

ATSDR Review of Gagetown Herbicide Spray Programs

Canadian Forces Base
Gagetown, New Brunswick, Canada

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Agency for Toxic Substances and Disease Registry

Introduction:

Senator Susan M. Collins (R–Maine) on June 6, 2012, requested that the Director of the Agency for Toxic Substances and Disease Registry (ATSDR) review a report completed on behalf of the Canadian Department of National Defense. The report concerned the use of Agent Orange and other commercial herbicides at the Canadian Forces Base in Gagetown, New Brunswick, Canada (CFB Gagetown). Senator Collins asked ATSDR to assess whether the concentrations and quantity of 2,3,7,8-tetrachlorodibenzo -p- dioxin and other herbicides used at CFB Gagetown could lead to health problems among those who were exposed to it over time. Senator Collins also asked ATSDR to evaluate whether the concentrations of contaminants at CFB Gagetown could be considered a past public health hazard, according to Environmental Protection Agency (EPA) guidelines.

ATSDR agreed to evaluate the available information concerning the use of herbicides at CFB Gagetown. Senator Collins' request included a copy of a field sampling protocol planned for CFB Gagetown. The copy did not contain sufficient information to support a health conclusion. In undertaking research to meet Senator Collins' request, ATSDR found a complete listing of reports related to the use of herbicides at CFB Gagetown at www.forces.gc.ca/site/reports-rapports/defoliant/index-eng.asp. The full versions of the reports, however, were unavailable online. In October 2012, ATSDR obtained electronic versions of all the complete reports from the Directorate of Force Health Protection, Canadian Forces Health Services Group Headquarters (CFHSG).

ATSDR reviewed the reports to determine whether the methods used and conclusions reached were consistent with the approach that ATSDR health assessors use when evaluating human health risks posed by exposure to environmental contaminants. These reports collectively will be referred to hereafter as “the Canadian report.” The following is a summary of ATSDR's findings.

ATSDR Summary

Conclusion 1: The concentrations of contaminants at CFB Gagetown do not represent a public health hazard now or in the past to members of the U.S. military/National Guard who trained at this Canadian base or to recreational users who access the site now. This finding also applies to soldiers who trained during the three years following the herbicide testing period, 1966–1967.

Basis for Conclusion 1: Members of the U.S. military or the National Guard who trained at CFB Gagetown, in addition to non-military personnel who currently visit the base, may have been exposed to herbicides. The levels to which they may have been exposed, however, were below a level of concern for both cancer health effects and non-cancer health effects. There is little to no increased risk of adverse effects on blood-forming tissues, the liver, and the central nervous system, and the risk of skin disorders or developmental effects is not enough to represent a public health hazard.

Conclusion 2: The methods used in the Canadian report, provided by CFHSG to evaluate the public health implications of past herbicide exposures, were consistent with ATSDR guidelines.

Basis for Conclusion 2: ATSDR conducted a detailed review of the Canadian report, focusing on the following sections: herbicide applications, field sampling techniques, quality assurance and quality control procedures, exposure pathways, the receptor population, comparison values, and cancer slope factors. The methods used in the report were all consistent with those typically used by ATSDR in the evaluation of the public health implications of human exposure.

Review of "Canadian Forces Base Gagetown Herbicide Spray Programs 1952–2004 Fact-Finder's Report (and related appendices) by Dr. Dennis Furlong. August 2007"

ATSDR compared the data and methodology used by the Canadian government to those used by ATSDR. The purpose of the comparison was to determine whether the approaches used in the Canadian report were consistent with those that ATSDR typically uses when reviewing environmental data and making public health determinations.

Purpose of the Canadian Report

In August 2005, the Canadian government commissioned a study to review the public health implications of the possible exposure of soldiers and non-military personnel to one or more herbicides—Agent Orange, Agent Purple, and Agent White—used or tested on the base from 1966 to 1967 and the possible exposure to any herbicide used or tested on the base from 1956 to 2004.

Herbicide Applications

In 1966 and 1967, various defoliants, including Agent Orange, Agent Purple, and Agent White, were tested at CFB Gagetown, New Brunswick, Canada. The on-base test sites were located in a remote, dense, undisturbed 83-acre forest containing both deciduous and conifer trees.

The Canadian military base and the United States Department of the Army conducted tests to determine how best to remove vegetation in training areas. These tests involved the application of certain herbicides.

Table 1.
Types of herbicides tested by year for the period from 1966 through 1967 (Furlong 2007)

Year	Herbicides tested	Number of days tested
1966	Agent Orange Agent Purple	3 days

1967	Agent Orange Agent White	4 days
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The 1966 test site was located on a four mile by 1,200 foot area. The herbicides were applied to 116 plots, each consisting of a 200 by 600 foot section with a 100 foot buffer zone. The 1967 herbicide applications were applied to 50 plots, each consisting of a 200 by 600 foot section with a 200 foot buffer zone.

The herbicides were applied by helicopters flown low over the tops of the trees. The spraying was applied during low- to no-wind conditions. (Furlong 2007)

Dioxins

The active ingredients of Agent Orange and Agent Purple contained some impurities. These impurities included 2,3,7,8-tetrachlorodibenzo -p-dioxin and similar compounds known as polychlorinated dibenzodioxins. This review and the Canadian report refer to these compounds as PCDDs.

Exposures for three years following the 1966–1967 herbicide applications

Estimated Soil Concentrations

No soil samples were collected during the 1966–1967 herbicide test applications. The data that the Canadian report used to estimate the concentrations of herbicides in those applications were determined by use of historic information on herbicide applications, as well as environmental fate and transport modeling. The reports predicted herbicide concentrations (including PCDDs) in surface soil by use of methods provided by the EPA Risk Assessment Protocol for Hazardous Waste Combustion Facilities, in combination with various estimates of chemical-specific soil half-life data and first-order rate law. The predicted soil PCDD concentration ranged from 6.5×10^{-5} to 7.6×10^{-4} mg/kg.

Observation: The predicted PCDD concentrations in surface soil appear correct, and the exposure reconstruction methods used are consistent with ATSDR and EPA exposure assessment methods.

Current Exposures (2005–present)

In order to determine whether the levels of herbicides in the soil represent a current health concern, the Canadian report contains detailed information on field sampling conducted in 2005.

Field Sampling from 2005

Nearly 38 years after Agent Orange, Agent Purple, and Agent White herbicides were tested at the base, environmental field sampling was conducted by Jacques Whiteford

Limited. Sampling occurred between September 28, 2005, and November 9, 2005. A total of 296 surface soil samples (119 discrete and 177 composites), 30 sediment samples, 30 surface water samples, 12 groundwater samples, and 81 composite vegetation samples were sent for analysis of various chemicals on the basis of historic herbicide applications (Furlong 2007).

Jacques Whiteford Limited collected soil samples from 0–10 centimeters in depth (about 0 to 4 inches), excluding root material and vegetation. This sample depth was based on information from a contamination survey in Vietnam, where Agent Orange was applied during the Vietnam War. The concentration of PCDDs in the soil ranged from a low of 1×10^{-8} to a high of 4×10^{-6} mg/kg. This highest concentration was found in samples from area APEC 2, where Agent Orange and Agent White were tested (Furlong 2007).

Observation: This section of the Canadian report is informative because it contains clear statements regarding sampling methods and the data derived from them. Those sampling methods and the data are typical of what ATSDR would use to evaluate the public health implications of the concentrations.

Quality Assurance and Quality Control (QA/QC) of Environmental Sampling

The field sampling conducted by Canada used standard QA/QC procedures, including trip blank, field blank, equipment rinsate blanks, and field duplicates. These standard, appropriate procedures result in data that contain a high degree of reliability.¹ The Canadian report discusses composite sampling used to ensure that the targeted area was adequately represented. Analytical results of these samples allow a determination of the quality of the sampling and shipping procedures. For example, if contaminants are found in a field blank, the integrity of the soil samples may be questionable.

Observation: It is not clear whether the laboratory that analyzed the samples used QA/QC approaches similar to those used by EPA.

Public Human Exposure Assessment—Exposure Pathways

The exposure pathways used in the Canadian report included the following:

- Inadvertent ingestion of soil.
- Dermal contact with soil.
- Inhalation of soil particulates.

¹ Trip blank: samples that are analyzed to measure the amount of chemicals that are present as a result of the transportation procedure (collected on a daily basis).

Field blank: samples that are analyzed to measure the amount of chemicals that are present as a result of the collection procedure (collected on a daily basis).

Equipment rinsate blanks: used to provide an indication of the effectiveness of the equipment decontamination procedures.

Field duplicates: used to measure the reproducibility of the data obtained from samples in the field.

- Inadvertent ingestion of sediment.
- Dermal contact with sediment.
- Inadvertent ingestion of groundwater.
- Dermal contact with groundwater.
- Inadvertent ingestion of surface water.
- Dermal contact with surface water.
- Human ingestion of deer or moose.
- Human ingestion of fish.
- Human ingestion of berries.

Observation: The exposure pathways listed are consistent with those used by ATSDR.

Public Human Assessment Exposure—Receptor Population

One population that may have been exposed to the herbicides was military personnel who trained at the base during 1966 and 1967. The Canadian report authors assumed that military personnel trained in close proximity to the spray test areas during the time of the spraying:

Historical records indicate that lands affected by herbicide applications may have been used for training military personnel. These receptors may have spent extended periods of time training within these areas. It was assumed that military training operations commenced the following year on the exact plot locations of the 1966 spray campaigns. Military Trainees were assumed to spend 2 months of the year at the 1966 spray campaign site. The exposure duration of 2 months was used. It was assumed that individuals . . . [came] into contact with contaminants of concern via three main exposure pathways including: incidental soil/dust ingestion, direct dermal contact with surface soils, and ingestion of wild berries. . . . Assumed exposures lasted for 3 years. . . . Incidental soil ingestion rate was estimated to be 100 gram per day. [the human body half-life for PCDD (the amount of time it takes for PCDD in the body to reduce in half) was estimated to be 7.1 years. . . . The soil half-life for PCDD (the amount of time it takes the amount of PCDD in soil to reduce in half) was estimated to range from 1 to 3 years] (Furlong 2007).

Observation: The approach used in this report section is typical of the approach used by ATSDR in evaluating the public health implications of any exposures, and the exposure reconstruction methods used are consistent with those used in ATSDR and EPA exposure assessments.

Comparison Values and Cancer Slope Factors

As part of the evaluation of exposure to 2,3,7,8-tetrachlorodibenzo -p-dioxin-like congeners, the Canadian report used comparison values, including: the EPA reference doses (RfDs), the EPA Region IX Preliminary Remediation Goals (PRGs), the EPA Region III Risk-Based Concentrations (RBCs), the EPA Cancer Slope Factors, and the World Health Organization Toxicity Equivalency Factors (TEFs). The Canadian report

modified some EPA values to be more conservative and protective of human health (the values were multiplied by 0.2). The report conducted cancer risk estimations by use of EPA cancer slope factors.

Observation: The comparison values (RfDs, PRGs, RBC, cancer slope factors, and TEFs) used in the Canadian report are consistent with those typically used by ATSDR.

The Canadian Report Conclusion

The overall conclusion of the Canadian report states:

Long-term or chronic risk estimates for military trainees who may have inadvertently trained in either the 1966 or 1967 spray areas more than a year following the spray applications were all less than levels that would be indicative of a concern ([hazard quotient²] $HQ < 1$); as a result, no dioxin related adverse health risks are predicted for military trainees potentially exposed in this manner (Furlong 2007).

The cancer health risk estimations in the Canadian report found no excess lifetime risk estimate (it estimated less than one case in 100,000 people similarly exposed).

ATSDR conducted a detailed review of the report, focusing on herbicide applications, field sampling techniques, quality assurance and quality control procedures, exposure pathways, receptor population, comparison values, and cancer slope factors. Procedures used in all these report sections were consistent with those typically used by ATSDR in evaluating the public health implications of human exposure.

Observation: The report's conclusions are supported by the risk assessment methods used in the report. ATSDR finds no reason to reject the conclusions regarding the exposure scenarios considered. ATSDR assumes that members of the U.S. military who were at the base in 1966 and 1967 had exposure scenarios similar to those of the military trainees.

Limitations of this ATSDR Assessment of the Canadian Report

ATSDR does not have specific information regarding the deployment of U.S. military or National Guard members at CFB Gagetown. In evaluating the Canadian report, ATSDR made two assumptions:

² The hazard quotient (HQ) is the ratio of the potential exposure to the substance and the level at which no adverse effects are expected. If the HQ is calculated to be equal to or less than 1, then no adverse health effects are expected as a result of exposure. If the HQ is greater than 1, then adverse health effects are possible. The HQ cannot be translated to a probability that adverse health effects will occur, and the HQ is unlikely to be proportional to risk. It is especially important to note that an HQ exceeding 1 does not necessarily mean that adverse effects will occur.

- (1) That U.S. servicemen and women who deployed for training to CFB Gagetown experienced conditions similar to those encountered by members of the Canadian forces who trained at the base during the same time period.
- (2) The information obtained electronically (including the complete set of the reports) is of sufficient quality to be used to assess the potential risk of persons (Canadian or American) who were deployed to CFB Gagetown.

ATSDR's conclusions are based upon an assumption that the exposure estimates developed in the Canadian report are reasonably accurate. As noted in the Canadian report, "The level of uncertainty resulting from ... activities, some of which occurred more than 50 years ago, coupled with the uncertainties inherent in standard forward-looking risk assessment, is very large. As a result, the expectations regarding the level of precision that this risk assessment exercise can produce should be limited" (Furlong 2007).

Reference

Furlong. 2007. CFB Gagetown Herbicide Spray Programs 1952–2004 Fact-Finder's Letter Report [including appendices identified as Task 2B-Stage 3, Task 3A-1, Task 3A-2] from Dennis Furlong to Peter MacKay, Minister, Canadian Department of National Defence [sic], Ottawa, Ontario, Canada. August 27, 2007.