

Washington Soil Dioxin Study Results

Background

The Department of Ecology (Ecology) recently completed a state-wide study where concentrations of certain chemicals were measured in soil collected from urban and rural areas. The overall goal of the study was to define the range of concentrations of dioxins and furans (dioxins) and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) found in the soil of urban and rural areas of Washington.

For the rural part of the study, Ecology collected soil samples from state parks throughout the state (Figure 1). Samples were collected to help Ecology understand what levels of these chemicals were present in areas not influenced by human activity. Samples were analyzed for dioxins, cPAHs and arsenic. Soil concentrations were similar to levels reported in previous studies conducted in Washington and other parts of the United States.

For the urban part of the study, Ecology partnered with the City of Seattle to collect soil samples in six Seattle neighborhoods. These neighborhoods were South Park, Georgetown, Ravenna, Capitol Hill, West Seattle and Ballard (Figure 2). In each neighborhood, Ecology and the City collected 20 samples from randomly selected planting strips. Samples were analyzed for dioxins and cPAHs.

The range of dioxin and cPAH concentrations in the Seattle soil samples were similar to the range of concentrations measured in other cities. In general, the average cPAH levels were somewhat lower than levels reported in other cities and average dioxin levels were somewhat higher than those found in other cities. This document contains information about the study methods, results and next steps.

Q: How were the samples collected?

A: Rural area sample collection:

- Ecology collected samples from state parks in areas with a population density of less than 500 people per square mile.
- Sample areas were located at least 2.5 miles away from a major highway.
- Each sample was made up of the top three inches of soil from five locations within a 0.5 acre sampling area.

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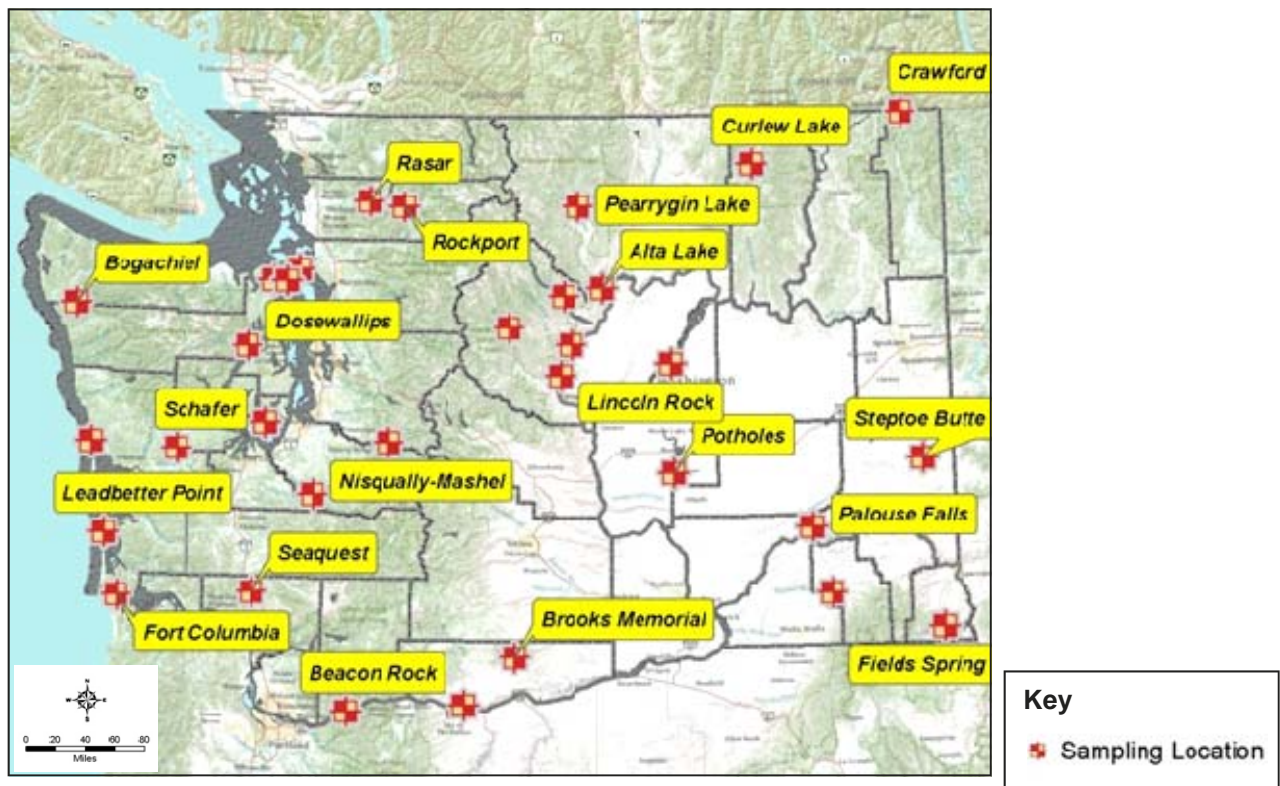
Visit Ecology's Web site to read the study report:

http://www.ecy.wa.gov/programs/tcp/sites_brochure/lower_duwamish/SoilDioxinStudy/SoilDioxinStudy-hp.html

Urban area sample collection:

- Ecology collected soil samples from six Seattle neighborhoods.
- A total of 20 soil samples were collected from city-owned roadway planting strips in each neighborhood area. The sample locations were randomly chosen using standard statistical methods.
- Each sample included soil gathered from five locations at one site. The top three inches of soil was used for sampling. The soil from the five locations was mixed together to form one sam-

Figure 1. Rural soil dioxin study area.



Q: What did the study find in urban areas?

A: Soil dioxin concentrations ranged from 1.7 parts per trillion (ppt) to 114.7 ppt. (Table 1). The average level of dioxin found in Seattle neighborhoods was 19 ppt. Dioxin levels varied within and across different neighborhoods. As shown in Table 1 (page 4), average levels range from 7.5 ppt (West Seattle) to 36 ppt (Georgetown).

Soil cPAH concentrations ranged from 1.9 parts per billion (ppb) to 8,851 ppb. The average level of cPAHs was 260 ppb. cPAH concentrations varied within and across neighborhoods. As shown in Table 2 (page 4), average levels range from 54 ppb (West Seattle) to 680 ppb (Capitol Hill).

Q: How do these levels compare with other urban areas?

A: Agencies and academic researchers have performed studies measuring dioxin and cPAH soil concentrations in urban areas. The data from this study cannot be directly compared to these studies because of differences in population size and density, traffic patterns, study design and other factors. However, information from these other studies can provide some context for evaluating the current study results.

Figure 2. Seattle urban soil dioxin study area.



- **Dioxin levels in other cities:** The range of dioxin concentrations in the Seattle study are similar to the range of concentrations reported for urban soils in other parts of the US. However, the average levels in this study are slightly higher than levels reported in other cities.
- **CPAH levels in other cities:** The range of cPAH concentrations in the Seattle study are similar to the range of concentrations reported for urban soils in other parts of the US. However, the average levels in this study generally fall at the lower end of the average concentrations reported in other cities.

Q: How do these numbers compare to state and federal cleanup levels?

A: This study was designed to get an overall idea of the range of dioxins and cPAHs levels in rural and urban soils. It was not designed to support decisions about whether individual properties or areas have contamination above state and federal cleanup levels. However, state and federal regulatory guidelines do pro-

vide some context for evaluating the study results. Tables 1 and 2 summarize the results of those comparisons for dioxins and cPAHs, respectively.

Cleanup levels and screening levels.

- Ecology, the Agency of Toxics and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA) have all developed cleanup levels or screening levels for dioxins and/or cPAHs. These values are typically used to define areas that require no further action.
- The average dioxin concentrations in five of the six neighborhoods are above the state Model Toxics Control Act (MTCA) cleanup levels. However, the average concentrations do not exceed the ATSDR and EPA soil screening levels for dioxins (Table 1).
- The average cPAH concentration in four neighborhoods are above the MTCA cleanup level. The average concentration of all six neighborhoods are higher than the EPA screening level.

Table 1. Dioxin Levels in Seattle Neighborhoods and Comparisons to State and Federal Regulatory Limits

Neighborhood	¹ Range (ppt)	Average	² Number of Samples above State MTCA Method B cleanup level (11 ppt)	³ Number of Samples above Federal ATSDR screening Level (50 ppt)	⁴ Number of Samples above EPA Draft cleanup Level (72 ppt)
Ballard	1.9 - 62.4	26	17	2	0
Capitol Hill	3.2 - 96.2	18	8	3	1
Georgetown	5.3 - 114.7	36	17	4	2
Ravenna	5.2 - 49.6	15	7	0	0
South Park	3.6 - 22.7	12	12	0	0
West Seattle	1.7 - 32.8	7.5	2	0	0
All areas	1.7 - 114.7	19	63	9	3

Table 2. Carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) Levels in Seattle Neighborhoods and Comparisons to State and Federal Regulatory Limits

Neighborhood	Range (ppb)	Average	² Number of Samples above State MTCA B Cleanup Level (137 ppb)	⁵ Number of Samples above EPA Screening Level (15 ppb)
Ballard	35.2 - 1247	340	13	20
Capitol Hill	34.4 - 8,851	680	12	20
Georgetown	46.5 - 973.4	240	11	20
Ravenna	25.9 - 1945	260	7	20
South Park	7.4 - 388.7	100	6	19
West Seattle	1.9 - 404.1	54	2	8
All areas	1.9 - 8851	260	51	107

¹ Soil data for dioxins is reported as toxic equivalents (TEQs). This means that the measured concentrations have been adjusted to reflect the different levels of potency of individual dioxin and furan components. The concentrations, adjusted for potency level, are combined into a single concentration that reflects the potential toxicity of the mixture of dioxin and furan components.

² State MTCA is a rule that outlines procedures for setting cleanup levels for hazardous substances.

³ Federal Agency for Toxic Substances Disease Registry Screening Levels. This level is used to identify areas where more study is needed and is not a cleanup level.

⁴ Environmental Protection Agency proposed soil screening levels. EPA's Superfund cleanup program published draft soil cleanup guidelines in 2009. These guidelines are used for setting cleanup levels for hazardous substances.

⁵ The EPA cPAH screening level is a guideline used for setting cleanup levels for hazardous substances.

Q: What did the study find in rural areas?

A: Dioxin levels in the soils from Washington state parks ranged from 0.15 - 9.4 ppt. The average concentration was 1.7 ppt. CPAH levels in the soils from Washington state parks ranged from 0.16 to 24 ppb. The average concentration was 2.3 ppb.

Q: Where do cPAHs and dioxins and furans come from?

A: Most dioxins are produced when people burn wood or waste. Waste incinerators, home burn barrels, fireplaces, and wood stoves release dioxins into the air. Exhaust from diesel engines also contains dioxins, as do emissions from natural sources such as forest fires and volcanoes. Some industrial processes, such as chlorine bleaching at pulp mills and certain types of chemical manufacturing, can also produce dioxins.

Currently, most of the cPAHs released to the atmosphere in the Puget Sound region come from vehicles and wood stoves. Creosote-treated wood, used motor oil, and some driveway sealers contain cPAHs that can enter the environment.

Dioxins and cPAHs released into the atmosphere can fall to the ground and contaminate soil and water. Due to changes in environmental regulations and industrial processes, emissions of dioxins and cPAHs in the U.S. have decreased significantly since the 1970s.

Q: How could I be exposed to dioxins or cPAHs?

A: Everyone is exposed to dioxins and cPAHs because they are in many foods (for dioxins, especially meat and dairy products) and present throughout our environment. For nonsmokers, about 90 to 95% of exposure usually comes from food. While cigarette smokers may have a little extra exposure to dioxins, their exposure to cPAHs may be significantly higher, equaling or exceeding that from food. Soil, air, and water usually contribute only a small part of our exposure to dioxins and cPAHs. Exposure to contamination could occur if you have direct contact with the soil (when gardening or playing in the dirt) or accidentally inhaling or ingesting soil.

Q: How could these chemicals affect the health of my family?

A: People's exposure to dioxins and cPAHs in Seattle soils is expected to be small compared to exposure from other sources such as food, and compared to exposures that have been found to have harmful effects in people and animals. Any potential effects are likely to be small enough that they would be difficult to even measure.

Several studies have found increased rates of cancer in people who have had many years of exposure to dioxins in their workplace. Dioxins have also been linked to cancer in many experiments in laboratory animals. However, the amount of exposure in these studies was significantly higher than would occur from Seattle soils. Based on data from animal studies, there is some concern that exposure to lower levels of dioxins over long periods (or higher levels at sensitive times) might affect reproduction or development. Dioxins may also have harmful effects on the liver, peripheral nerves, and the immune system.

Several cPAH-containing mixtures, including tobacco smoke, coal tar, and creosote are known to cause cancer in people, while studies in animals found that exhaust from gasoline and diesel engines can cause cancer. Also, individual cPAHs have been shown to cause cancer in animals. Other health effects have been observed for a few cPAHs, but the evidence is not as strong as for cancer. The levels of cPAH exposure in these studies were significantly higher than would be expected from soils in Seattle neighborhoods.

Q: How can I reduce my exposure to dioxins and cPAHs?

A: There are several ways that you can reduce your exposure to dioxins and cPAHs. These include:

- Washing your hands before eating after playing or working outside
- Removing your shoes before going inside
- Preventing children from eating dirt
- Washing children's toys, bedding and pacifiers often
- Damp dusting, mopping and vacuuming often
- Keeping your pets clean – brush and bathe them often
- Eating a healthy and balanced diet and reducing your intake of fatty foods (whole milk, meat)
- Washing fruits and vegetables before eating them, especially if they are grown at home
- Gardening in raised beds with clean soil
- Wearing gloves when gardening or landscaping

Q: Can I eat the vegetables in my garden?

A: Fruits and vegetables are okay to eat because they take up only a small fraction of dioxins and cPAHs that are in soil. However, since garden soils may cling to the outside of the edible portions, it is important to peel or thoroughly wash the produce to remove any contamination that may be present.

Q: Will Ecology clean up the soil found to have contamination above state cleanup levels?

A: The goal of the study was not to determine areas for cleanup but instead to determine the range of contamination in urban and rural areas of Washington. While some soil concentrations exceed the MTCA

cleanup levels, Ecology does not believe those concentrations are high enough to require immediate cleanup actions. Exposure to these chemicals can be reduced by taking the steps outlined on page 6.

Q: Will more sampling be done?

A: Ecology has no current plans to do more soil sampling.

Q: How will Ecology use the results from the Seattle neighborhood study?

A: There are many MTCA cleanup sites in Washington with dioxin and cPAH contamination. The Seattle neighborhood soil sampling data will help Ecology in several ways. Ecology will use the results to:

- Determine if more sampling is needed in one or more of the six Seattle neighborhoods and where.
- Design future studies in other Washington cities. No two cities are completely alike. However, study results will help Ecology to design studies to provide context for decisions on soil cleanup actions in other areas.
- Help identify ways to prevent sediment contamination in Seattle rivers and lakes. For example, Ecology is currently exploring the relationships between contamination levels in soil, storm water and sediment. These data will help Ecology better understand geographic patterns of contamination.

Q: How will Ecology use the rural background sampling results?

A: The rural sampling data will help Ecology define natural background levels for dioxins and cPAHs. Ecology evaluates natural background levels when making cleanup decisions under the MTCA rule. The rule specifies that soil cleanup levels shall not be established at levels below natural background levels. Natural background levels are typically considered to be levels found in rural areas that are not near local sources of contamination.

Q: How does this study relate to the T117 and other cleanup sites near the areas that were sampled?

A: Our study goal was to gather information about dioxins and cPAHs in soil around the Seattle area. The study results will provide context for investigations of individual cleanup sites. However, the study results are not meant to be part of an Ecology remedial investigation and will not lead to property cleanups by Ecology.



DEPARTMENT OF
ECOLOGY

State of Washington

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Seattle Soil Dioxin Study Seattle, WA

Results of Soil Dioxin Study in South Park, Georgetown, Ravenna, Capitol Hill, Ballard and West Seattle

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Photo credit John Monnat

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clean up the Duwamish River?**

Contact the Duwamish River Cleanup
Coalition at contact@duwamishcleanup.org,
(206) 954-0218 or visit
<http://www.duwamishcleanup.org/index.html>



Results of a Department of Ecology Washington Soil Dioxin Study

The Department of Ecology (Ecology) recently completed a state-wide study where concentrations of certain chemicals were measured in soil collected from urban and rural areas. The overall goal of the study was to define the range of concentrations of dioxins and furans (dioxins) and polycyclic aromatic hydrocarbons (PAHs) found in the soil of urban and rural areas of Washington. Samples were collected to help Ecology understand what levels of these chemicals were present in areas not influenced by human activity.

For the rural part of the study, Ecology collected soil samples from state parks throughout the state. Samples were analyzed for dioxins, PAHs and arsenic. Soil concentrations were similar to levels reported in previous studies conducted in Washington and other parts of the United States.

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The range of dioxin and PAH concentrations in the Seattle soil samples were similar to the range of concentrations measured in other cities. In general, the average PAH levels were somewhat lower than levels reported in other cities and average dioxin levels were somewhat higher than those found in other cities. This document contains information about the study methods, results and next steps. If you would like a copy of this fact sheet in another language, please contact Meg Bommarito at (425) 649-7256 or Meg.Bommarito@ecy.wa.gov.

Kết quả của Bộ Sinh Thái Học Của Washington Về Đất Dioxin

Khoa Sinh thái học (Sinh thái học) gần đây đã hoàn thành một nghiên cứu trên toàn tiểu bang nơi nồng độ của một số hóa chất được đo trong đất được thu thập từ các khu vực đô thị và nông thôn. Mục tiêu tổng thể của nghiên cứu là để xác định phạm vi của nồng độ dioxin và furan (dioxin) và hydrocarbon aromatic (PAHs) được tìm thấy trong đất của các khu vực đô thị và nông thôn của Washington. Các mẫu được thu thập để giúp Sinh thái học hiểu mức độ các hóa chất này đã có mặt tại các khu vực không bị ảnh hưởng bởi hoạt động của con người.

Đối với một phần nông thôn của nghiên cứu, sinh thái học thu thập đất mẫu từ các công viên của tiểu bang. Mẫu được phân tích cho dioxin, PAHs và asen. Nồng độ đất tương tự như mức độ báo cáo trong các nghiên cứu trước đây tiến hành ở Washington và các bộ phận khác của Hoa Kỳ.

Đối với phần đô thị của nghiên cứu, Sinh Thái Học hợp tác với Seattle City Light để thu thập đất mẫu trong sáu khu phố Seattle. Các khu dân cư là South Park, Georgetown, Raven0na, Capitol Hill, West Seattle và Ballard. Tại mỗi khu phố, Sinh Thái và City of Seattle thu thập 20 mẫu từ lựa chọn ngẫu nhiên trồng dải. Các mẫu được phân tích dioxin và PAH,

Phạm vi của các nồng độ dioxin và PAH trong các mẫu đất Seattle tương tự như phạm vi của nồng độ đo ở các thành phố khác. Nhìn chung, các mức trung bình PAH thấp hơn mức được báo cáo ở các thành phố

khác và mức độ trung bình của dioxin cao hơn so với những người được tìm thấy ở các thành phố khác. Tài liệu này chứa thông tin về các phương pháp nghiên cứu, kết quả và các bước tiếp theo. Nếu bạn muốn một bản sao của tờ thông tin này trong một ngôn ngữ khác, xin vui lòng liên hệ với Meg Bommarito at (425) 649-7256 hoặc Meg.Bommarito@ecy.wa.gov.

Resultados del Estudio de la Dioxina de la Tierra del Departamento de Ecología de Washington

El Departamento de Ecología (Ecología) completó recientemente un estudio a nivel del estado en el que se midieron las concentraciones de algunos químicos en la tierra que se recogió en áreas rurales y urbanas. El objetivo general del estudio era definir el rango de concentración de dioxinas y furanos (dioxinas) e hidrocarburos aromáticos policíclicos (PAH) que se encuentran en la tierra de las áreas urbanas y rurales de Washington. Las muestras se recogieron para ayudar a Ecología a comprender qué niveles de estos químicos estaban presentes en áreas en las que la actividad humana no está presente.

En las partes rurales del estudio, Ecología recolectó muestras de tierra de los parques estatales en todo el estado. Se analizaron dichas muestras en busca de dioxinas, PAH y arsénico. Las concentraciones de tierra eran similares a los niveles informados en estudios anteriores llevados a cabo en Washington y otras ciudades de Estados Unidos.

En las partes urbanas del estudio, Ecología se asoció con City of Seattle para recolectar la tierra de seis urbanizaciones de Seattle. Dichas urbanizaciones fueron South Park, Georgetown, Ravenna, Capitol Hill, West Seattle y Ballard. En cada una de ellas, Ecología y Seattle City Light recogieron 20 muestras de franjas de plantas seleccionadas al azar. Estas muestras se analizaron en busca de dioxinas y PAH.

El rango de concentración de dioxinas y PAH en las muestras de tierra de Seattle fue similar al rango de concentración que se midió en otras ciudades. En general, los niveles promedio de PAH estuvieron un tanto por debajo de los niveles estudiados en otras ciudades, mientras que los niveles promedio de dioxinas estuvieron un poco por encima de los hallados en otras ciudades. Este documento contiene información sobre los métodos de estudio, los resultados y los próximos pasos. Si desea una copia de esta hoja informativa en otro idioma, por favor, entre en contacto con Meg Bommarito por el (425) 649-7256 o por su correo Meg.Bommarito@ecy.wa.gov.

生態部華盛頓州土壤「戴奧辛」含量調查

生態部最近完成了對全州城市及郊區土壤樣本中化學物質濃度的調查。調查的總體目標是確定華盛頓州城市及郊區土壤中戴奧辛和呔喃以及多環芳香烴的濃度範圍。採集樣本是為了幫助生態部了解這些化學物質在尚未受到人類活動影響的地區的存在水準。

在本次調查的郊區部份，生態部從全州的州立公園中收集土壤樣本，分析其中所含的戴奧辛、多環芳香烴和砷。些化學物質在土壤中的濃度與華盛頓州及美國其他部分報告的水準相似。

在調查的城市部份，生態部與西雅圖City Light 合作採集了西雅圖六個社區的土壤樣本。這些社區是South Park、Georgetown、Ravenna、Capitol Hill、West Seattle和Ballard。生態部和西雅圖 City Light 在每個社區從隨機挑選的種植地帶收集 20 個樣本，分析樣本中的戴奧辛和多環芳香烴。

西雅圖土壤樣本中戴奧辛和多環芳香烴的濃度範圍與其他城市測得的濃度範圍相似。一般而言，多環芳香烴平均水準略低於其他城市報告的水準，而戴奧辛平均水準則略高於其他城市。此文件列出調查方法、結果及後續步驟的相關資訊。如果您希望得到翻譯成其他語言文字的副本，請聯絡Meg Bommarito，電話 (425) 649-7256 或發送電子郵件至 Meg.Bommarito@ecy.wa.gov。