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Environmental Radiation Program

STATE OF WASHINGTON DEPARTMENT OF HEALTH

HANFORD SITE
SHORELINE VEGETATION STUDY 1999

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Hanford Site Shoreline Vegetation Study 1999

Introduction

The Washington State Department of Health (DOH) is mandated by the state legislature to protect the public health and safety from sources of ionizing radiation. A part of this mandate requires DOH to conduct radiation monitoring to determine the presence and significance of radiation in the environment. The Division of Radiation Protection's Environmental Radiation Section maintains several projects across the state to accomplish this task, including monitoring of the USDOE Hanford Site. At Hanford, numerous media are routinely collected and analyzed for radiological constituents from locations on-site, off-site, and at the site boundary. As part of a quality assurance program, many of the DOH samples are collected at locations where other monitoring programs also collect samples, and in many cases, samples are split with other agencies.

Shoreline Vegetation Sampling Plan

On June 21, 1999, DOH carried out routine sampling and radiological analysis of terrestrial vegetation growing along the Columbia River shoreline at the Hanford Site boundary. The project was conducted jointly with PNNL. A representative of the Government Accountability Project (GAP) also participated in the sampling.

Sample collection sites were chosen to coincide with locations where groundwater contains concentrations of radionuclides above background levels. These included sites near the reactors in the 100 Area, sites near the old Hanford Townsite, sites at the 300 Area, and a background site near Vernita Bridge upstream of the Hanford reactors. In previous activities, GAP had identified particular mulberry trees reported to have measurable strontium-90 (Sr-90) activity. Where possible, samples were collected from these previously identified trees.

DOH collected fruit from mulberry trees growing along the Columbia River shoreline. Fruit samples were collected at 100-H Area and near the old Hanford Townsite. The mulberry tree at 100-H Area was previously identified by GAP as having elevated Sr-90 activity in its vegetation. This tree is located near peak Sr-90 concentrations in 100-H Area groundwater. Mulberry trees at other shoreline locations either had no berries to collect, or had so few berries, that DOH deferred collection to PNNL. Mulberry fruit was not available at the background site near Vernita Bridge. PNNL collected reed canary grass, mulberry fruit and leaves, and vegetation rooting zone groundwater from numerous locations along the entire Hanford Reach.

Results

DOH mulberry fruit samples were counted wet and analyzed for gamma emitters, tritium (H-3), and Sr-90 by the Washington State Public Health Lab. Shown below are the resulting radiological concentrations, along with their 95% confidence intervals.

Sample Site	Sr-90 (pCi/g)	H-3 (pCi/L)	Cs-137 (pCi/g)	Co-60 (pCi/g)
100-H	0.036 ± 0.004	83 ± 51	0.002 ± 0.007	0.005 ± 0.007
Hanford Townsite	0.000 ± 0.003	160 ± 60	0.002 ± 0.004	0.0002 ± 0.003

Within the reported uncertainties, these results are consistent with the results from co-located samples independently collected and analyzed by PNNL, thus providing assurance that the results are reasonable estimates of the true concentrations.

Concentrations of gamma emitting isotopes, including Cs-137 and Co-60, were below the detection limit of about 0.01 pCi/g and are not distinguishable from zero. Concentrations of tritium at both locations are measurable, but small. The concentration of Sr-90 in fruit at the Hanford Townsite is below the detection limit of about 0.01 pCi/g, while the Sr-90 concentration in fruit at 100-H is measurable, but again small.

Impacts

Shoreline vegetation results are used 1) to estimate impacts to humans and biota that may ingest the vegetation, 2) to look for changes in radioactivity levels as a function of time, and 3) as an indicator of radioactivity in other parts of the environment, such as soil and groundwater in the rooting zone of the plants.

The dose to a human from ingesting mulberry fruit would be 0.002 mrem per pound for the fruit at 100-H, and 0.000004 mrem per pound for the fruit at the Hanford Townsite. These doses are far below levels for which there is a known human health impact, and also below limits set by federal regulations. An individual must consume twenty five tons of fruit in one year to reach the maximum dose of 100 mrem/y allowed to a member of the public from facility operations.

The estimated dose rate to a typical deer consuming 100-H mulberry fruit and leaves (leave concentrations reported elsewhere by PNNL) is 0.0004 rad/day per kg of ingested vegetation. This estimated dose rate is several hundred times lower than the biota dose rate limit of 0.1 rad/day set forth in DOE orders. This dose rate limit is based on ICRP and IAEA findings in which measurable, deleterious changes in populations and communities of aquatic and terrestrial organisms have not been observed at dose rates below the limit. The radionuclide concentrations

found in shoreline vegetation near 100-H Area and the Old Hanford Townsite are not indicative of environmental impacts to organisms consuming the vegetation.

The data from this study are not sufficient to determine off-shore environmental impacts from radionuclide concentrations that may be upwelling in the river-bed substrate. This is because the relationship between radiological concentrations in either shoreline vegetation or shoreline groundwater and water upwelling in the river-bed substrate has not been measured. It is not possible to reliably estimate impacts to offshore biota, such as salmon redds, from shoreline vegetation studies.

Elevated tritium and Sr-90 concentrations in mulberry fruit from these areas are not surprising, since the roots of shoreline mulberry trees reside in groundwater with elevated concentrations of these same radionuclides. It is typical that shoreline vegetation samples from areas near the reactors or other known plumes contain above background levels of radioactivity. Strontium-90 concentrations in shoreline vegetation typically range from levels below the detection limit of about 0.01 pCi/g to a few pCi/g, with concentrations up to a few tens to a few hundreds of pCi/g at 100-N Area. The fruit concentrations reported here, as well as the fruit, leaves, and twig results from PNNL as part of the same study, are similar in magnitude to historical vegetation concentrations along the Columbia River shoreline, and do not indicate significant change.

Elevated radioactivity in vegetation may indicate elevated radioactivity in the groundwater in the vicinity of the vegetation's rooting zone. However, the quantitative relationship between radioactivity in near-shore vegetation and rooting zone groundwater is not known to a reasonable degree of accuracy. This relationship is expected to be highly variable, in part due to the large fluctuations in river stage which influence groundwater concentrations. The Department of Health and PNNL intend to further investigate the relationship between radioactivity in vegetation and rooting zone groundwater in future studies.

Summary

The 1999 shoreline vegetation data collected and analyzed by DOH at Hanford's 100-H Area and old Hanford Townsite are limited in scope. These data primarily provide quality assurance to the larger data set collected by PNNL, which includes mulberry fruit and leaves, reed canary grass, and groundwater collected along the entire Hanford Reach. PNNL plans to report on the entire study. The results of the DOH portion of this study do not indicate a threat to public health and safety, a threat to the environment, or unexpected trends in radiation levels found in vegetation at Hanford’s 100-H Area and the old Hanford Townsite. DOH plans to collect a broader scope of samples in future shoreline vegetation studies.