage	76	Natural
12/1/2008	Power Line River Crossing	77	Natural
12/1/2008	Renauld Brothers	78	Natural
12/1/2008	Vernon Elementary School	79	Natural
12/1/2008	Wilmington State Garage	80	Natural
12/1/2008	Windham County Court	81	Natural
12/23/2008	Brattleboro State Police	73	Natural
12/23/2008	D & E Tree	74	Natural
12/23/2008	Dummerston State Garage	75	Natural
12/23/2008	Guilford Town Garage	76	Natural
12/23/2008	Power Line River Crossing	77	Natural
12/23/2008	Renauld Brothers	78	Natural
12/23/2008	Vernon Elementary School	79	Natural
12/23/2008	Wilmington State Garage	80	Natural
12/23/2008	Windham County Court	81	Natural

Table 11. 2008 Air Sample Quarterly Composite Results

Sample Date	Sample Location	Results pCi	Error pCi	Sample Comment
4/15/2008	All 9 Vermont Yankee Filters for Quarter 1	5730	460	Be-7
7/18/2008	All 9 Vermont Yankee Filters for Quarter 2	6140	540	Be-7
11/13/2008	All 9 Vermont Yankee Filters for Quarter 3	6490	510	Be-7
1/13/2009	All 9 Vermont Yankee Filters for Quarter 4	5830	290	Be-7

Table 12. Common Natural Gamma Radiation Emitters

Actinium-228		Beryllium-7
Bismuth-212	Bismuth-214	Lead-210
Lead-212	Lead-214	Polonium-210
Potassium-40	Protactinium-234m	Radium-224
Radium-226	Radium-228	Radon-222
Technetium-99	Thallium-208	Thorium-228
Thorium-229	Thorium-230	Thorium-231
Thorium-232	Thorium-234	Uranium-233
Uranium-234	Uranium-235	Uranium-238

Table 13. Nuclear Facility Gamma Radiation Emitters

Antimony-124	Antimony-126	
Barium-140/Lanthanum-140	Cerium-139	Cerium-140
Cerium-144/promethium-144	Cobalt-56	Cobalt-60
Chromium-51	Cesium-134	Cesium-136
Cesium-137	Iodine-131	Iodine-132
Iodine-133	Iodine-135	Krypton-85
Krypton-88	Manganese-54	Plutonium-239
Plutonium-240	Ruthenium-103	Ruthenium-106
Strontium-85	Strontium-89	Strontium-90
Tellurium-132	Xenon-133	Xenon-133m
Xenon-135	Zinc-65	Zirconium-95/Niobium-95

Water Sampling Results

Water is sampled each month at 10 locations. Six are sample locations in the Connecticut River. Of these six Connecticut River locations, two samples are taken monthly in the pool where the plant discharges cooling water, two are taken monthly downstream of the station in the pool just below the Vernon dam, and two are taken from the river upstream of the station in Brattleboro. The remaining four sample locations include one representing the Brattleboro municipal water supply, and one each from groundwater wells that serve the Miller and Blodgett Farms in Vernon and the Vernon Elementary School. Results are in Tables 14 - 17. As with last year, we have included samples from elsewhere in Vermont for comparison purposes.

Each of the water samples undergoes four different analyses. The first three analyses are like those for the air samples: analysis for alpha radioactivity, analysis for beta radioactivity, and analysis for radionuclides by gamma spectroscopy. The fourth analysis is unique to water samples. It is an analysis for tritium, the common name for the radioisotope hydrogen-3. Some of the water samples were also analyzed specifically for uranium and radium. New for this year, we have included gamma and tritium analyses of groundwater samples from Vermont Yankee's onsite wells.

The concerns about alpha, beta and gamma radiation were discussed earlier. Tritium is a source of very weak beta radiation. Tritium is created when water passes through the reactor core. The reactor coolant water at Vermont Yankee, as is the case at all nuclear power stations, becomes tritiated as the hydrogen atoms in water molecules are activated by neutron radiation in the reactor core. Tritiated water may leave the plant site any way non-radioactive water leaves the plant - in the air, in groundwater and through discharges into surface waters like the Connecticut River. Unmonitored tritium releases from nuclear facilities have always been a source of concern. Tritium monitoring by the Vermont Department of Health may help identify releases if they develop.

A map showing the routine water sample locations around the Vermont Yankee site, Map 9, is below. Tables 14, 15, 16 and 17 present the water sample results. The tables list the map identification numbers so the locations can be seen on Map 9. Sample locations 84A and 86 are in the Connecticut River downstream. These are labeled in Tables 14 to 17 as Connecticut River, Station 3-3 and Connecticut River Downstream. Sample locations 84B and 84D are in the basin where Vermont Yankee Nuclear Power Station discharges water from the plant into the Connecticut River. The tables identify them as Connecticut River, Station 3-4 and Discharge Forebay. Samples 84C and 87 are in the Connecticut River upstream of the plant. They are identified as Connecticut River, Station 3-8 and Connecticut River Upstream in Tables 14, 15, 16 and 17.

In addition to showing the individual analysis results over the course of 2008, we have taken the mean results of each of the samples at the 10 water sample locations, and plotted them in graphs. Figures 3 and 4 allow comparisons of the mean alpha and mean beta radioactivity results for the 10 locations. These figures also depict the analytical results for three other sites in Vermont. The Vermont Department of Health is collecting samples and analyzing them throughout Vermont as part of our emergency preparedness program, and including the analytical results in our annual Vermont Yankee environmental surveillance report. We hope these sample measurements will help us better understand the specific results around Vermont Yankee, as well as the general nature of radioactivity in Vermont as a whole. These sites are depicted in Maps 10 and 11.

As with the samples from 2007, the Department of Health analyzed ground water samples from the Miller Farm, Blodgett Farm and Vernon Elementary School for radium and uranium. This was done to help identify the source of some of the elevated alpha and beta radioactivity found in ground water samples over the years. We believed that the elevated alpha and beta radioactivity measurements in ground water samples as compared to Brattleboro municipal water was due to radium, uranium and other natural radioactive materials being filtered from the water at the Brattleboro water treatment facility. We also

believed the ground water samples had higher alpha and beta radioactivity as compared to surface water samples because of contact with naturally occurring radioactive materials. Precursors of radon - uranium, radium and thorium, the radon gas itself and the particulate radon decay products are often found in groundwater but not surface water.

Alpha Radioactivity Analyses

The alpha radioactivity measured in all samples is within the historical range for alpha radioactivity. In particular, alpha radioactivity measurements around Vermont Yankee over the past 37 years of operations and environmental surveillance have ranged from below the limit of detection for alpha radioactivity up to 15 picocuries per liter (pCi). The 2008 results for all samples ranged from -1.64 to 7.28 pCi/l and are shown in Table 14. The mean results, shown in Figure 3, indicate the Blodgett Farm and the Vernon Elementary School have the highest natural alpha emitters in their water.

The mean Connecticut River upstream sample results of 0.113 to 0.18 picocuries per liter (pCi/l) may be useful as a sort of background relative to water samples taken in the Connecticut River near the Vermont Yankee Nuclear Power Station discharge area and downstream in the Connecticut River. The upstream samples are taken near Brattleboro. The samples more likely to be affected by Vermont Yankee Nuclear Power Station operations, near the discharge and downstream of the plant discharge have mean sample results in the range of -0.07 to 0.029 pCi/l and -0.185 to 0.387 pCi/l, respectively. Considering the results with their uncertainty at the 95 percent confidence level, there is no statistical difference between water samples in the discharge basin and downstream of Vermont Yankee Nuclear Power Station as compared to water samples upstream of Vermont Yankee. The Brattleboro municipal water supply mean results of -0.154 pCi/l are also not significantly different from samples obtained from the Connecticut River upstream of the nuclear power station.

While there are elevated measurements of alpha radioactivity at the Blodgett Farm and at the Vernon elementary School, the same results were not found at the Miller Farm. Given

the Miller Farm samples do show elevated beta radioactivity (see below) and traces of uranium and radium, it is thought that the Miller Farm geology consists of more natural beta radiation emitting radioactive materials and less natural alpha emitting radioactive materials as compared to the Blodgett Farm and Vernon Elementary School. This characteristic is not unique to the Miller Farm, as indicated in Figures 3 and 4. These graphs show similarly low alpha radioactivity measurements and elevated beta radioactivity measurements at Allis State Park in Randolph, Vermont and the Vermont State Police barracks in Royalton, Vermont.

Beta Radioactivity Analysis

The beta radioactivity analysis results are found in Table 15. The results were all well within the historical range of less than the calculated limit of detection and 15 picocuries per liter. Specifically, the measurements in Table 15 range from -2.87 to 7.88 picocuries per liter. Taking the mean results for each of the sample sites and plotting them gives us the graph in Figure 4. In this graph, some of the characteristic results observed in the alpha radioactivity analyses are also seen with beta radioactivity. Specifically, the river water samples contain significantly less radioactivity as compared to the groundwater samples. Also like the alpha radioactivity sample results, the samples from the Connecticut River near the Vermont Yankee Nuclear Power Station discharge area and downstream of the plant, ranging from 0.87 to 1.12 pCi/l and from 0.97 to 1.44 pCi/l, respectively, are not significantly different from the samples from the Connecticut River upstream of the station where the sample means ranged between 0.99 and 1.27 pCi/l. Another similarity is seen in the Brattleboro municipal water sample: the mean beta radioactivity measured over the year is not significantly different from other mean beta radioactivity measurements, including in the Connecticut River upstream of Vermont Yankee.

One difference between the alpha and beta radioactivity measurements is what is seen in the groundwater measurements. While the Blodgett Farm and the Vernon Elementary School alpha radioactivity samples were significantly higher than the Miller Farm alpha

radioactivity results, the beta radioactivity measurements for the three sites fed by well water are not significantly different. As mentioned above, the elevated beta radioactivity at Miller Farm is not coincident with elevated alpha radioactivity, and this characteristic is shared with the samples taken from bodies of surface water near Randolph, Vermont and from ground water from Royalton, Vermont. These features are thought to be due to the different geological attributes at each of the sites causing the expression of certain natural radioactive materials and not others.

Analysis of Natural Radioactivity in Water

There is a relatively small number of naturally occurring radioactive materials. They are found in the soil and sediments that cover the Earth and they are always found in minute quantities in the air and waters that flow around, over and through the Earth. A list of some of these naturally occurring radioactive materials is found in Table 12 above. The natural isotopes uranium-235, uranium-238 and thorium-232 are very important because as they undergo radioactive decay to shed the excess energy in their nuclei, these three isotopes generate many other prominent radioactive materials including radium 226, radium 228 and radon-222. Each of these decays to create other radioactive materials. Most of them emit beta and gamma radiation, and most of the heaviest isotopes, those heavier than lead, emit alpha radiation. The Vermont Department of Health Laboratory can analyze water samples for radium-226, radium-228 and total uranium to assess the relative risk to members of the public from these radioisotopes and their precursor and daughter decay products.

In Figures 5, 6 and 7, the mean of radium and uranium measurements for the Miller and Blodgett Farms and for the Vernon Elementary School are presented. While the bars in the charts seem to indicate a lot of natural radioactivity, note that the values in picocuries per liter and milligrams per liter are quite small. To put them into context, the United States Environmental Protection Agency and the State of Vermont have limits on these three radioactive contaminants to help manage risk. Radium-226 and radium-228 radioactivity are limited to 5 picocuries per liter (pCi/l), while total uranium is limited to

20 micrograms per liter (µg/l). None of the sample natural radioactivity measurements from the Blodgett Farm, the Miller Farm or the Vernon Elementary School are near these limits. The mean radium-226 results shown in Figure 5 range from 0.15 to 0.95 pC/l; the mean radium-228 results shown in Figure 6 range from 0.12 to 0.63 pCi/l; and the mean uranium results shown in Figure 7 range from 0.0 to 0.006 mg/l.

Gamma Spectroscopy

Gamma spectroscopy is a technique that allows for the identification and quantification of radioactive material that emits gamma radiation. Most of the water samples, 85 of them, were found to be less than the calculated limit of detection. Gamma radiation-emitting radioactive materials were identified in the remaining 32 samples, but all were naturally occurring radioactive materials. The gamma spectroscopy results for the water samples are found in Table 16. The calculated limits of detection for water samples are listed in Table 19 below. The commonly identified natural radioactive materials that emit gamma radiation may be found listed in Table 12 above.

Tritium Measurement Results

From January through March 2008, no tritium radioactivity above the laboratory instrumentation limit of detection of approximately 500 pCi/l was identified in any of the offsite groundwater, surface water or municipal water samples obtained by the Vermont Department of Health. Starting in April and throughout the rest of the year, the Vermont Department of Health Laboratory reported results numerically (as calculated) and levels are well below this previous limit of detection. The results of these changes are reported in Table 17, showing tritium concentrations less than 500 pCi/l. with their associated error at the 95 percent confidence level.

While 85 of the 90 tritium measurements of offsite water samples made from April through December 2008 were not statistically significant at the 95 percent confidence level, i.e. not indicative of tritium, five samples did indicate the presence of tritium. Two of the five samples were from the same source for two consecutive months and the

remaining three samples were from different sources for a single month each. The tritium levels detected were extremely low. In particular, even the highest positive result of 156 pCi/l would indicate a dose of less than 0.0004 percent of the Vermont limit on doses from all liquid discharges of five millirem per year. Subsequent monthly tests from the source with the highest result in one month were not indicative of tritium.
Also, the presence of tritium in a sample does not mean the tritium is from Vermont Yankee or any other human-made source. Tritium is found in the natural environment due to cosmic radiation interactions with water. This fact is seen where one of the five samples that tested positive for tritium came from Royalton, Vermont far from Vermont Yankee and another positive sample was taken from the Connecticut River upstream of the station. In addition, each of the samples that tested positive for tritium was preceded by a negative sample the month before or a negative sample the month after. It is important to note as well that the groundwater samples from wells actually on the Vermont Yankee Nuclear Power Station site did not test positive for tritium (see below).

This is the first year tritium levels have been detected, due to the instrument improvements at the Public Health Laboratory. There is little to no dose consequence indicated by these samples, nor any evidence that the positive test results are not simply natural tritium. The Department of Health will continue to obtain on-site and off-site samples of water and analyze the results carefully for tritium to determine whether there has been any kind of release from Vermont Yankee Nuclear Power Station. All of the tritium analysis results are presented in Table 17.

On-site Groundwater Well Sample Results

New this year is analysis of seven groundwater wells that are located on the Vermont Yankee Nuclear Power Station site itself. Although groundwater analysis has been conducted for years to ascertain whether drinking water has been contaminated by plant operations, obtaining and analyzing groundwater from wells on-site gets our assessment closer to the source. This is assumed to be an improved posture for assessing impacts on the public and natural environment.

Seven wells within the Vermont Yankee property were sampled by the Vermont Department of Health and the samples were analyzed by the Vermont Department of Health Laboratory. As with the off-site groundwater samples, there was no radioactivity solely attributable to Vermont Yankee operations detected in the samples. The specific results are that the only gamma radiation emitting radionuclides that were detected were of natural origin, and no tritium was detected outside the limits of uncertainty at the 95 percent confidence level. Table 18 lists these results.

Figure 3

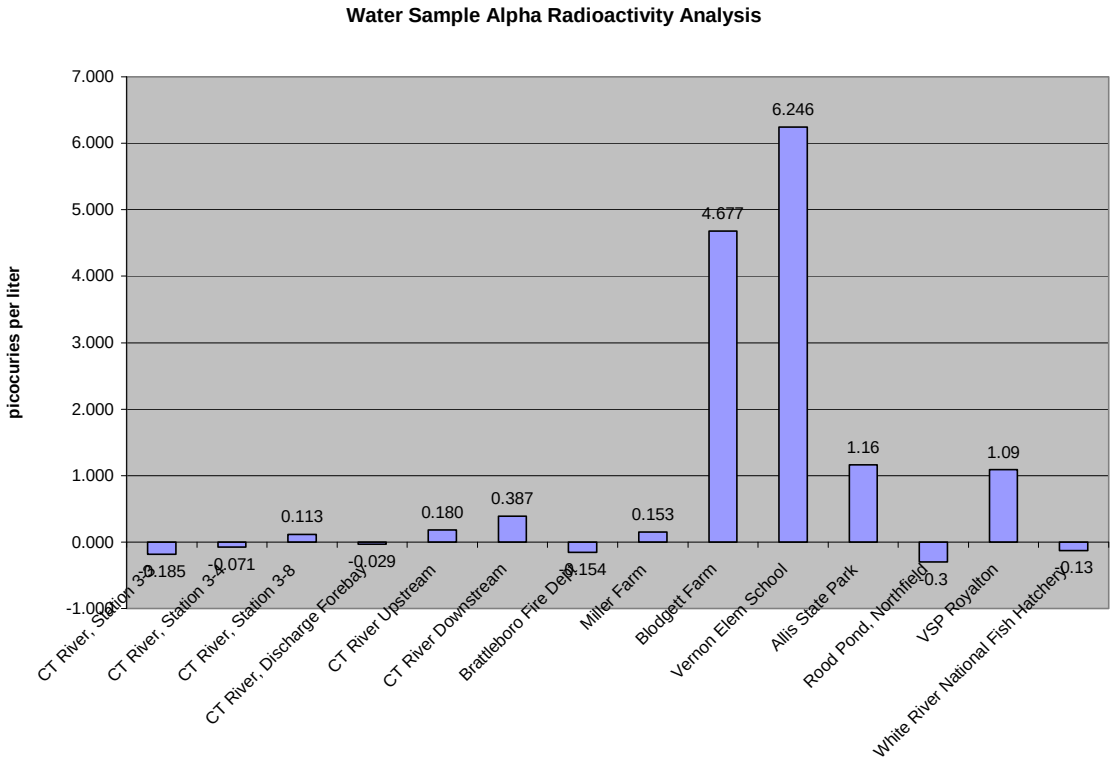

Water Sample Alpha Radioactivity Analysis
picocuries per liter
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
-1.000
-0.185
-0.071
0.113
-0.029
0.180
0.387
-0.154
0.153
4.677
6.246
1.16
-0.3
1.09
-0.13
CT River, Station 3-2
CT River, Station 3-4
CT River, Station 3-8
CT River, Discharge Forebay
CT River Upstream
CT River Downstream
Brattleboro Fire Dept.
Miller Farm
Blodgett Farm
Vernon Elem School
Allis State Park
Rood Pond, Northfield
VSP Royalton
White River National Fish Hatchery

Figure 4

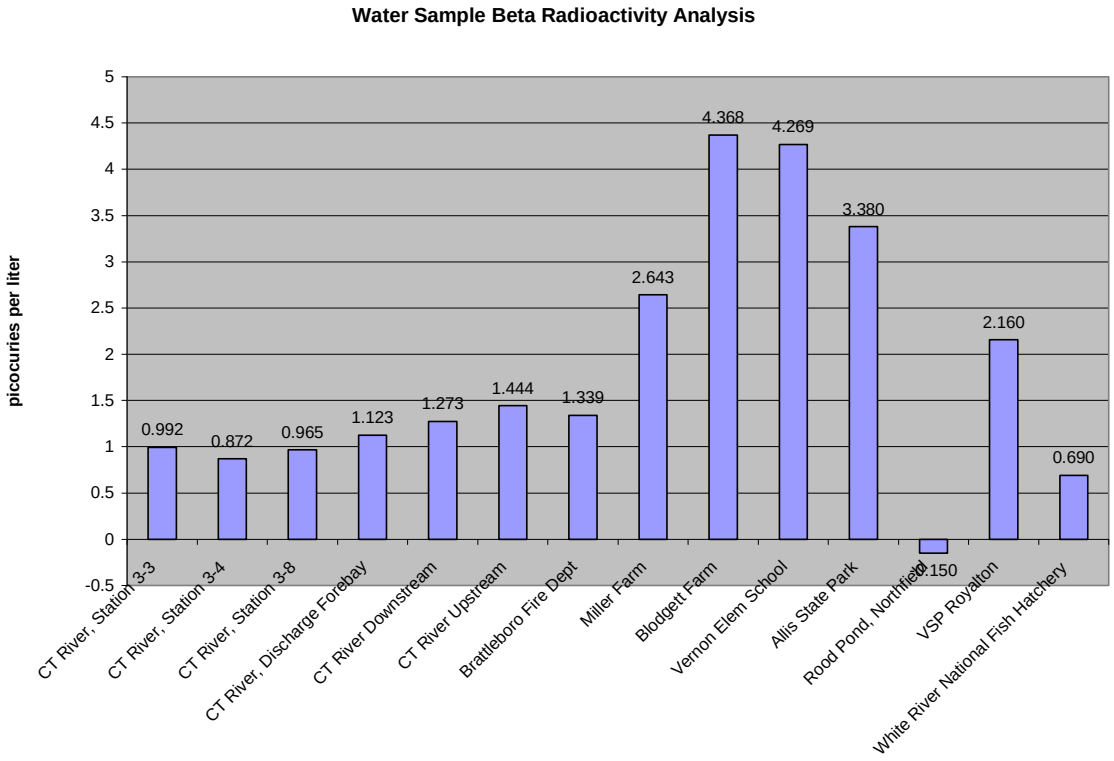

Water Sample Beta Radioactivity Analysis
picocuries per liter
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
0.992
0.872
0.965
1.123
1.273
1.444
1.339
2.643
4.368
4.269
3.380
-0.150
2.160
0.690
CT River, Station 3-3
CT River, Station 3-4
CT River, Station 3-8
CT River, Discharge Forebay
CT River Downstream
CT River Upstream
Brattleboro Fire Dept
Miller Farm
Blodgett Farm
Vernon Elem School
Allis State Park
Rood Pond, Northfield
VSP Royalton
White River National Fish Hatchery

Figure 5

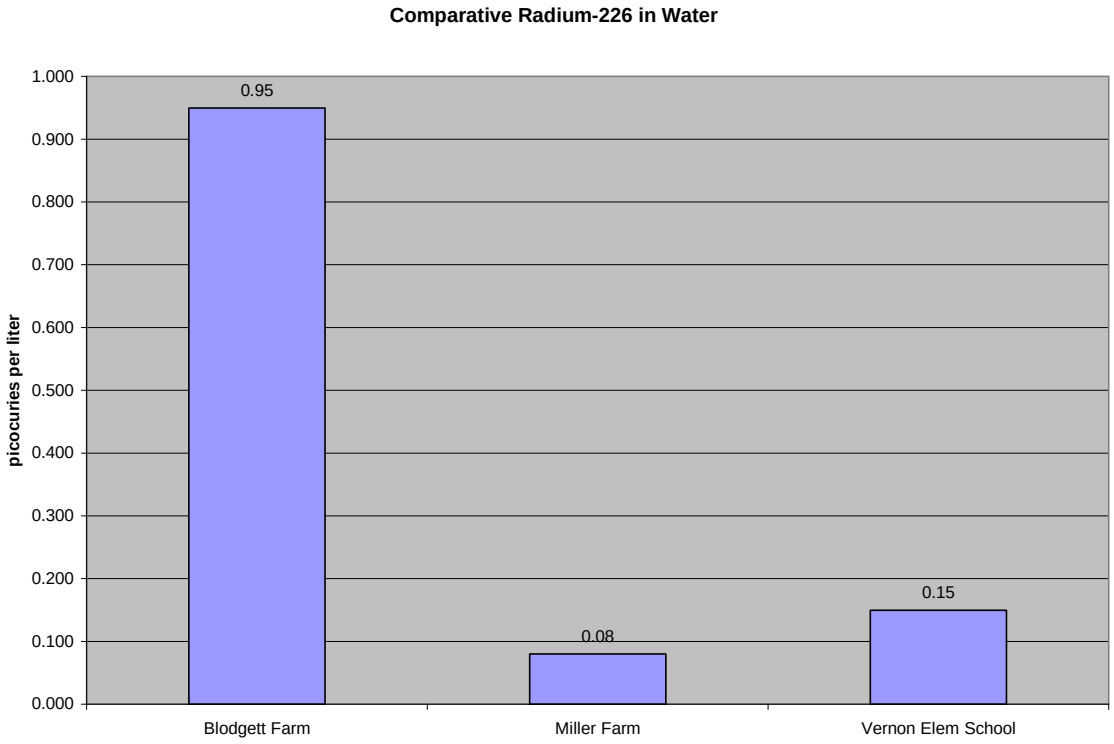

Comparative Radium-226 in Water
picocuries per liter
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.95
0.08
0.15
Blodgett Farm
Miller Farm
Vernon Elem School

Figure 6

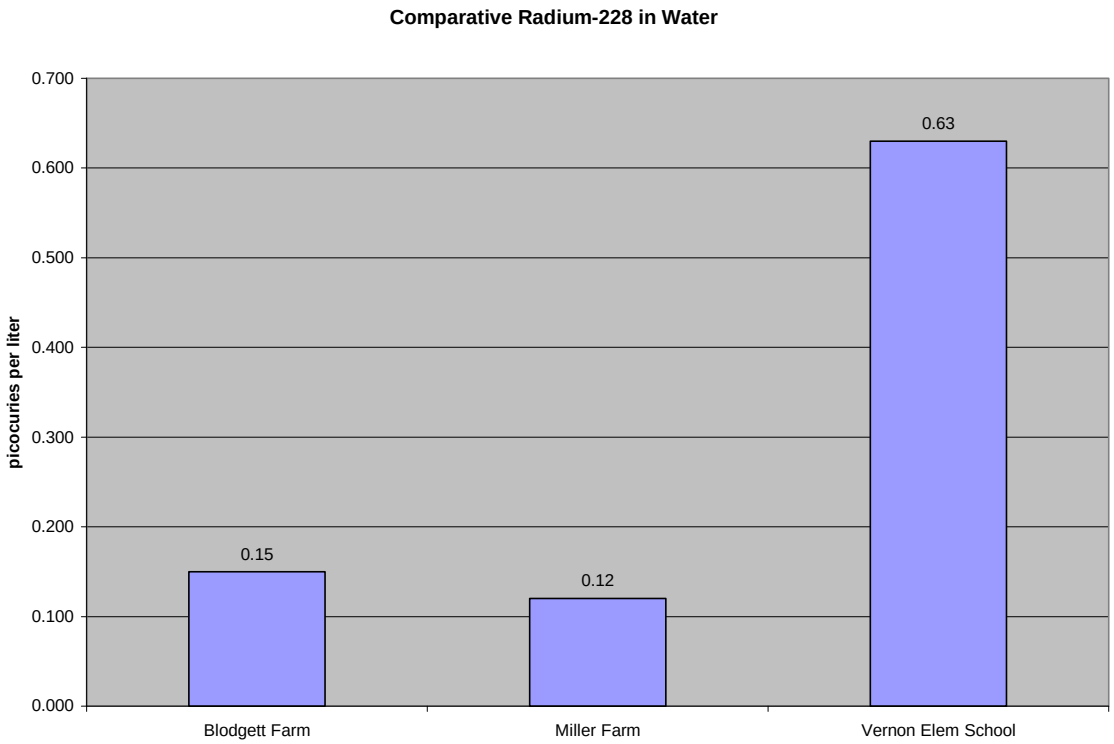
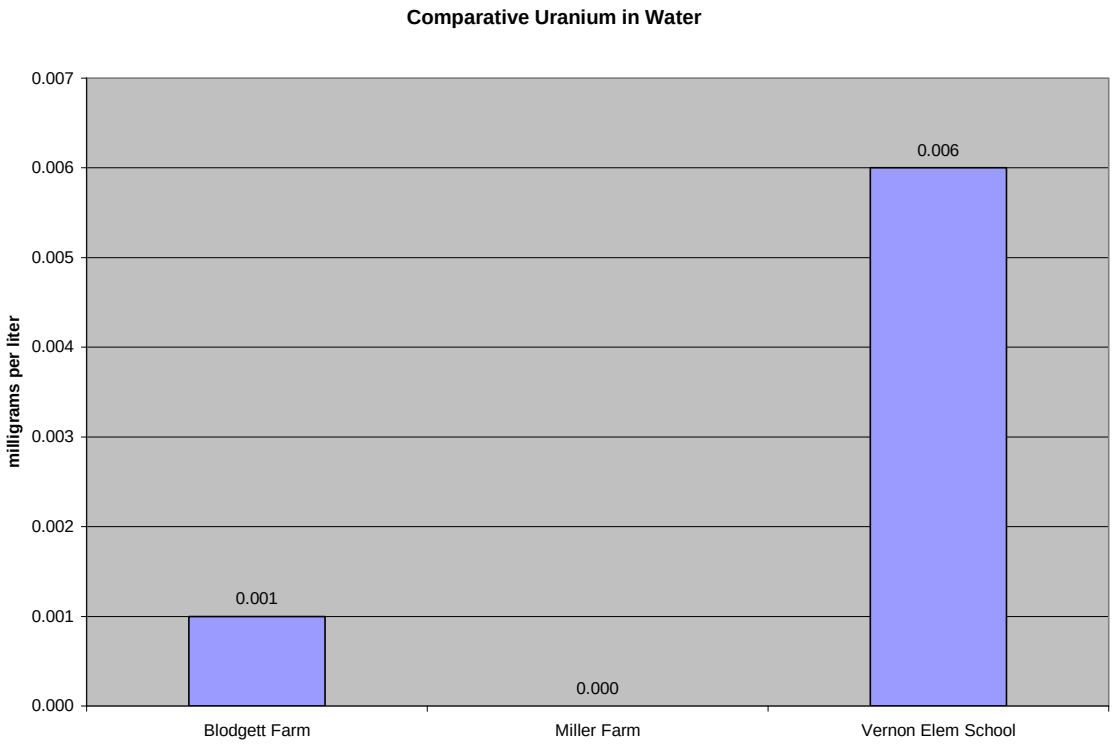
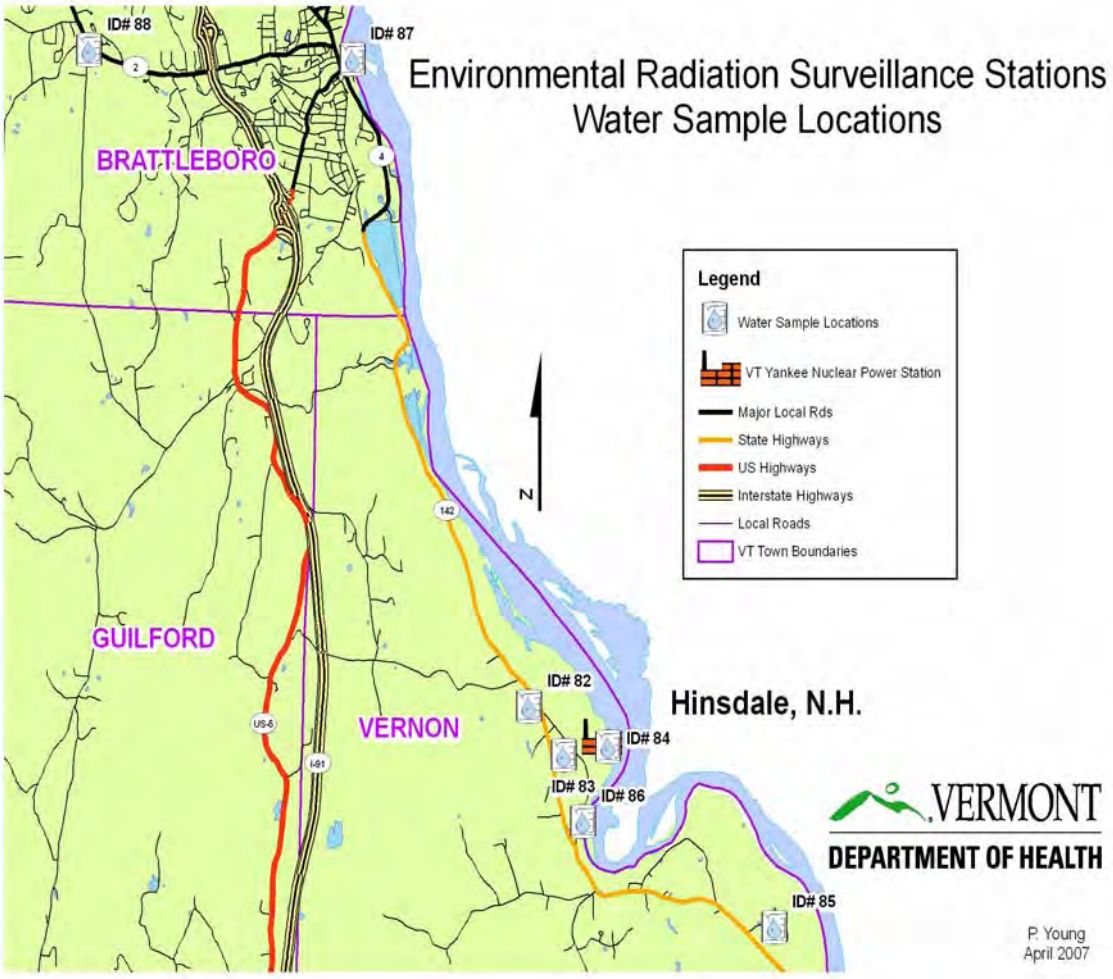

Comparative Radium-228 in Water
picocuries per liter
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.15
0.12
0.63
Blodgett Farm
Miller Farm
Vernon Elem School

Figure 7


Comparative Uranium in Water
milligrams per liter
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.001
0.000
0.006
Blodgett Farm
Miller Farm
Vernon Elem School

Map 9


Environmental Radiation Surveillance Stations
Water Sample Locations
ID# 88
ID# 87
BRATTLEBORO
GUILFORD
VERNON
ID# 82
ID# 84
ID# 83
ID# 86
ID# 85
Hinsdale, N.H.
N
Legend
Water Sample Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
VT Town Boundaries
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Map 10, Special Sampling Locations for 2008, Central Vermont

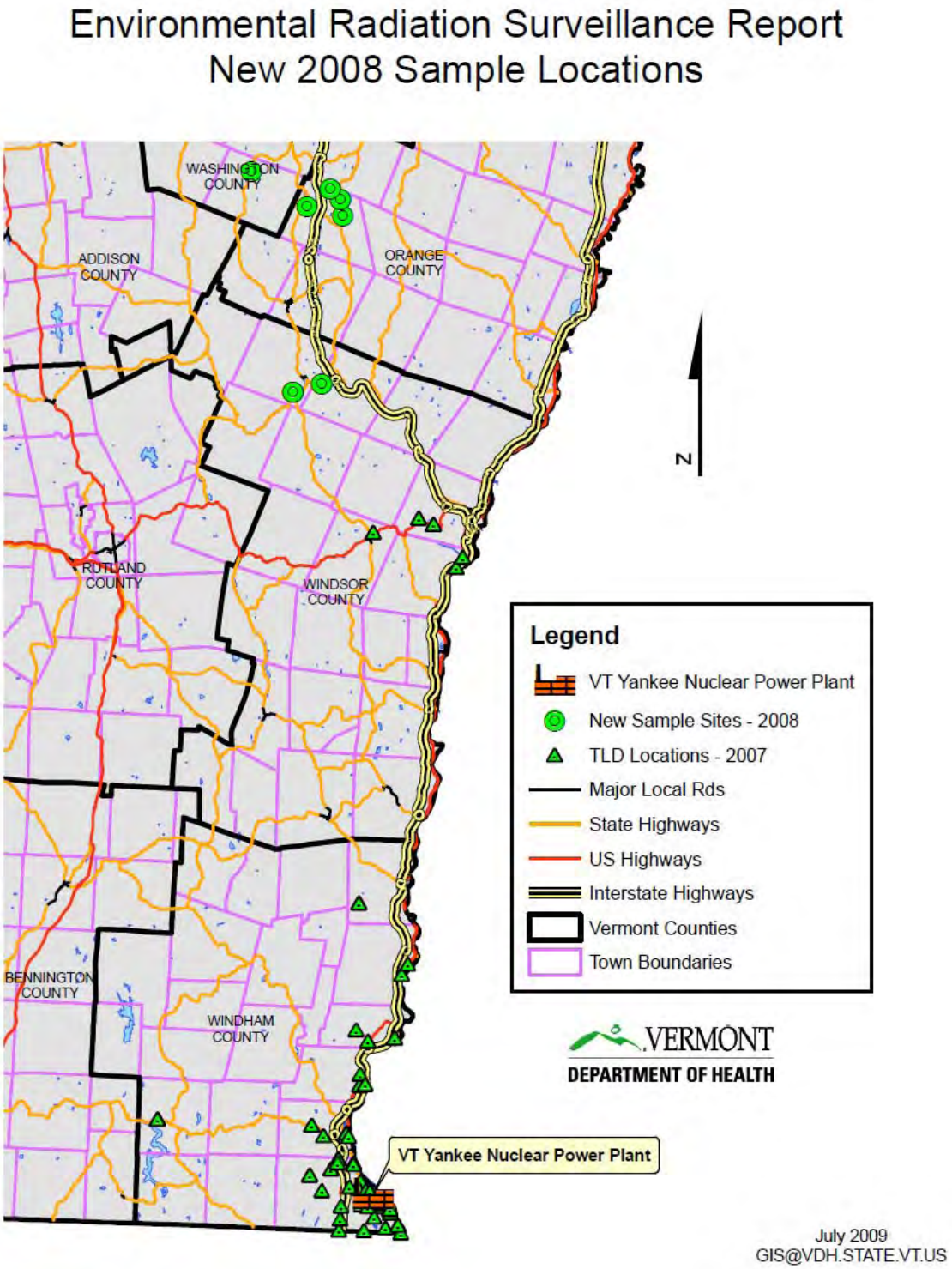


Table 14. 2008 Water Sample Alpha Radioactivity Results

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l	Analysis Method
1/15/2008	3-3	84A	0.29	0.76	EPA 900
1/15/2008	3-4	84B	0.15	0.77	EPA 900
1/15/2008	3-8	84C	0.15	0.76	EPA 900
1/15/2008	Discharge Forebay	84D	-0.29	0.73	EPA 900
1/31/2008	Blodgett Farm	85	3.64	1	EERF 00-02
1/31/2008	Brattleboro Fire Dept	88	-0.15	0.75	EPA 900
1/31/2008	Conn River Downstream	86	1.04	1.41	EPA 900
1/31/2008	Conn River Upstream	87	0.27	1.4	EPA 900
1/31/2008	Miller Farm	82	0.28	0.73	EERF 00-02
1/31/2008	Vernon Elem School	83	7.28	1.23	EERF 00-02
2/14/2008	3-3		-1.08	1.43	EPA 900
2/14/2008	3-4		-0.27	1.48	EPA 900
2/14/2008	3-8		-0.06	0.32	EPA 900
2/14/2008	Discharge Forebay		-1.64	1.41	EPA 900
2/25/2008	Blodgett Farm		5.27	1.1	EERF 00-02
2/25/2008	Brattleboro Fire Dept		-0.61	0.8	EPA 900
2/25/2008	Miller Farm		0.34	0.73	EERF 00-02
3/13/2008	3-3	84A	0.3	0.86	EPA 900
3/13/2008	3-4	84B	-0.6	0.79	EPA 900
3/13/2008	3-8	84C	0.91	0.9	EPA 900
3/13/2008	Discharge Forebay	84D	1.37	0.92	EPA 900
3/27/2008	Blodgett Farm	85	3.43	0.97	EERF 00-02
3/27/2008	Brattleboro Fire Dept	88	1.09	1.41	EPA 900
3/27/2008	Conn River Downstream	86	0.26	1.31	EPA 900
3/27/2008	Conn River Upstream	87	0.27	1.35	EPA 900
3/27/2008	Miller Farm	82	0.48	0.73	EERF 00-02
3/27/2008	Vernon Elem School	83	6.66	1.18	EERF 00-02
4/17/2008	3-3	84A	0.87	1	EPA 900
4/17/2008	3-4	84B	1.85	1.08	EPA 900
4/17/2008	3-8	84C	1.3	1.41	EPA 900
4/17/2008	Discharge Forebay	84D	1.86	1.09	EPA 900
4/29/2008	Blodgett Farm	85	4.96	1.12	EERF 00-02
4/29/2008	Brattleboro Fire Dept	88	0.46	1.01	EPA 900
4/29/2008	Conn River Downstream	86	1.62	0.84	EPA 900
4/29/2008	Conn River Upstream	87	1.26	0.79	EPA 900
4/29/2008	Miller Farm	82	-0.2	0.75	EERF 00-02
4/29/2008	Vernon Elem School	83	4.76	1.11	EERF 00-02
1/15/2008	3-3	84A	0.29	0.76	EPA 900
1/15/2008	3-4	84B	0.15	0.77	EPA 900
1/15/2008	3-8	84C	0.15	0.76	EPA 900

Table 14. 2008 Water Sample Alpha Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l	Analysis Method
5/14/2008	3-3	84A	-1.1	1.35	EPA 900
5/14/2008	3-4	84B	0	1.51	EPA 900
5/14/2008	3-8	84C	-0.54	1.37	EPA 900
5/14/2008	Discharge Forebay	84D	0.28	1.45	EPA 900
5/29/2008	Blodgett Farm	85	3.72	0.96	EERF 00-02
5/29/2008	Conn River Downstream	88	0	1.58	EPA 900
5/29/2008	Conn River Upstream	86	-0.31	1.57	EPA 900
5/29/2008	Miller Farm	87	0.39	0.67	EERF 00-02
5/29/2008	Vernon Elem School	82	6.92	1.17	EERF 00-02
6/4/2008	Brattleboro Fire Dept	83	-0.45	0.75	EPA 900
6/13/2008	3-3	84A	0.83	1.48	EPA 900
6/13/2008	3-4	84B	-1.08	1.32	EPA 900
6/13/2008	3-8	84C	0	1.34	EPA 900
6/13/2008	Discharge Forebay	84D	-0.27	1.36	EPA 900
6/30/2008	Blodgett Farm	85	6.33	1.18	EERF 00-02
6/30/2008	Brattleboro Fire Dept	88	-0.52	1.31	EPA 900
6/30/2008	Conn River Downstream	86	0.26	1.38	EPA 900
6/30/2008	Conn River Upstream	87	0.52	1.38	EPA 900
6/30/2008	Miller Farm	82	0.24	0.74	EERF 00-02
6/30/2008	Vernon Elem School	83	6.12	1.17	EERF 00-02
7/14/2008	3-3	84A	-0.54	1.33	EPA 900
7/14/2008	3-4	84B	0	1.37	EPA 900
7/14/2008	3-8	84C	0	1.37	EPA 900
7/14/2008	Discharge Forebay	84D	-0.54	1.32	EPA 900
7/28/2008	Blodgett Farm	85	4.81	1.1	EERF 00-02
7/28/2008	Brattleboro Fire Dept	88	-0.53	1.3	EPA 900
7/28/2008	Conn River Downstream	86	0.45	0.79	EPA 900
7/28/2008	Conn River Upstream	87	0.46	0.8	EPA 900
7/28/2008	Miller Farm	82	-0.61	0.68	EERF 00-02
7/28/2008	Vernon Elem School	83	5.83	1.16	EERF 00-02
8/14/2008	3-3	84A	-0.51	1.29	EPA 900
8/14/2008	3-4	84B	0.72	0.79	EPA 900
8/14/2008	3-8	84C	-0.14	0.74	EPA 900
8/14/2008	Discharge Forebay	84D	0.57	0.77	EPA 900
8/21/2008	Blodgett Farm	85	5.42	1.11	EERF 00-02
8/21/2008	Brattleboro Fire Dept	88	-0.52	1.31	EPA 900
8/21/2008	Conn River Downstream	86	0.8	1.43	EPA 900
8/21/2008	Conn River Upstream	87	0.27	1.4	EPA 900
8/21/2008	Miller Farm	82	0.07	0.7	EERF 00-02
8/21/2008	Vernon Elem School	83	5.07	1.09	EERF 00-02

Table 14. 2008 Water Sample Alpha Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l	Analysis Method
9/15/2008	3-3	84A	-0.26	1.37	EPA 900
9/15/2008	3-4	84B	-0.27	1.42	EPA 900
9/15/2008	3-8	84C	-0.27	1.42	EPA 900
9/15/2008	Discharge Forebay	84D	-0.55	1.41	EPA 900
9/29/2008	Blodgett Farm	85	5.26	1.13	EERF 00-02
9/29/2008	Brattleboro Fire Dept	88	0	1.41	EPA 900
9/29/2008	Conn River Downstream	86	-0.56	1.45	EPA 900
9/29/2008	Conn River Upstream	87	-0.54	1.4	EPA 900
9/29/2008	Miller Farm	82	0.63	0.8	EERF 00-02
9/29/2008	Vernon Elem School	83	6.94	1.23	EERF 00-02
10/14/2008	3-3	84A	0	1.4	EPA 900
10/14/2008	3-4	84B	0	1.41	EPA 900
10/14/2008	3-8	84C	0.27	1.42	EPA 900
10/14/2008	Discharge Forebay	84D	-0.55	1.37	EPA 900
10/24/2008	Blodgett Farm	85	5.04	1.12	EERF 00-02
10/24/2008	Brattleboro Fire Dept	88	0.15	0.77	EPA 900
10/24/2008	Conn River Downstream	86	0.55	1.45	EPA 900
10/24/2008	Conn River Upstream	87	-0.28	1.43	EPA 900
10/24/2008	Miller Farm	82	0.28	0.77	EERF 00-02
10/24/2008	Vernon Elem School	83	6.35	1.2	EERF 00-02
11/14/2008	3-3	84A	-1.32	1.34	EPA 900
11/14/2008	3-4	84B	-1.35	1.37	EPA 900
11/14/2008	3-8	84C	-0.27	0.72	EPA 900
11/14/2008	Discharge Forebay	84D	-0.8	1.39	EPA 900
12/1/2008	Blodgett Farm	85	3.42	0.99	EERF 00-02
12/1/2008	Brattleboro Fire Dept	88	-0.3	0.81	EPA 900
12/1/2008	Conn River Downstream	86	-0.31	0.81	EPA 900
12/1/2008	Conn River Upstream	87	-0.15	0.8	EPA 900
12/1/2008	Miller Farm	82	0.21	0.73	EERF 00-02
12/1/2008	Vernon Elem School	83	6.84	1.2	EERF 00-02
12/15/2008	3-3	84A	0.3	0.86	EPA 900
12/15/2008	3-4	84B	0	0.88	EPA 900
12/15/2008	3-8	84C	0	0.35	EPA 900
12/15/2008	Discharge Forebay	84D	0	0.83	EPA 900
12/23/2008	Blodgett Farm	85	4.82	1.05	EERF 00-02
12/23/2008	Brattleboro Fire Dept	88	-0.47	0.85	EPA 900
12/23/2008	Conn River Downstream	86	0.15	0.88	EPA 900
12/23/2008	Conn River Upstream	87	0.21	0.62	EPA 900
12/23/2008	Miller Farm	82	-0.28	0.62	EERF 00-02
12/23/2008	Vernon Elem School	83	5.94	1.12	EERF 00-02

Table 15. 2008 Water Sample Beta Radioactivity Results

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l	Analysis Method
1/15/2008	3-3	84A	1.26	0.94	EPA 900
1/15/2008	3-4	84B	0.94	0.93	EPA 900
1/15/2008	3-8	84C	-0.08	0.91	EPA 900
1/15/2008	Discharge Forebay	84D	0.71	0.93	EPA 900
1/31/2008	Blodgett Farm	85	3.01	1.9	EPA 900
1/31/2008	Brattleboro Fire Dept	88	1.57	0.95	EPA 900
1/31/2008	Conn River Downstream	86	1.1	1.84	EPA 900
1/31/2008	Conn River Upstream	87	1.89	1.86	EPA 900
1/31/2008	Miller Farm	82	3.15	1.9	EPA 900
1/31/2008	Vernon Elem School	83	2.84	1.89	EPA 900
2/14/2008	3-3	84A	0.62	2.04	EPA 900
2/14/2008	3-4	84B	3.91	2.12	EPA 900
2/14/2008	3-8	84C	0.69	0.42	EPA 900
2/14/2008	Discharge Forebay	84D	2.66	2.09	EPA 900
2/25/2008	Blodgett Farm	85	5.5	2.17	EPA 900
2/25/2008	Brattleboro Fire Dept	88	2.66	1.08	EPA 900
2/25/2008	Miller Farm	82	3.93	2.14	EPA 900
3/13/2008	3-3	84A	1.1	1.04	EPA 900
3/13/2008	3-4	84B	2.97	1.09	EPA 900
3/13/2008	3-8	84C	2.27	1.07	EPA 900
3/13/2008	Discharge Forebay	84D	3.29	1.1	EPA 900
3/27/2008	Blodgett Farm	85	3.8	1.97	EPA 900
3/27/2008	Brattleboro Fire Dept	88	2.68	1.94	EPA 900
3/27/2008	Conn River Downstream	86	1.42	1.91	EPA 900
3/27/2008	Conn River Upstream	87	0.94	1.9	EPA 900
3/27/2008	Miller Farm	82	0.32	1.89	EPA 900
3/27/2008	Vernon Elem School	83	2.05	1.93	EPA 900
4/17/2008	3-3	84A	2.67	1.06	EPA 900
4/17/2008	3-4	84B	1.49	1.08	EPA 900
4/17/2008	3-8	84C	1.41	1.03	EPA 900
4/17/2008	Discharge Forebay	84D	2.51	1.05	EPA 900
4/29/2008	Blodgett Farm	85	7.88	2.18	EPA 900
4/29/2008	Brattleboro Fire Dept	88	0.71	1.01	EPA 900
4/29/2008	Conn River Downstream	86	2.05	0.71	EPA 900
4/29/2008	Conn River Upstream	87	1.89	0.71	EPA 900
4/29/2008	Miller Farm	82	3.78	2.08	EPA 900
4/29/2008	Vernon Elem School	83	5.35	2.12	EPA 900

Table 15. 2008 Water Sample Beta Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l	Analysis Method
5/14/2008	3-3	84A	1.39	1.84	EPA 900
5/14/2008	3-4	84B	1.08	1.83	EPA 900
5/14/2008	3-8	84C	2.01	1.85	EPA 900
5/14/2008	Discharge Forebay	84D	-0.62	1.79	EPA 900
5/29/2008	Blodgett Farm	85	4.2	1.91	EPA 900
5/29/2008	Conn River Downstream	88	1.09	1.83	EPA 900
5/29/2008	Conn River Upstream	86	1.55	1.85	EPA 900
5/29/2008	Miller Farm	87	3.1	1.88	EPA 900
5/29/2008	Vernon Elem School	82	4.34	1.91	EPA 900
6/4/2008	Brattleboro Fire Dept	83	0.7	0.92	EPA 900
6/13/2008	3-3	84A	1.53	1.92	EPA 900
6/13/2008	3-4	84B	0.46	1.89	EPA 900
6/13/2008	3-8	84C	0.46	1.89	EPA 900
6/13/2008	Discharge Forebay	84D	1.53	1.92	EPA 900
6/30/2008	Blodgett Farm	85	5.08	2.02	EPA 900
6/30/2008	Brattleboro Fire Dept	88	2.3	1.31	EPA 900
6/30/2008	Conn River Downstream	86	2.15	1.94	EPA 900
6/30/2008	Conn River Upstream	87	2.45	1.95	EPA 900
6/30/2008	Miller Farm	82	3.22	1.97	EPA 900
6/30/2008	Vernon Elem School	83	4.92	2.02	EPA 900
7/14/2008	3-3	84A	0	1.81	EPA 900
7/14/2008	3-4	84B	-0.31	1.81	EPA 900
7/14/2008	3-8	84C	1.1	1.84	EPA 900
7/14/2008	Discharge Forebay	84D	0.63	1.83	EPA 900
7/28/2008	Blodgett Farm	85	4.9	1.94	EPA 900
7/28/2008	Brattleboro Fire Dept	88	0	1.81	EPA 900
7/28/2008	Conn River Downstream	86	1.03	0.93	EPA 900
7/28/2008	Conn River Upstream	87	1.58	0.95	EPA 900
7/28/2008	Miller Farm	82	3	1.89	EPA 900
7/28/2008	Vernon Elem School	83	3.63	1.91	EPA 900
8/14/2008	3-3	84A	1.86	1.74	EPA 900
8/14/2008	3-4	84B	2.09	0.9	EPA 900
8/14/2008	3-8	84C	1.78	0.89	EPA 900
8/14/2008	Discharge Forebay	84D	2.33	0.9	EPA 900
8/21/2008	Blodgett Farm	85	6.69	1.86	EPA 900
8/21/2008	Brattleboro Fire Dept	88	4.49	1.8	EPA 900
8/21/2008	Conn River Downstream	86	2.94	1.76	EPA 900
8/21/2008	Conn River Upstream	87	2.94	1.76	EPA 900
8/21/2008	Miller Farm	82	7	1.87	EPA 900
8/21/2008	Vernon Elem School	83	5.93	1.85	EPA 900

Table 15. 2008 Water Sample Beta Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l	Analysis Method
9/15/2008	3-3	84A	1.25	1.87	EPA 900
9/15/2008	3-4	84B	0.16	1.84	EPA 900
9/15/2008	3-8	84C	1.1	1.86	EPA 900
9/15/2008	Discharge Forebay	84D	-1.1	1.81	EPA 900
9/29/2008	Blodgett Farm	85	3.94	1.94	EPA 900
9/29/2008	Brattleboro Fire Dept	88	-0.63	1.82	EPA 900
9/29/2008	Conn River Downstream	86	0.63	1.85	EPA 900
9/29/2008	Conn River Upstream	87	1.73	1.88	EPA 900
9/29/2008	Miller Farm	82	2.51	1.9	EPA 900
9/29/2008	Vernon Elem School	83	3.15	1.92	EPA 900
10/14/2008	3-3	84A	1.21	1.84	EPA 900
10/14/2008	3-4	84B	0.91	1.84	EPA 900
10/14/2008	3-8	84C	0.46	1.83	EPA 900
10/14/2008	Discharge Forebay	84D	3.04	1.89	EPA 900
10/24/2008	Blodgett Farm	85	2.75	1.89	EPA 900
10/24/2008	Brattleboro Fire Dept	88	1.37	0.94	EPA 900
10/24/2008	Conn River Downstream	86	1.97	1.86	EPA 900
10/24/2008	Conn River Upstream	87	0.61	1.83	EPA 900
10/24/2008	Miller Farm	82	5.17	1.94	EPA 900
10/24/2008	Vernon Elem School	83	6.4	1.97	EPA 900
11/14/2008	3-3	84A	-1.66	1.9	EPA 900
11/14/2008	3-4	84B	-2.72	1.88	EPA 900
11/14/2008	3-8	84C	0.38	0.98	EPA 900
11/14/2008	Discharge Forebay	84D	-1.36	1.91	EPA 900
12/1/2008	Blodgett Farm	85	1.97	1.99	EPA 900
12/1/2008	Brattleboro Fire Dept	88	-0.3	0.81	EPA 900
12/1/2008	Conn River Downstream	86	-0.38	0.96	EPA 900
12/1/2008	Conn River Upstream	87	-0.15	0.8	EPA 900
12/1/2008	Miller Farm	82	-2.87	1.87	EPA 900
12/1/2008	Vernon Elem School	83	6.84	1.2	EPA 900
12/15/2008	3-3	84A	0.67	0.99	EPA 900
12/15/2008	3-4	84B	-0.52	0.97	EPA 900
12/15/2008	3-8	84C	0	0.39	EPA 900
12/15/2008	Discharge Forebay	84D	-0.15	0.97	EPA 900
12/23/2008	Blodgett Farm	85	2.7	2.02	EPA 900
12/23/2008	Brattleboro Fire Dept	88	0.52	0.99	EPA 900
12/23/2008	Conn River Downstream	86	0	0.98	EPA 900
12/23/2008	Conn River Upstream	87	0.45	0.66	EPA 900
12/23/2008	Miller Farm	82	-0.6	1.94	EPA 900
12/23/2008	Vernon Elem School	83	1.51	2.02	EPA 900

Table 16. 2008 Water Sample Gamma Radioactivity Results

Sample Date	Sample Location	Map ID No.	Results pCi/l
1/15/2008	3-3	84A	< LOD
1/15/2008	3-4	84B	< LOD
1/15/2008	3-8	84C	< LOD
1/15/2008	Discharge Forebay	84D	< LOD
1/31/2008	Blodgett Farm	85	Natural
1/31/2008	Brattleboro Fire Dept	88	< LOD
1/31/2008	Conn River Downstream	86	< LOD
1/31/2008	Conn River Upstream	87	< LOD
1/31/2008	Miller Farm	82	Natural
1/31/2008	Vernon Elem School	83	Natural
2/14/2008	3-3	84A	< LOD
2/14/2008	3-4	84B	< LOD
2/14/2008	3-8	84C	< LOD
2/14/2008	Discharge Forebay	84D	< LOD
2/25/2008	Blodgett Farm	85	Natural
2/25/2008	Brattleboro Fire Dept	88	< LOD
2/25/2008	Miller Farm	82	Natural
3/13/2008	3-3	84A	< LOD
3/13/2008	3-4	84B	< LOD
3/13/2008	3-8	84C	< LOD
3/13/2008	Discharge Forebay	84D	< LOD
3/27/2008	Blodgett Farm	85	Natural
3/27/2008	Brattleboro Fire Dept	88	< LOD
3/27/2008	Conn River Downstream	86	< LOD
3/27/2008	Conn River Upstream	87	< LOD
3/27/2008	Miller Farm	82	Natural
3/27/2008	Vernon Elem School	83	Natural
4/17/2008	3-3	84A	< LOD
4/17/2008	3-4	84B	< LOD
4/17/2008	3-8	84C	< LOD
4/17/2008	Discharge Forebay	84D	< LOD
4/29/2008	Blodgett Farm	85	Natural
4/29/2008	Brattleboro Fire Dept	88	< LOD
4/29/2008	Conn River Downstream	86	< LOD
4/29/2008	Conn River Upstream	87	< LOD
4/29/2008	Miller Farm	82	Natural
4/29/2008	Vernon Elem School	83	Natural

LOD: limits of detection

Table 16. 2008 Water Sample Gamma Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l
5/14/2008	3-3	84A	< LOD
5/14/2008	3-4	84B	< LOD
5/14/2008	3-8	84C	< LOD
5/14/2008	Discharge Forebay	84D	< LOD
5/29/2008	Blodgett Farm	85	Natural
5/29/2008	Conn River Downstream	86	< LOD
5/29/2008	Conn River Upstream	87	< LOD
5/29/2008	Miller Farm	82	Natural
5/29/2008	Vernon Elem School	83	Natural
6/4/2008	Brattleboro Fire Dept	88	< LOD
6/13/2008	3-3	84A	< LOD
6/13/2008	3-4	84B	< LOD
6/13/2008	3-8	84C	< LOD
6/13/2008	Discharge Forebay	84D	< LOD
6/30/2008	Blodgett Farm	85	Natural
6/30/2008	Brattleboro Fire Dept	88	< LOD
6/30/2008	Conn River Downstream	86	< LOD
6/30/2008	Conn River Upstream	87	< LOD
6/30/2008	Miller Farm	82	Natural
6/30/2008	Vernon Elem School	83	Natural
7/14/2008	3-3	84A	< LOD
7/14/2008	3-4	84B	< LOD
7/14/2008	3-8	84C	< LOD
7/14/2008	Discharge Forebay	84D	< LOD
7/28/2008	Blodgett Farm	85	Natural
7/28/2008	Brattleboro Fire Dept	88	< LOD
7/28/2008	Conn River Downstream	86	< LOD
7/28/2008	Conn River Upstream	87	< LOD
7/28/2008	Miller Farm	82	Natural
7/28/2008	Vernon Elem School	83	< LOD
8/14/2008	3-3	84A	< LOD
8/14/2008	3-4	84B	< LOD
8/14/2008	3-8	84C	< LOD
8/14/2008	Discharge Forebay	84D	< LOD
8/21/2008	Blodgett Farm	85	Natural
8/21/2008	Brattleboro Fire Dept	88	< LOD
8/21/2008	Conn River Downstream	86	< LOD
8/21/2008	Conn River Upstream	87	< LOD
8/21/2008	Miller Farm	82	< LOD
8/21/2008	Vernon Elem School	83	< LOD

LOD: limits of detection

Table 16. 2008 Water Sample Gamma Radioactivity Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l
9/15/2008	3-3	84A	< LOD
9/15/2008	3-4	84B	< LOD
9/15/2008	3-8	84C	< LOD
9/15/2008	Discharge Forebay	84D	< LOD
9/29/2008	Blodgett Farm	85	Natural
9/29/2008	Brattleboro Fire Dept	88	< LOD
9/29/2008	Conn River Downstream	86	< LOD
9/29/2008	Conn River Upstream	87	< LOD
9/29/2008	Miller Farm	82	Natural
9/29/2008	Vernon Elem School	83	Natural
10/14/2008	3-3	84A	< LOD
10/14/2008	3-4	84B	< LOD
10/14/2008	3-8	84C	< LOD
10/14/2008	Discharge Forebay	84D	< LOD
10/24/2008	Blodgett Farm	85	Natural
10/24/2008	Brattleboro Fire Dept	88	< LOD
10/24/2008	Conn River Downstream	86	< LOD
10/24/2008	Conn River Upstream	87	< LOD
10/24/2008	Miller Farm	82	Natural
10/24/2008	Vernon Elem School	83	Natural
11/14/2008	3-3	84A	< LOD
11/14/2008	3-4	84B	< LOD
11/14/2008	3-8	84C	< LOD
11/14/2008	Discharge Forebay	84D	< LOD
12/1/2008	Blodgett Farm	85	Natural
12/1/2008	Brattleboro Fire Dept	88	< LOD
12/1/2008	Conn River Downstream	86	< LOD
12/1/2008	Conn River Upstream	87	< LOD
12/1/2008	Miller Farm	82	Natural
12/1/2008	Vernon Elem School	83	Natural
12/15/2008	3-3	84A	< LOD
12/15/2008	3-4	84B	< LOD
12/15/2008	3-8	84C	< LOD
12/15/2008	Discharge Forebay	84D	< LOD
12/23/2008	Blodgett Farm	85	Natural
12/23/2008	Brattleboro Fire Dept	88	< LOD
12/23/2008	Conn River Downstream	86	< LOD
12/23/2008	Conn River Upstream	87	< LOD
12/23/2008	Miller Farm	82	Natural
12/23/2008	Vernon Elem School	83	Natural

LOD: limits of detection

Table 17. 2008 Water Sample Tritium Results

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l
1/15/2008	3-3	84A	< 500	N/A
1/15/2008	3-4	84B	< 500	N/A
1/15/2008	3-8	84C	< 500	N/A
1/15/2008	Discharge Forebay	84D	< 500	N/A
1/31/2008	Blodgett Farm	85	< 500	N/A
1/31/2008	Brattleboro Fire Dept	88	< 500	N/A
1/31/2008	Conn River Downstream	86	< 500	N/A
1/31/2008	Conn River Upstream	87	< 500	N/A
1/31/2008	Miller Farm	82	< 500	N/A
1/31/2008	Vernon Elem School	83	< 500	N/A
2/14/2008	3-3	84A	< 500	N/A
2/14/2008	3-4	84B	< 500	N/A
2/14/2008	3-8	84C	< 500	N/A
2/14/2008	Discharge Forebay	84D	< 500	N/A
2/25/2008	Blodgett Farm	85	< 500	N/A
2/25/2008	Brattleboro Fire Dept	88	< 500	N/A
2/25/2008	Miller Farm	82	< 500	N/A
3/13/2008	3-3	84A	< 500	N/A
3/13/2008	3-4	84B	< 500	N/A
3/13/2008	3-8	84C	< 500	N/A
3/13/2008	Discharge Forebay	84D	< 500	N/A
3/27/2008	Blodgett Farm	85	< 500	N/A
3/27/2008	Brattleboro Fire Dept	88	< 500	N/A
3/27/2008	Conn River Downstream	86	< 500	N/A
3/27/2008	Conn River Upstream	87	< 500	N/A
3/27/2008	Miller Farm	82	< 500	N/A
3/27/2008	Vernon Elem School	83	< 500	N/A
4/17/2008	3-3	84A	-129	153
4/17/2008	3-4	84B	-74	153
4/17/2008	3-8	84C	25	154
4/17/2008	Discharge Forebay	84D	-35	154
4/29/2008	Blodgett Farm	85	-4	154
4/29/2008	Brattleboro Fire Dept	88	37	154
4/29/2008	Conn River Downstream	86	14	154
4/29/2008	Conn River Upstream	87	-37	154
4/29/2008	Miller Farm	82	-55	154
4/29/2008	Vernon Elem School	83	49	155

Table 17. 2008 Water Sample Tritium Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l
5/14/2008	3-3	84A	-96	154
5/14/2008	3-4	84B	-35	155
5/14/2008	3-8	84C	92	156
5/14/2008	Discharge Forebay	84D	-72	154
5/29/2008	Blodgett Farm	85	176	157
5/29/2008	Conn River Downstream	88	82	156
5/29/2008	Conn River Upstream	86	108	156
5/29/2008	Miller Farm	87	72	156
5/29/2008	Vernon Elem School	82	121	156
6/4/2008	Brattleboro Fire Dept	83	80	156
6/13/2008	3-3	84A	96	155
6/13/2008	3-4	84B	116	155
6/13/2008	3-8	84C	35	155
6/13/2008	Discharge Forebay	84D	123	155
6/30/2008	Blodgett Farm	85	313	157
6/30/2008	Brattleboro Fire Dept	88	49	155
6/30/2008	Conn River Downstream	86	47	155
6/30/2008	Conn River Upstream	87	-45	154
6/30/2008	Miller Farm	82	104	155
6/30/2008	Vernon Elem School	83	98	155
7/14/2008	3-3	84A	-6	157
7/14/2008	3-4	84B	-62	157
7/14/2008	3-8	84C	-6	157
7/14/2008	Discharge Forebay	84D	-115	156
7/28/2008	Blodgett Farm	85	-86	156
7/28/2008	Brattleboro Fire Dept	88	-92	156
7/28/2008	Conn River Downstream	86	-76	157
7/28/2008	Conn River Upstream	87	-102	156
7/28/2008	Miller Farm	82	-28	157
7/28/2008	Vernon Elem School	83	66	158
8/14/2008	3-3	84A	12	157
8/14/2008	3-4	84B	68	157
8/14/2008	3-8	84C	-68	156
8/14/2008	Discharge Forebay	84D	58	157
8/21/2008	Blodgett Farm	85	8	157
8/21/2008	Brattleboro Fire Dept	88	18	157
8/21/2008	Conn River Downstream	86	58	157
8/21/2008	Conn River Upstream	87	131	158
8/21/2008	Miller Farm	82	127	158
8/21/2008	Vernon Elem School	83	-44	156

Table 17. 2008 Water Sample Tritium Results (continued)

Sample Date	Sample Location	Map ID No.	Results pCi/l	Error pCi/l
9/15/2008	3-3	84A	-95	155
9/15/2008	3-4	84B	8	156
9/15/2008	3-8	84C	177	158
9/15/2008	Discharge Forebay	84D	-76	155
9/29/2008	Blodgett Farm	85	-2	170
9/29/2008	Brattleboro Fire Dept	88	-50	156
9/29/2008	Conn River Downstream	86	-66	156
9/29/2008	Conn River Upstream	87	-68	155
9/29/2008	Miller Farm	82	-24	156
9/29/2008	Vernon Elem School	83	26	156
10/14/2008	3-3	84A	37	170
10/14/2008	3-4	84B	-2	170
10/14/2008	3-8	84C	45	170
10/14/2008	Discharge Forebay	84D	-56	169
10/24/2008	Blodgett Farm	85	-32	170
10/24/2008	Brattleboro Fire Dept	88	-45	170
10/24/2008	Conn River Downstream	86	106	171
10/24/2008	Conn River Upstream	87	84	171
10/24/2008	Miller Farm	82	34	170
10/24/2008	Vernon Elem School	83	-43	170
11/14/2008	3-3	84A	-84	177
11/14/2008	3-4	84B	-11	178
11/14/2008	3-8	84C	-91	177
11/14/2008	Discharge Forebay	84D	-6	178
12/1/2008	Blodgett Farm	85	69	170
12/1/2008	Brattleboro Fire Dept	88	-82	177
12/1/2008	Conn River Downstream	86	86	179
12/1/2008	Conn River Upstream	87	22	178
12/1/2008	Miller Farm	82	9	178
12/1/2008	Vernon Elem School	83	149	179
12/15/2008	3-3	84A	-41	171
12/15/2008	3-4	84B	-160	170
12/15/2008	3-8	84C	-142	170
12/15/2008	Discharge Forebay	84D	28	172
12/23/2008	Blodgett Farm	85	-132	170
12/23/2008	Brattleboro Fire Dept	88	-99	170
12/23/2008	Conn River Downstream	86	-71	171
12/23/2008	Conn River Upstream	87	-22	171
12/23/2008	Miller Farm	82	183	173
12/23/2008	Vernon Elem School	83	-45	171

Table 18, On-Site Groundwater Sample Analysis Results

Sample Date	Sample Location	Results pCi/l Gamma	Results pCi/l Tritium	Error +/- pCi/l Tritium
10/23/2008	Well GW0201	Less than LOD	-30	169
10/21/2008	Well GW0202	Naturally Occuring Radionuclides	-83	211
10/23/2008	Well GW0203	Naturally Occuring Radionuclides	54	213
10/21/2008	Well GW0204	Less than LOD	62	213
10/21/2008	Well GZ-1	Naturally Occuring Radionuclides	3	212
10/21/2008	Well GZ-3	Naturally Occuring Radionuclides	-32	212
10/21/2008	Well GZ-5	Naturally Occuring Radionuclides	13	212

Food Chain Sampling Results

Monitoring of the food chain involves direct monitoring of some foods such as milk, cultivated vegetation and fish. It also involves monitoring of the soil and sediment that support land and aquatic species, and natural vegetation like grass, ferns, and fungi that serves as feed to land animals.

Milk Sample Results for 2008

Cow's raw milk is sampled monthly from two farms in Vernon. One farm is about one-half mile north of Vermont Yankee Nuclear Power Station and the other is about three miles south of the plant. Map 11 shows the location of these two dairy farms.

Milk is analyzed for all gamma radiation-emitting radioactive materials, and a separate assessment for iodine-131 is conducted. Table 20 shows the iodine-131 results. The analyses found no iodine-131 greater than the calculated limit of detection, which is 2.53 picocuries per liter (pCi/l).

As recorded in Table 21, the gamma spectroscopy of milk also revealed no nuclear facility-generated radioactive materials in excess of the counting system's limits of detection. The calculated limits of detection for radioactive materials in milk are listed in Table 19. Note also that there are iodine-131 and gamma spectrometry results for the Sprague Farm this year. This is a farm in Brookfield, Vermont, and their milk was sampled during a radiological emergency response plan exercise conducted in June of 2008. Samples of milk from other parts of the state will routinely be obtained from now on in order that we may be able to show background levels of radioactivity, if any is detected, in these samples from sites far from, and unaffected by, Vermont Yankee.

The one radioactive material that was detected above its calculated limit of detection was potassium-40, a primordial radioactive material. Primordial radioactive materials are those created with the formation of the earth and other cosmic features. Potassium-40 has a half-life of 1,280,000,000 years. The gamma spectroscopy results are presented in

Table 21. The potassium-40 results for all milk samples, ranging from 1340 to 1790 pCi/l, fall within the historical range for potassium-40 of 1,200 to 2,000 pCi/l.

Vegetation Sample Results for 2008

A variety of natural and cultivated plants are sampled to verify that no Vermont Yankee Nuclear Power Station radioactive materials are accumulating in the human and animal food chains. No vegetation samples taken in the immediate vicinity of Vermont Yankee were analyzed in 2008. Instead, samples were obtained elsewhere in Vermont to help us understand what the background levels of radioactivity in vegetation are in Vermont. None of the sample results were outside of the historical range for vegetation samples that have been reported from the Vermont Yankee vicinity in other years. The historical range for gamma radioactivity in vegetation varies for the specific kind of plant, but, generally, the range is from the calculated limit of detection to 20,400 picocuries per kilogram (pCi/kg). The specific values for 2008 are found in Table 23.

In June 2008, members of the Vermont Emergency Management Radiological Sampling Team, composed of employees from the Vermont Department of Health, the Agency for Natural Resources and the Agency of Agriculture, conducted one of their biannual Vermont Yankee emergency preparedness drills in the Randolph area of Vermont. During the drill, many environmental samples were collected and several of them were analyzed by the Vermont Department of Health Laboratory. From this June 2008 drill, samples of natural vegetation were analyzed. These results from Roxbury, Brookfield, Bethel and Northfield, Vermont help serve as a background for comparison to samples near Vermont Yankee taken in past years. Map 10 above shows where all of the environmental samples were taken. Table 23 lists four of the sites from Map 10 where vegetation samples were taken, the Roxbury Fish Hatchery, the White River Natioanl Fish Hatchery, Stowell and Son Farm and Rood Pond.

The gamma radioactivity results in picocuries per kilogram for the 2008 vegetation samples are shown in Figures 8 and 9. Figure 8 shows the beryllium-7 results, while Figure 9 shows the potassium-40 results. Remember that these radioactive materials, potassium-40 and beryllium-7, are purely naturally-occurring radioactive materials, Remember, too, that these concentrations are within the historical range for vegetation samples which has been as high as 20,400 picocuries per kilogram.

Soil Sample Results for 2008

Soil samples were also collected in the same fashion as with the vegetation samples – at a Sampling Team drill in the spring of 2008. The locations of the June 2008 samples in the Randolph area are shown on Map 10 above. The table of soil sample results is Table 24.

All sample results were within the historical range of less than the calculated limit of detection to 500 picocuries per kilogram for cesium-137, and from 7,000 to 20,000 picocuries per kilogram for potassium-40. There is also one sample that tested positive for the natural radionuclide beryllium-7. Of course, potassium-40 is also a purely natural radionuclide. Unlike potassium-40 and beryllium-7, cesium-137 exists only due to human activity. Figure 10 shows the samples with cesium-137 activity. As can be seen, cesium-137 may be found in central Vermont near Randolph. This is true for samples throughout Vermont and the United States as a whole. This must be recollected when sample results from past and future years show cesium-137 in southern Vermont near Vermont Yankee. In past reports, we have explained the positive cesium-137 results around Vermont Yankee in terms of residual radioactivity from above ground nuclear weapons testing fallout and from fallout from the plume that sent radioactivity around the world for several weeks following the nuclear reactor explosion and fire at Chernobyl in the former Soviet Union.

Sediment Sample Results for 2008

Sediment samples are taken from the bottom of the Connecticut River by an environmental contractor. The samples in this report are analyzed by the Vermont Department of Health Laboratory. The sediment samples are taken from four areas of the Connecticut River. The first is near what is called the North Storm Drain. It is an area where radioactive sedimentary contaminants from Vermont Yankee Nuclear Power Station were discovered prior to 1998, and it is an area just east of the plant stack. Sample locations S-1, S-2, T-1, T-2, T-3, U-1, U-2, U-3, U-4, V-3, V-4, V-5, W-4, W-5 and X-5 are from this North Storm Drain area. These sample locations are shown in an illustration included as Figure 12.

The second location is in the pool upstream of the Vernon Dam, near the primary plant discharge at the south end of the plant property near the cooling towers. In Table 25, the samples for location 3-4 are from this part of the Connecticut River. The third location, 3-3, is south of the Vernon Dam in the pool created downstream of the hydroelectric facility there. The final sample location, 3-8, is well upstream of the plant where the Route 9 highway bridge crosses the Connecticut River north of Brattleboro.

Two sets of samples are obtained, one set in the spring and one set in the fall. A sediment sample is taken with a mass ranging from 0.75 to 1.25 kilograms. At the Vermont Department of Health Laboratory, the sample is dried, weighed on a top-loaded balance and placed in a 500 milliliter high density polyethylene bottle. The sample is counted on the gamma spectrometer system using a reverse germanium detector. A normal spectrum will include naturally occurring, primordial radioactive materials such as potassium-40, cosmogenic, naturally occurring radioactive materials such as beryllium-7, and archival cesium-137 from past atmospheric nuclear weapons testing and the releases from Chernobyl. North Storm Drain samples in the past included trace amounts of cobalt-60. Like cesium-137, cobalt-60 is radioactive material of only human origin.

For 2008, primordial potassium-40 is within the historical range of 6,000 – 26,000 pCi/kg at 7,660 – 21,200 pCi/kg. The archival cesium-137 is within the historical range of the calculated limit of detection to 500 pCi/kg at 45.5 – 218 pCi/kg. There were no other radioactive materials in excess of the counting system's calculated limits of detection including cobalt-60. The calculated limits of detection for sediment are the same as those for soil, and shown in Table 22. The potassium-40 results are graphed in Figure 13, while the results for cesium-137 are graphed in Figure 14.

Fish Sample Results for 2008

Table 26 presents the results of gamma spectroscopy of fish samples. The fish were obtained from the Connecticut River by an environmental contractor. The fish samples were analyzed by the Vermont Department of Health Laboratory. Table 26 shows that the only results in excess of the counting system's calculated limits of detection were for naturally occurring, cosmogenic potassium-40. Potassium-40 in 2008, ranging from 2,590 to 2,970 pCi/kg falls within the historical range for these samples: 1,000 – 5,000 pCi/kg.

Location 3-4 in the table above corresponds with the Vernon Pond, the basin formed by the Vernon Dam on the Connecticut River just downstream from Vermont Yankee Nuclear Power Station. Location 3-8 is near the Route 9 highway bridge north of Brattleboro. Fish are captured via an electroshock method. The fish are frozen whole, weighed and chopped or blended for loading into a reentrant beaker. The total sample of about one kilogram is then analyzed with a gamma spectrometer system using a reverse electrode germanium detector.

Table 19. Gamma Spectroscopy Calculated Limits of Detection for Milk, Water, Vegetation and Fish Samples

Radioactive material	Calculated Limit of Detection
Cadmium-109	46 pCi/l or pCi/kg
Cobalt-58	2 pCi/l or pCi/kg
Cerium-139	2 pCi/l or pCi/kg
Mercury-203	2 pCi/l or pCi/kg
Tin-113	3 pCi/l or pCi/kg
Cesium-137	3 pCi/l or pCi/kg
Yttrium-88	2 & 3 pCi/l or pCi/kg
Cobalt-60	2 & 2 pCi/l or pCi/kg
Beryllium-7	20 pCi/l or pCi/kg
Potassium-40	42 pCi/l or pCi/kg
Barium-133	3 pCi/l or pCi/kg
Cesium-134	3 pCi/l or pCi/kg
Iodine-131	3 pCi/l or pCi/kg
Zinc-65	5 pCi/l or pCi/kg
Manganese-54	3. pCi/l or pCi/kg
Silver-110m	3 pCi/l or pCi/kg
Cerium-144	15 pCi/l or pCi/kg
Cerium-141	4 pCi/l or pCi/kg
Chromium-51	20 pCi/l or pCi/kg
Antimony-126	2. pCi/l or pCi/kg
Ruthenium-103	2 pCi/l or pCi/kg
Strontium-90	3 pCi/l or pCi/kg
Antimony-124	3 pCi/l or pCi/kg
Ruthenium-106	25 pCi/l or pCi/kg
Cesium-136	3 pCi/l or pCi/kg
Cobalt-58	2 pCi/l or pCi/kg

Map 11

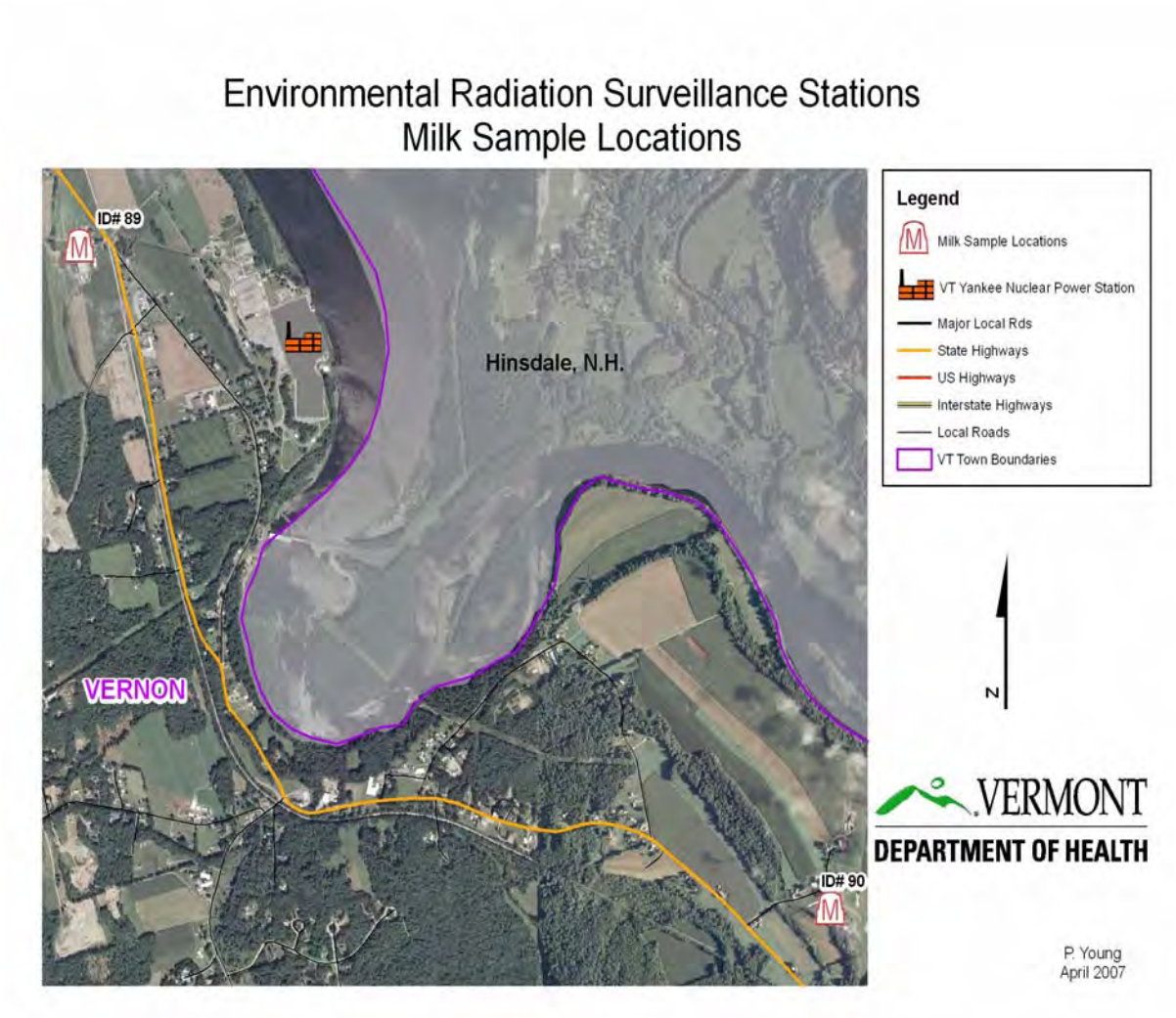

Environmental Radiation Surveillance Stations
Milk Sample Locations
ID# 89
Hinsdale, N.H.
VERNON
ID# 90
Legend
Milk Sample Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
VT Town Boundaries
N
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Table 20. 2008 Milk Sample Iodine-131 Results

Sample Date	Sample Location	Map ID No.	Results Nuclides	Results pCi/l
1/31/2008	Blodgett Farm	90	I-131	< LOD
1/31/2008	Miller Farm	89	I-131	< LOD
2/25/2008	Blodgett Farm	90	I-131	< LOD
2/25/2008	Miller Farm	89	I-131	< LOD
3/27/2008	Blodgett Farm	90	I-131	< LOD
3/27/2008	Miller Farm	89	I-131	< LOD
4/29/2008	Blodgett Farm	90	I-131	< LOD
4/29/2008	Miller Farm	89	I-131	< LOD
5/29/2008	Blodgett Farm	90	I-131	< LOD
5/29/2009	Miller Farm	89	I-131	< LOD
6/17/2008	Sprague Farm	*	I-131	< LOD
7/28/2008	Miller Farm	89	I-131	< LOD
7/28/2008	Blodgett Farm	90	I-131	< LOD
8/21/2008	Miller Farm	89	I-131	< LOD
8/21/2008	Blodgett Farm	90	I-131	< LOD
9/29/2008	Miller Farm	89	I-131	< LOD
9/29/2008	Blodgett Farm	90	I-131	< LOD
10/24/2008	Miller Farm	89	I-131	< LOD
10/23/2008	Blodgett Farm	90	I-131	< LOD
12/1/2008	Miller Farm	89	I-131	< LOD
12/1/2008	Blodgett Farm	90	I-131	< LOD
12/23/2008	Miller Farm	89	I-131	< LOD
12/23/2008	Blodgett Farm	90	I-131	< LOD

*Brookfield, Vermont

Table 21. 2008 Milk Sample Gamma Radioactivity Results

Sample Date	Sample Location	Map ID No.	Results Nuclides	Results pCi/l	Error pCi/l
1/31/2008	Blodgett Farm	90	K-40	1480	100
1/31/2008	Miller Farm	89	K-40	1560	100
2/25/2008	Blodgett Farm	90	K-40	1500	100
2/25/2008	Miller Farm	89	K-40	1550	110
3/27/2008	Blodgett Farm	90	K-40	1450	100
3/27/2008	Miller Farm	89	K-40	1790	120
4/29/2008	Blodgett Farm	90	K-40	1380	100
4/29/2008	Miller Farm	89	K-40	1370	90
5/29/2008	Blodgett Farm	90	K-40	1520	100
5/29/2009	Miller Farm	89	K-40	1340	90
6/17/2008	Sprague Farm	*\	K-40	1360	170
7/28/2008	Miller Farm	89	K-40	1690	120
7/28/2008	Blodgett Farm	90	K-40	1500	100
8/21/2008	Miller Farm	89	K-40	1480	100
8/21/2008	Blodgett Farm	90	K-40	1370	100
9/29/2008	Miller Farm	89	K-40	1370	940
9/29/2008	Blodgett Farm	90	K-40	1380	940
10/24/2008	Miller Farm	89	K-40	1660	120
10/23/2008	Blodgett Farm	90	K-40	1500	100
12/1/2008	Miller Farm	89	K-40	1410	100
12/1/2008	Blodgett Farm	90	K-40	1510	100
12/23/2008	Miller Farm	89	K-40	1530	100
12/23/2008	Blodgett Farm	90	K-40	1480	100

*Brookfield, Vermont

Table 22. Calculated Limits of Detection for Soil and Sediment Samples

Radioactive material	Calculated Limit of Detection
Cadmium-109	272 pCi/kg
Cobalt-57	11 pCi/kg
Cerium-139	13 pCi/kg
Mercury-203	15 pCi/kg
Tin-113	21 pCi/kg
Cesium-137	17 pCi/kg
Yttrium-88	19 & 13 pCi/kg
Cobalt-60	17 pCi/kg
Beryllium-7	1278 pCi/kg
Potassium-40	274 pCi/kg
Barium-133	20 pCi/kg
Cesium-134	17 pCi/kg
Iodine-131	16 pCi/kg
Zinc-65	35 pCi/kg
Manganese-54	18 pCi/kg
Silver-110m	16 pCi/kg
Cerium-144	88 pCi/kg
Cerium-141	21 pCi/kg
Chromium-51	124 pCi/kg
Antimony-126	15. pCi/kg
Ruthenium-103	15 pCi/kg
Strontium-90	18 pCi/kg
Antimony-124	17 pCi/kg
Ruthenium-106	159 pCi/kg
Cesium-136	16 pCi/kg
Cobalt-58	17 pCi/kg

Table 23. 2008 Vegetation Gamma Radioactivity Results

Sample Date	Sample Location	Results pCi/kg	Error pCi/kg	Results Nuclides	Comment
6/17/2008	Roxbury Fish Hatchery	7150	760	K-40	Grass
6/17/2008	Roxbury Fish Hatchery	1630	380	Be-7	Grass
6/17/2008	White River National Fish Hatchery	7220	660	K-40	Grass
6/17/2008	White River National Fish Hatchery	725	231	Be-7	Grass
6/17/2008	Stowell & Son Farm, Brookfield	5220	520	K-40	Grass
6/17/2008	Stowell & Son Farm, Brookfield	2460	350	Be-7	Grass
6/17/2008	Rood Pond, Northfield	4970	420	K-40	Grass
6/17/2008	Rood Pond, Northfield	633	125	Be-7	Grass

Figure 8

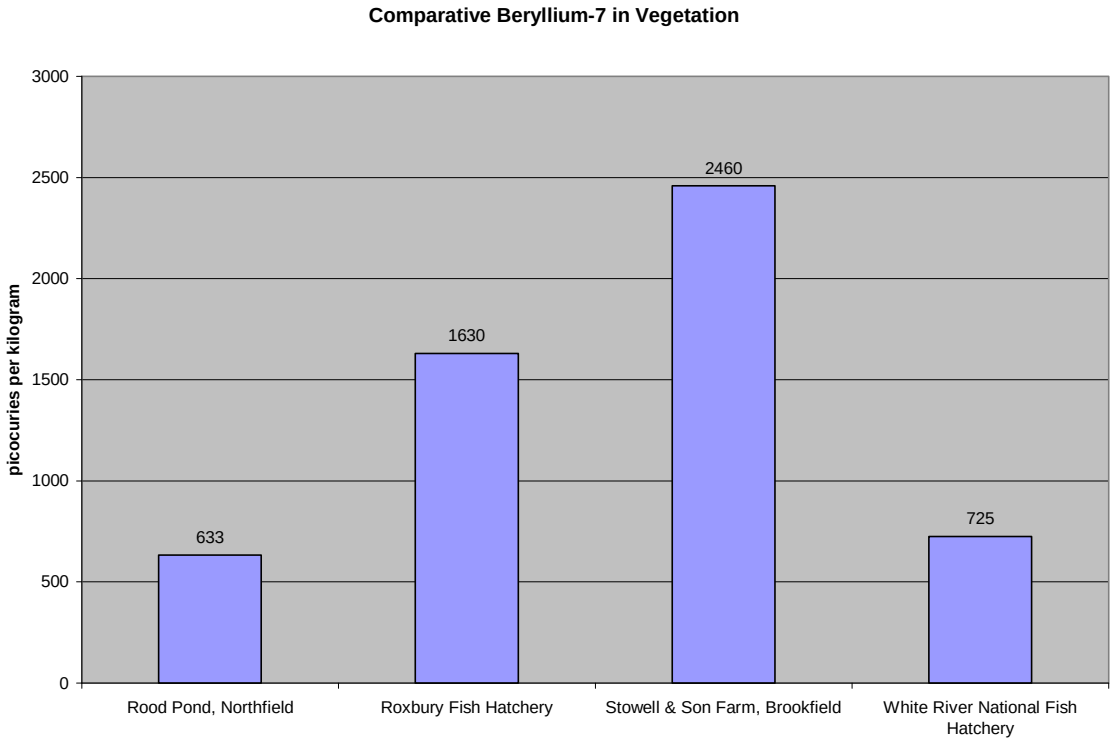
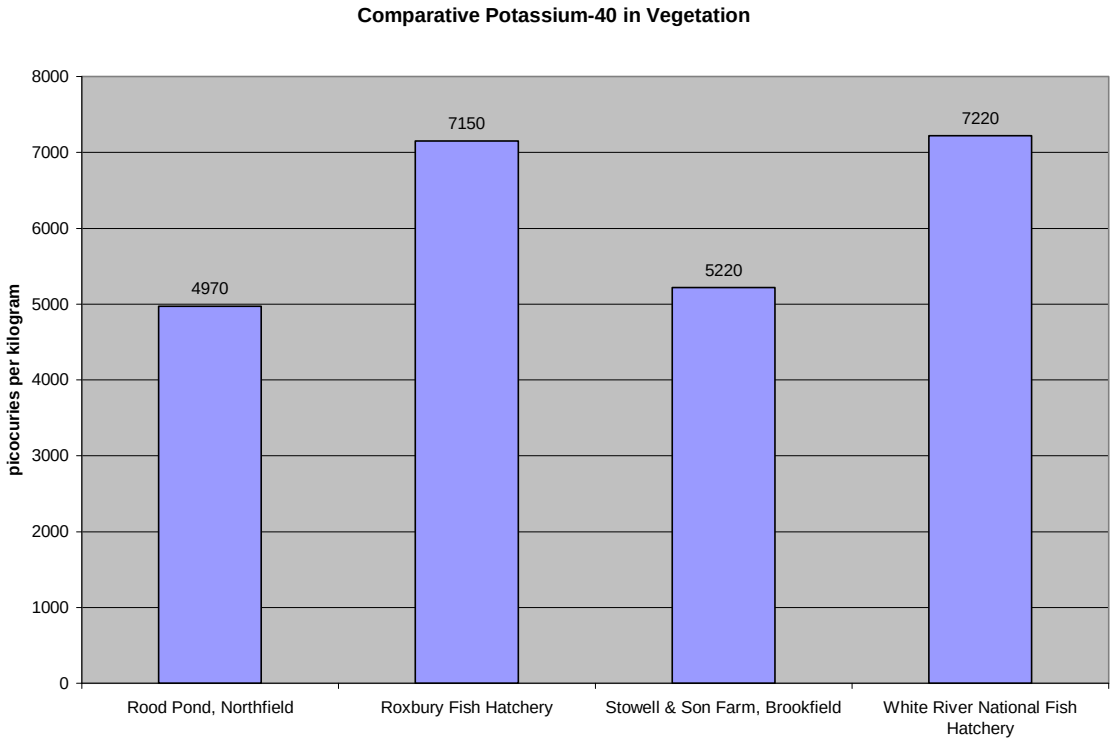

Comparative Beryllium-7 in Vegetation
picocuries per kilogram
3000
2500
2000
1500
1000
500
0
633
1630
2460
725
Rood Pond, Northfield
Roxbury Fish Hatchery
Stowell & Son Farm, Brookfield
White River National Fish Hatchery

Figure 9


Comparative Potassium-40 in Vegetation
picocuries per kilogram
8000
7000
6000
5000
4000
3000
2000
1000
0
4970
7150
5220
7220
Rood Pond, Northfield
Roxbury Fish Hatchery
Stowell & Son Farm, Brookfield
White River National Fish Hatchery

Map 12

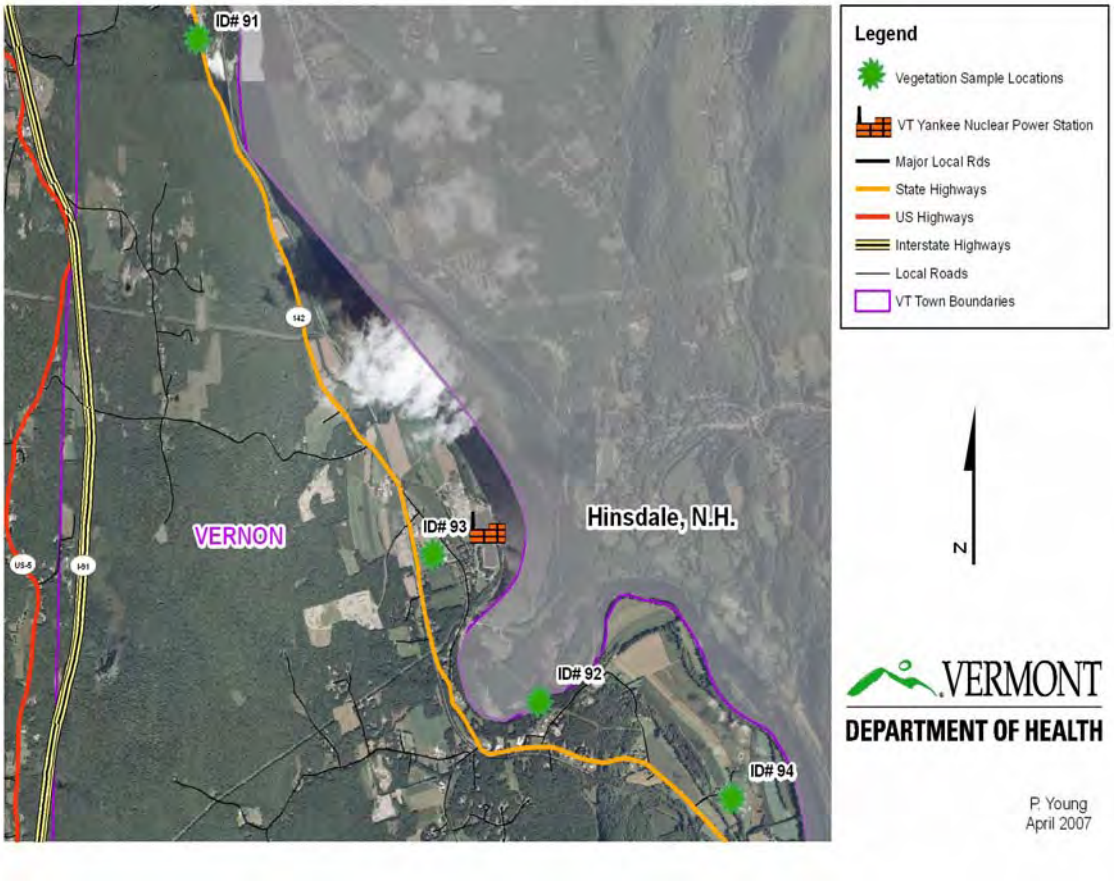

Environmental Radiation Surveillance Stations
Vegetation Sample Locations
ID# 91
ID# 93
ID# 92
ID# 94
VERNON
Hinsdale, N.H.
Legend
Vegetation Sample Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
VT Town Boundaries
N
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Table 24. 2008 Soil Sample Gamma Radioactivity Results

Sample Date	Sample Location	Results pCi/kg	Error pCi/kg	Results Nuclides	Comment
6/17/2008	White River National Fish Hatchery	12500	1000	K-40	Natural
6/17/2008	White River National Fish Hatchery	168	25	Cs-137	
6/17/2008	White River National Fish Hatchery	746	185	Be-7	Natural
6/17/2008	Stowell Farm, Brookfield	12300	1700	K-40	Natural
6/17/2008	Rood Pond, Northfield	18000	1400	K-40	Natural
6/17/2008	Vermont State Police, Royalton	8710	1220	K-40	Natural
6/17/2008	Vermont State Police, Royalton	86	27	Cs-137	

Figure 10

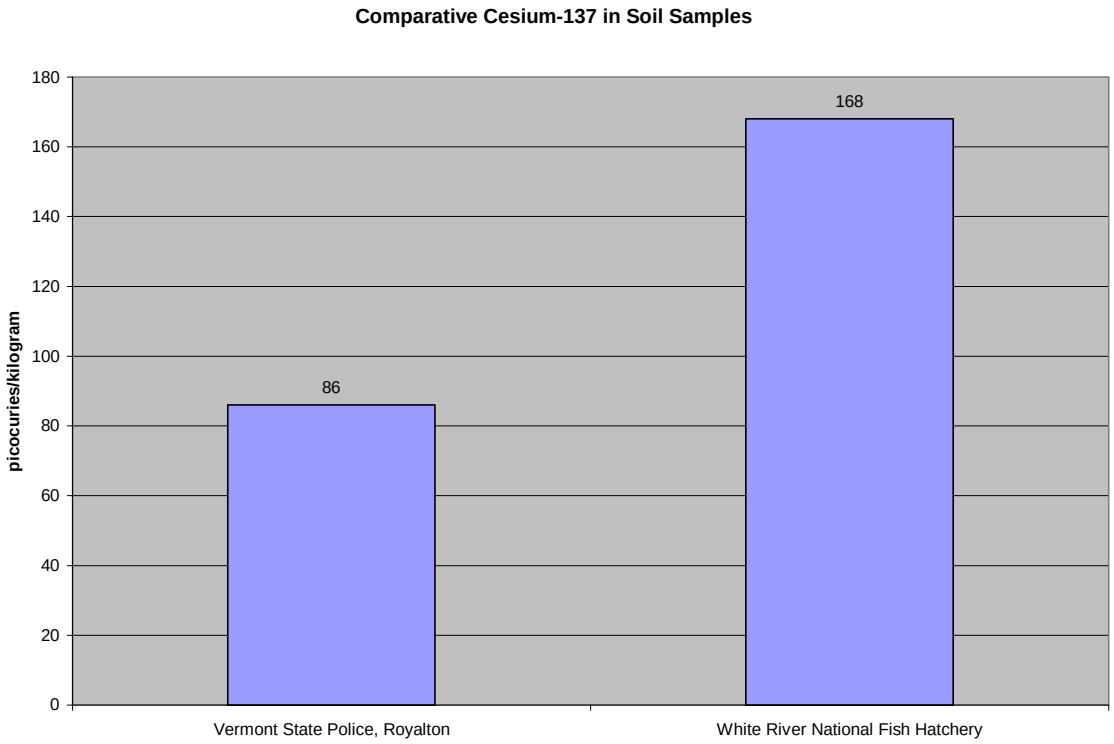
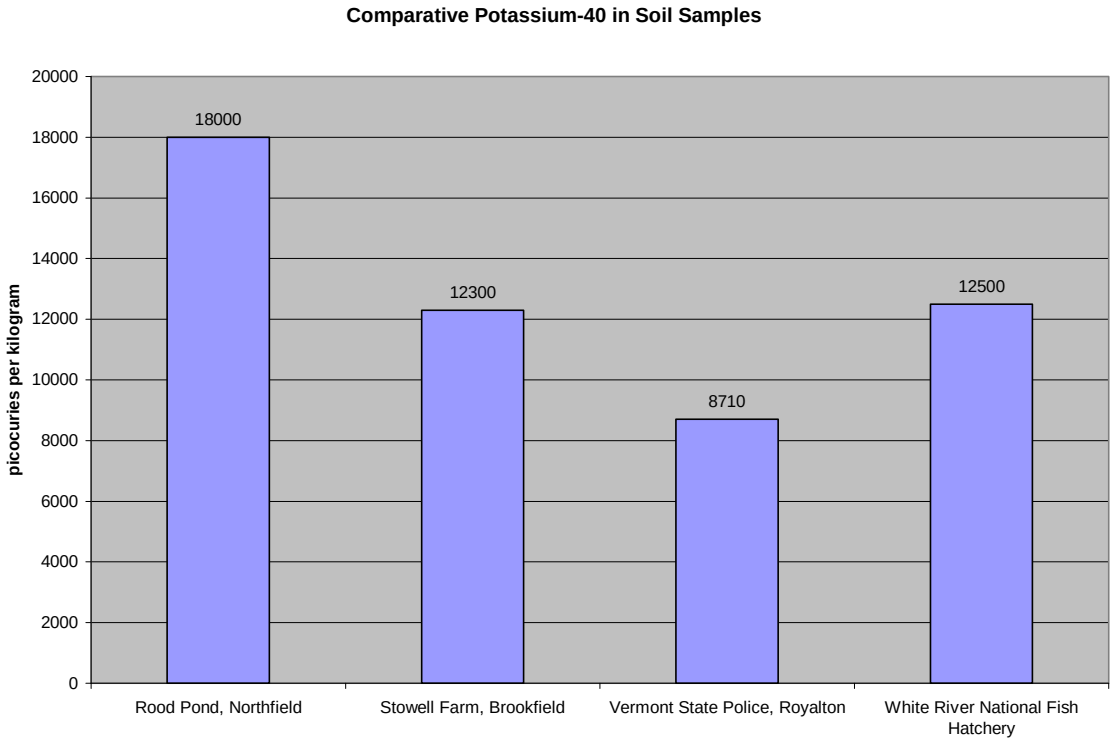

Comparative Cesium-137 in Soil Samples
picocuries/kilogram
180
160
140
120
100
80
60
40
20
0
86
168
Vermont State Police, Royalton
White River National Fish Hatchery

Figure 11


Comparative Potassium-40 in Soil Samples
picocuries per kilogram
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
18000
12300
8710
12500
Rood Pond, Northfield
Stowell Farm, Brookfield
Vermont State Police, Royalton
White River National Fish Hatchery

Map 13

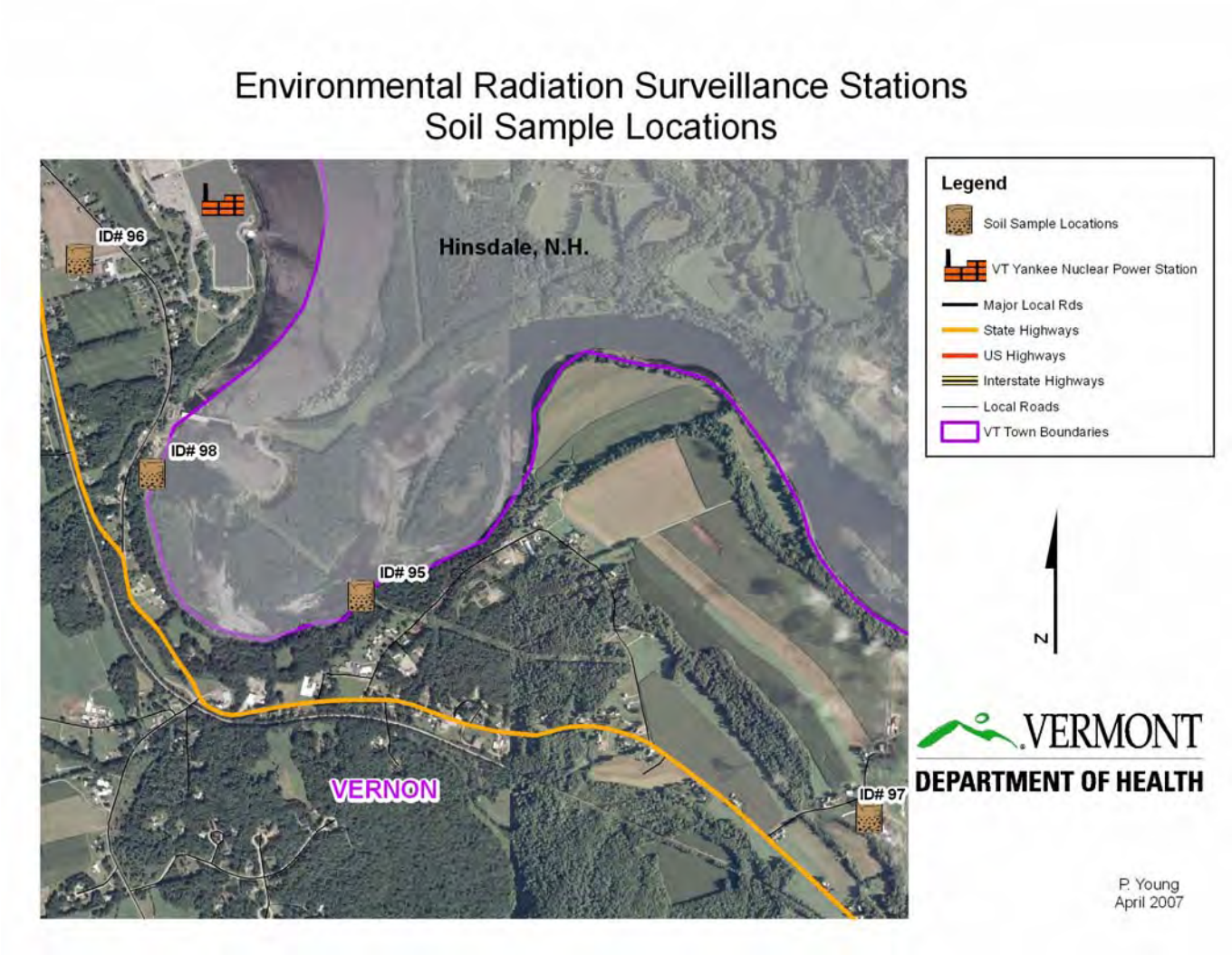

Environmental Radiation Surveillance Stations
Soil Sample Locations
ID# 96
Hinsdale, N.H.
ID# 98
ID# 95
VERNON
ID# 97
Legend
Soil Sample Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
VT Town Boundaries
N
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Figure 12, Sediment Sample Locations

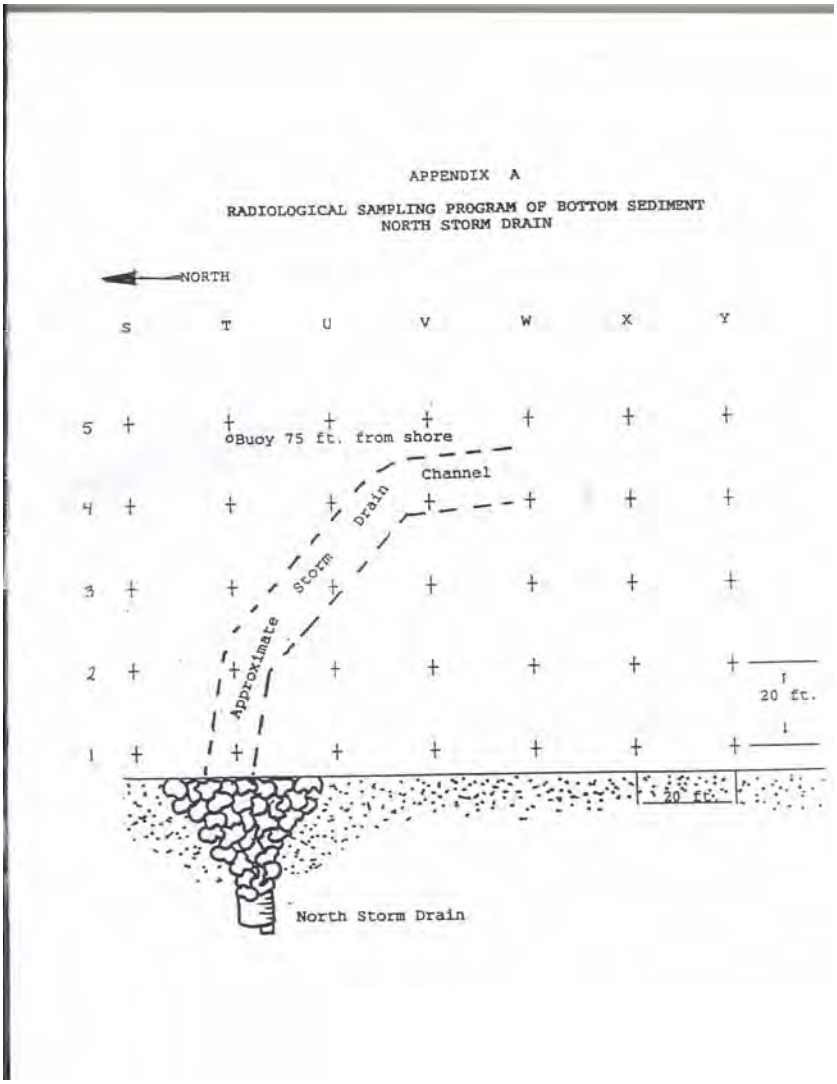


Figure 13

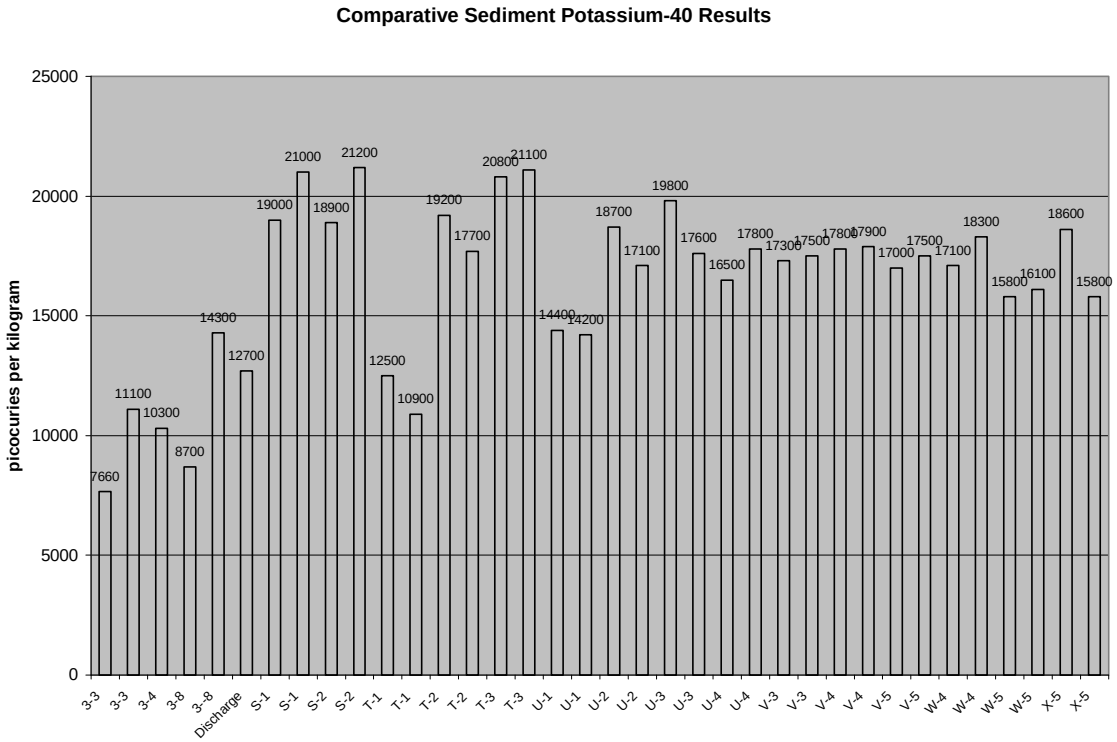

Comparative Sediment Potassium-40 Results
picocuries per kilogram
25000
20000
15000
10000
5000
0
7660
11100
10300
8700
14300
12700
19000
21000
18900
21200
12500
10900
19200
17700
20800
21100
14400
14200
18700
17100
19800
17600
16500
17800
17300
17500
17800
17900
17000
17500
17100
18300
15800
16100
18600
15800
3-3
3-3
3-4
3-8
3-8
Discharge
S-1
S-1
S-2
S-2
T-1
T-1
T-2
T-2
T-3
T-3
U-1
U-1
U-2
U-2
U-3
U-3
U-4
U-4
V-3
V-3
V-4
V-4
V-5
V-5
W-4
W-4
W-5
W-5
X-5
X-5

Figure 14

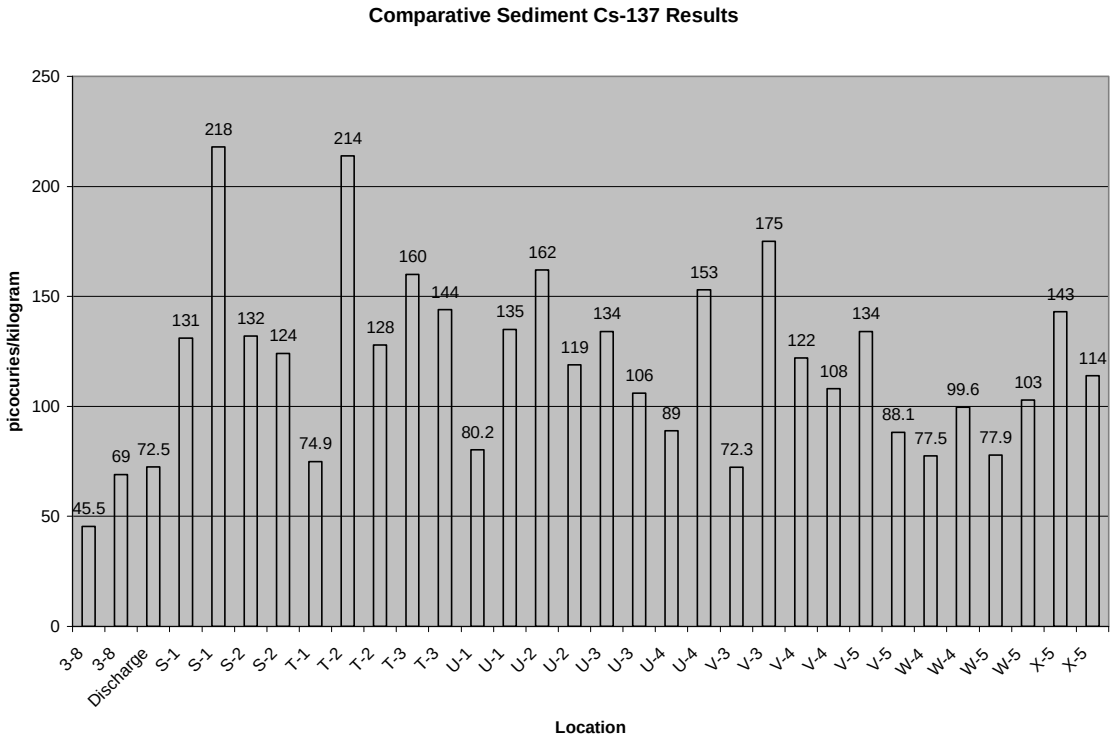

Comparative Sediment Cs-137 Results
picocuries/kilogram
250
200
150
100
50
0
45.5
69
72.5
131
218
132
124
74.9
214
128
160
144
80.2
135
162
119
134
106
89
153
72.3
175
122
108
134
88.1
77.5
99.6
77.9
103
143
114
3-8
3-8
Discharge
S-1
S-1
S-2
S-2
T-1
T-2
T-2
T-3
T-3
U-1
U-1
U-2
U-2
U-3
U-3
U-4
U-4
V-3
V-3
V-4
V-4
V-5
V-5
W-4
W-4
W-5
W-5
X-5
X-5
Location

Table 25. 2008 Sediment Sample Gamma Radioactivity Results

Sample Date	Sample Location	Results Nuclides	Results pCi/kg	Error pCi/kg	Comment
5/15/2008	3-8	K-40	8700	1210	Natural
5/15/2008	3-8	Cs-137	45.5	17	
5/15/2008	3-4	K-40	10300	1400	Natural
5/15/2008	S-1	Cs-137	131	32	
5/15/2008	S-1	K-40	19000	2600	Natural
5/15/2008	S-2	K-40	18900	1500	Natural
5/15/2008	S-2	Cs-137	132	36	
5/15/2008	T-1	K-40	12500	1000	Natural
5/15/2008	T-1	Cs-137	74.9	26.7	
5/15/2008	T-2	K-40	19200	2700	Natural
5/15/2008	T-2	Cs-137	214	55	
5/15/2008	T-3	K-40	20800	1700	Natural
5/15/2008	T-3	Cs-137	160	46	
5/15/2008	U-1	K-40	14400	1200	Natural
5/15/2008	U-1	Cs-137	80.2	34.3	
5/15/2008	U-2	K-40	18700	2600	Natural
5/15/2008	U-2	Cs-137	162	34	
5/15/2008	U-3	K-40	19800	1600	Natural
5/15/2008	U-3	Cs-137	134	34	
5/15/2008	U-4	K-40	16500	2300	Natural
5/15/2008	U-4	Cs-137	89	33.7	
5/15/2008	V-3	K-40	17300	1400	Natural
5/15/2008	V-3	Cs-137	72.3	31.1	
5/15/2008	V-4	K-40	17800	2500	Natural
5/15/2008	V-4	Cs-137	122	35	
5/15/2008	V-5	K-40	17000	1400	Natural
5/15/2008	V-5	Cs-137	134	47	
5/15/2008	W-4	K-40	17100	2400	Natural
5/15/2008	W-4	Cs-137	77.5	29.9	
5/15/2008	W-5	K-40	15800	1300	Natural
5/15/2008	W-5	Cs-137	77.9	25.8	
5/15/2008	X-5	K-40	18600	2600	Natural
5/15/2008	X-5	Cs-137	143	46	
5/15/2008	3-3	K-40	7660	680	Natural
5/15/2008	3-8	K-40	8700	1210	Natural
5/15/2008	3-8	Cs-137	45.5	17	

Table 25. 2008 Sediment Sample Gamma Radioactivity Results (continued)

Sample Date	Sample Location	Results Nuclides	Results pCi/kg	Error pCi/kg	Comment
10/30/2008	3-3	K-40	11100	900	Natural
10/30/2008	Discharge	K-40	12700	1800	Natural
10/30/2008	Discharge	Cs-137	72.5	24.8	
10/30/2008	X-5	K-40	15800	1300	Natural
10/30/2008	X-5	Cs-137	114	35	
10/30/2008	W-5	K-40	16100	2200	Natural
10/30/2008	W-5	Cs-137	103	26	
10/30/2008	W-4	K-40	18300	1400	Natural
10/30/2008	W-4	Cs-137	99.6	32.2	
10/30/2008	V-5	K-40	17500	2400	Natural
10/30/2008	V-5	Cs-137	88.1	27.1	
10/30/2008	V-4	K-40	17900	1400	Natural
10/30/2008	V-4	Cs-137	108	30	
10/30/2008	V-3	K-40	17500	2400	Natural
10/30/2008	V-3	Cs-137	175	42	
10/30/2008	U-4	K-40	17800	1400	Natural
10/30/2008	U-4	Cs-137	153	42	
10/30/2008	U-3	K-40	17600	2400	Natural
10/30/2008	U-3	Cs-137	106	31	
10/30/2008	U-2	K-40	17100	1300	Natural
10/30/2008	U-2	Cs-137	119	37	
10/30/2008	U-1	K-40	14200	2000	Natural
10/30/2008	U-1	Cs-137	135	31	
10/30/2008	T-3	K-40	21100	1700	Natural
10/30/2008	T-3	Cs-137	144	43	
10/30/2008	T-2	K-40	17700	2400	Natural
10/30/2008	T-2	Cs-137	128	32	
10/30/2008	T-1	K-40	10900	1500	Natural
10/30/2008	T-1	Be-7	628	238	Natural
10/30/2008	S-2	K-40	21200	1700	Natural
10/30/2008	S-2	Cs-137	124	41	
10/30/2008	S-1	K-40	21000	1700	Natural
10/30/2008	S-1	Cs-137	218	57	
10/30/2008	3--8	K-40	14300	2000	Natural
10/30/2008	3-8	Be-7	448	336	Natural
10/30/2008	3-8	Cs-137	69	24.6	

Table 26. 2008 Fish Sample Gamma Radioactivity Results

Sample Date	Sample Location	Results pCi/kg	Error pCi/kg	Results Nuclides
5/28/2008	3-4	2600	210	K-40
5/28/2008	3-8	2970	250	K-40
10/27/2008	3-8	2700	240	K-40
10/29/2008	3-4	2590	190	K-40

List of Tables, Figures and Maps

Tables

Tables (Continued)

Figures

Maps