

## What is the “Moss Study”?

People living in the Duwamish Valley want a place to live and work where the air they breathe does not harm their health and livelihood (Duwamish Valley Vision 2009).

A new study by the Duwamish River Cleanup Coalition’s Clean Air Program is helping to achieve this vision by measuring indicators of metal pollution in the Duwamish Valley. Metals occur naturally in the environment, but cities and industrial areas often have high levels of metals and other pollution from sources like traffic and factories. If small particles of metals are in the air, they can be breathed in and cause health problems in your lungs and respiratory system.



DRCC’s Duwamish Valley Youth Corps partnered with federal scientists from the US Forest Service, local government and universities, community leaders, and health advocates to conduct a community-based pilot project to measure heavy metals in moss on street trees. Using community-based participatory methods, 26 teens from the Duwamish Valley learned how to collect moss samples to use as an indicator of air pollution in Georgetown and South Park. This project aims to use the information gathered from moss sampled to reduce air pollution and, ultimately, improve the community’s health.

## Why the Duwamish Valley?

People living in the Duwamish Valley have higher rates of diseases linked to air pollution than other areas of Seattle, including twice the rate of children hospitalized for asthma than the city average (Duwamish Valley Cumulative Health Impacts Analysis 2013). The area is also the largest center of industry in King County and has several major highways and truck traffic routes, which are common sources of heavy metals and other air pollution.

Moss can be used as a “bioindicator” of air pollution. Bioindicators are living things that help us understand what is happening in our environment. The most famous example is “the canary in the coal mine” that was once used to warn coal miners if the air in the mine became unsafe (if the canary died, the workers knew they should leave the mine). Moss is one of the best bioindicators of air pollution because it doesn’t have roots and directly captures both nutrients and air pollution directly from the atmosphere.

## Who is conducting the study?

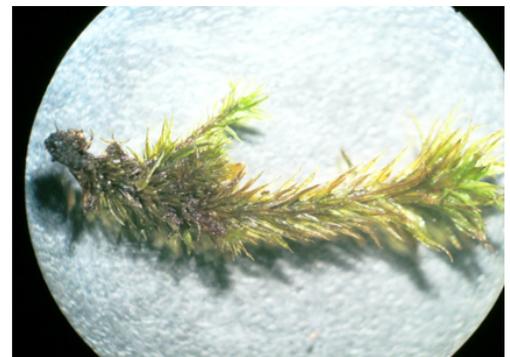
The US Forest Service partnered with the Duwamish Valley Youth Corps to collect tree moss samples to use as bioindicators of air pollution in communities of the Duwamish Valley. Supporting partners included the Duwamish Infrastructure Restoration Team (DIRT Corps), Just Health Action, Street Sound Ecology, City of Seattle's Office of Sustainability and Environment, Western Washington University's Huxley College of the Environment, and the University of Washington's Department of Environmental and Occupational Health.

The purpose of this project is to investigate if local community partners, with guidance from the scientists on the team, could collect and prepare moss samples to be analyzed for heavy metals. If successful, the results would be used as a screening tool to provide guidance for additional air quality monitoring in the Duwamish Valley, and to inform mitigation strategies that can be used to protect the health of people who work and live in the area.

## What have we learned?

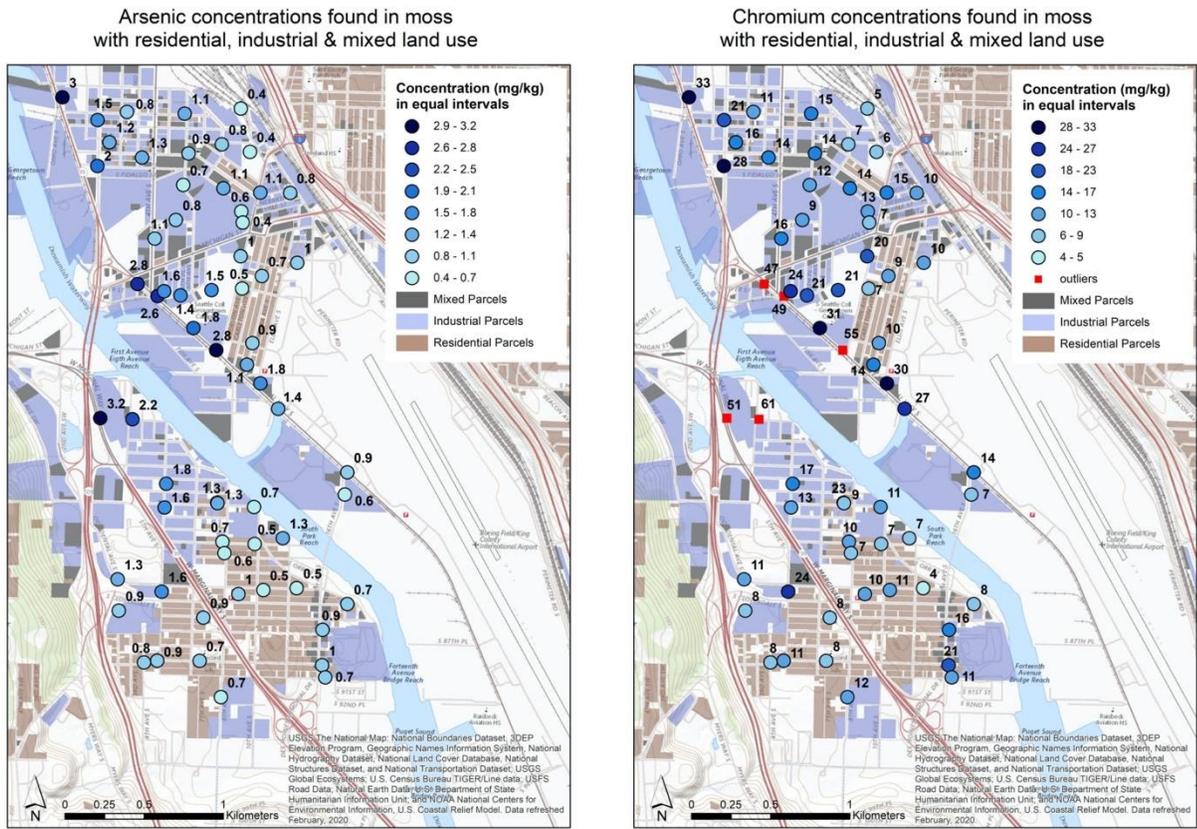
Trained local youth from Duwamish Valley Youth Corps collected 80 samples from moss on trees in a grid covering South Park and Georgetown in 2019. Scientists collected an additional 20 samples to compare to the samples collected by the Youth Corps. All samples were analyzed for 25 heavy metals and other elements in a US Forest Service laboratory. The main findings from the project were:

1. The samples collected by the youth were consistent with the samples collected by the scientists, demonstrating that *trained youth could collect reliable scientific samples*;
2. Levels of Arsenic, Chromium, Cobalt and Lead in moss sampled in the Duwamish Valley were higher than similar studies of moss in Seattle area parks and in residential areas of Portland, Oregon – *Arsenic and Chromium were generally twice as high as in Portland*;
3. *Metal concentrations found in the samples were highest in the industrial areas of South Park and Georgetown, especially along the Duwamish River, and lower in the residential areas.*

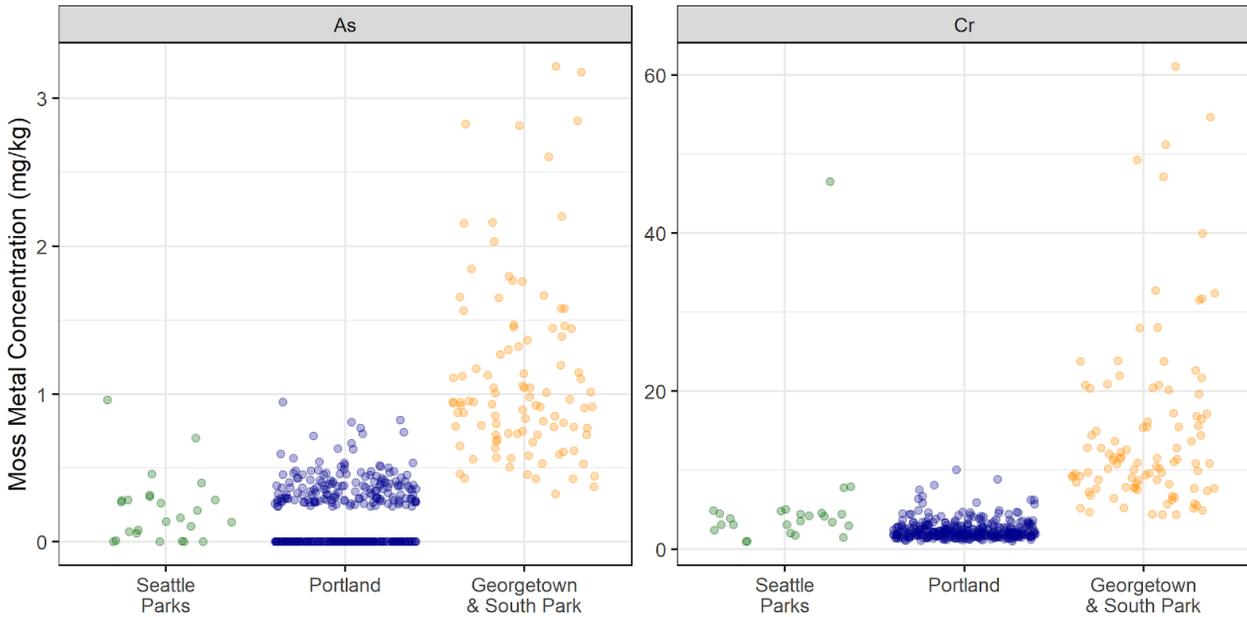


**Figure 1.** Moss accumulates Particulate Matter (PM) air pollution and provides an inexpensive screening tool for mapping air quality and directing new monitoring efforts.

The greatest difference between levels of metals in moss in the Duwamish Valley and levels seen in previous studies were for arsenic and chromium. The figures below show maps of the arsenic and chromium data and a "scatterplot" figure showing how the Duwamish Valley data for these two metals compares to the Seattle parks and Portland studies.



**Figure 2:** The light dots show where moss samples with lower concentrations of arsenic and chromium were collected; the concentration increases as the dots get darker, with “outliers” in red. The blue areas are industrial and the brown areas are residential.



**Figure 3:** Samples from Seattle parks are shown in green, from Portland residential areas in blue, and from the Duwamish Valley in orange. The average concentration of chromium in moss in Georgetown and South Park was 11.1 mg/kg – more than double the average of 4.6 mg/kg found in Portland and nearly triple the average found in Seattle Parks (3.9 mg/kg). In addition, 98 percent and 94 percent of the Georgetown and South Park chromium and

arsenic concentrations in moss, respectively, were higher than the average in residential Portland.

## What does this mean?

There are no environmental or health standards for metals in moss. The data collected in this study are only an *indicator* of air pollution, not a direct measurement of metals in the air. The relationship between the metal concentrations found in the moss to what people might be breathing is unknown. Air monitoring instruments are needed to determine how much metal is actually in the air. Additional research will also be needed to determine if those levels are high enough to cause health problems for workers and people living in the area.

In Portland, the city's moss data was used to decide where to put air monitors to directly measure air pollution. Monitors were placed at locations where the highest metals levels in moss were found, and confirmed that concentrations of some metals exceeded state health benchmarks in two neighborhoods. Air quality in both neighborhoods has since improved. The findings led Governor Kate Brown to create the Cleaner Air Oregon program, which was a major overhaul of how air toxics are monitored across the state. The Environmental Protection Agency also created stricter regulations for toxics emissions by art glass manufacturers across the nation.

## What's next?

The US Forest Service is continuing to analyze the results from this study and will issue a full report next year.

The Puget Sound Clean Air Agency (PSCAA) has a single air monitor in the South Park/ Georgetown study area, which does not measure metals concentrations. The agency is seeking funding to add more monitors in areas where the Moss Study found high levels of metals.

**Right now, DRCC, US Forest Service, PSCAA, and the other project partners need your help.** Community members are invited to help determine the areas that are the highest priority for additional air monitoring, and what other next steps should be taken. Options might include building green barriers or planting trees between industrial and residential areas to capture airborne pollution, limiting traffic routes to avoid impacts in residential areas, and screening workers in industries for health problems associated with airborne metals and other industrial pollution.

**The community will be involved in deciding the next questions to ask and steps to take.** For more information, please email [contact@duwamishcleanup.org](mailto:contact@duwamishcleanup.org)

Visit [www.duwamishcleanup.org/moss-study](http://www.duwamishcleanup.org/moss-study) for more information about this project.

Study partners include: the US Forest Service, State and Private Forestry, Pacific Northwest Region; Urban Waters Federal Partnership; Duwamish Infrastructure Restoration Team (DIRT Corps); Just Health Action; Street Sounds Ecology; the City of Seattle's Office of Sustainability and Environment; Western Washington University's Huxley College of the Environment; and the University of Washington Department of Environmental and Occupational Health Sciences.



Questions? Please contact us at:

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*DRCC elevates the voice of those impacted by Duwamish River pollution and other environmental injustices to advocate for a clean, healthy, equitable environment for people and wildlife. We promote placekeeping and prioritize community capacity and empowerment.*