

Health Impact Assessment: Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site

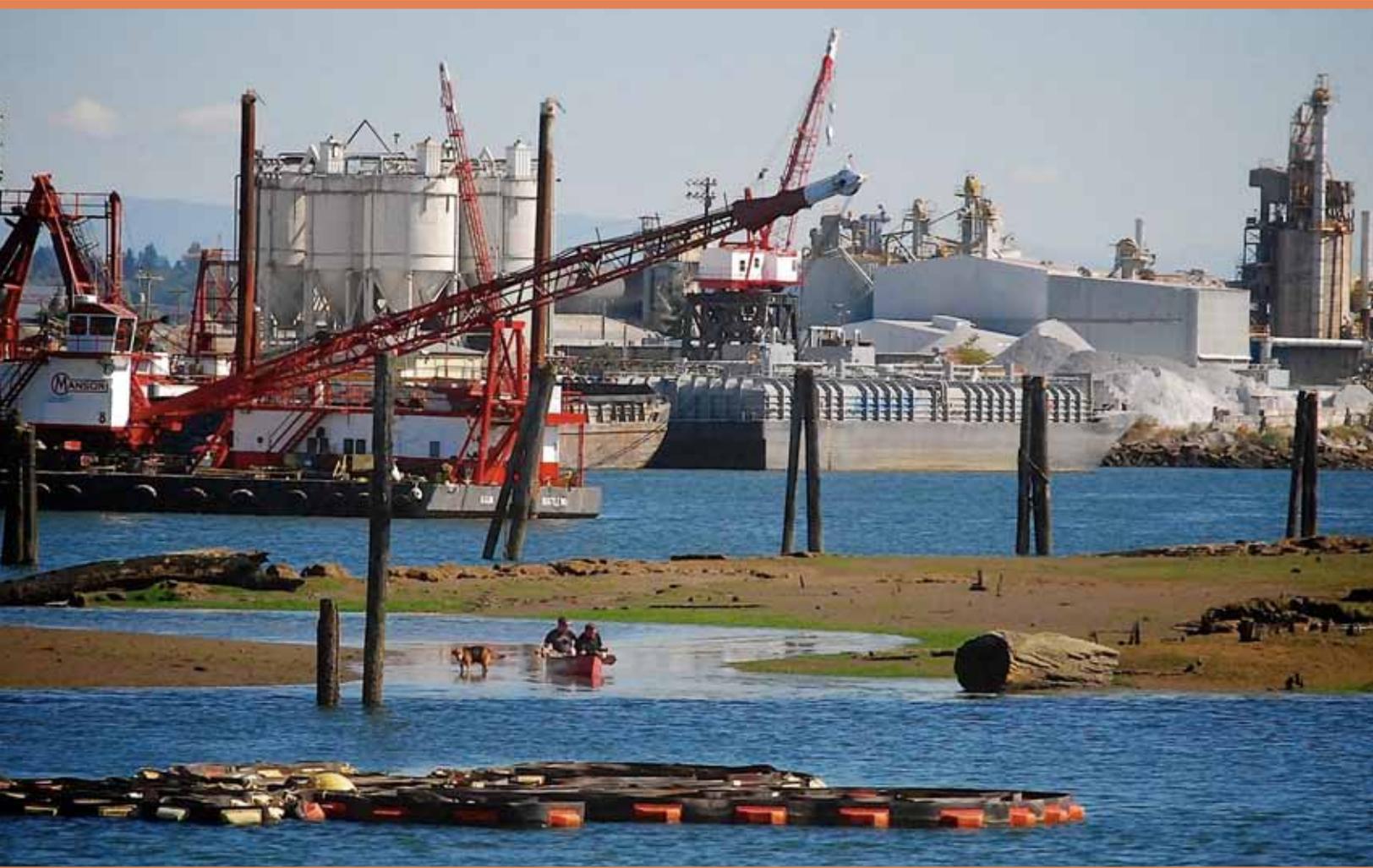


Photo: Patrick Robinson, *West Seattle Herald*

FINAL REPORT
September 2013



Photo: Paul Joseph Brown

Table of Contents

Executive Summary and Recommendations	4
Introduction	10
Effects of the proposed cleanup plan on local residents	15
Effects of the proposed cleanup plan on Tribes	21
Effects of the proposed cleanup plan on subsistence fishing populations	25
Institutional controls and health	30
Effects of the proposed cleanup plan on workers and employment in local industries	34
Other considerations	38

This is the *Final Report* for the HIA. This report is accompanied by six Technical Reports that provide details about the HIA methods, assessment, and recommendations. This second printing of the *Final Report* includes small changes since the first printing: typographical corrections, small text changes, and a different copyright statement. We previously published two interim reports. The *Advance Report* (May 2013) provided information for stakeholders during the EPA public comment period for the proposed cleanup plan. The *Public Comment Report* (June 2013) was submitted to EPA as formal public comment. All of these reports are available on the UW Duwamish Superfund Cleanup HIA website: <http://deohs.washington.edu/hia-duwamish>.

HEALTH IMPACT ASSESSMENT AUTHORS

William Daniell, University of Washington
 Linn Gould, Just Health Action
 BJ Cummings, Duwamish River Cleanup Coalition/
 Technical Advisory Group
 Jonathan Childers, University of Washington
 Amber Lenhart, University of Washington



DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH
 University of Washington

W UNIVERSITY of WASHINGTON

JustHealthAction



Acknowledgments & Disclaimer

We are indebted to the many agencies, organizations, and individuals who have contributed their time, information, and expertise to this project.

Fishing community advisors and assistance

- Washington State Commission on Pacific and Asian American Affairs: Kendee Yamaguchi
- Vietnamese Friendship Association: Vu Lee
- Filipino Community Center
- South Park Neighborhood Center
- Providence Regina House Food Bank
- Rainier Valley Food Bank
- The many individuals who served as key informants and focus group participants

Tribal community advisors and assistance

- Suquamish Tribe: Alison O’Sullivan, Denice Taylor (Tribal staff)
- Duwamish Tribe: James Rasmussen, Ken Workman (Tribal members)
- Urban Indian Health Institute: Seattle Indian Health Board
- Catherine O’Neill

Resident community advisors and assistance

- South Park: Paulina Lopez, Peter Quenguyen, Yamilette Rios, Morgan Watson
- Georgetown: Marianne Clark, Holly Krejci
- Nickelsville: Trace deGarmo
- Governor’s Panel on Health Disparities: Former State Representative Velma Veloria
- Puget Sound Sage: Genevieve Aguilar

Liaison committee

Anchor QEA, ERM Consulting, The Boeing Company, Port of Seattle, City of Seattle, King County, Public Health - Seattle & King County, Puget Sound Clean Air Agency, Washington Department of Ecology, Washington Department of Health, Washington Department of Natural Resources, United States Environmental Protection Agency

Technical assistance provided or supported by the Health Impact Project

- The Pew Charitable Trusts: Katherine Hirono, Aaron Wernham, Alex Dery Snider
- Habitat Health Impact Consulting: Marla Orenstein
- Decision Research: Jamie Donatuto, Robin Gregory

Graphic Design

Cathy Schwartz

This project and report were supported by a grant from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts; and also by the Rohm & Haas Professorship in Public Health Sciences, sponsored by the Rohm & Haas Company of Philadelphia.

The views expressed are those of the authors and do not necessarily reflect the views of the Health Impact Project, The Pew Charitable Trusts, the Robert Wood Johnson Foundation, or the Rohm & Haas Company.

Suggested citation

Daniell W, Gould L, Cummings BJ, Childers J, Lenhart A. Health Impact Assessment: Proposed Cleanup Plan for the Lower Duwamish Waterway Superfund Site; Final Report. Seattle, WA: University of Washington, Just Health Action, and Duwamish River Cleanup Coalition/Technical Advisory Group. September 2013.



© 2013. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License, http://creativecommons.org/licenses/by-nc-nd/3.0/deed.en_US.



Executive Summary and Recommendations

Photo: Linn Gould, Just Health Action

BACKGROUND

More than a century of industrial and urban wastes have contaminated Seattle's Duwamish River. The Environmental Protection Agency (EPA) placed the Lower Duwamish Waterway on the Superfund List in 2001. On February 28, 2013, EPA released its *Proposed Plan* for cleanup of the site. EPA accepted public comment on the Plan until June 13, 2013.

The Plan calls for capping in place or removing highly contaminated river sediments, plus enhanced and natural recovery for moderately or low-level contaminated sediments. Resident fish and shellfish will be less contaminated but probably still unsafe for human consumption, even after the 17-year period of active cleanup and monitored recovery.

HEALTH IMPACT ASSESSMENT (HIA)

Three partner organizations—UW School of Public Health, Just Health Action, and the Duwamish River Cleanup Coalition/Technical Advisory Group—conducted a Health Impact Assessment of EPA's *Proposed Plan*.

This assessment did not examine alternate cleanup scenarios, although most of the HIA findings and recommendations are probably transferable to whatever remedy EPA selects for its final cleanup decision.

The HIA focused on four vulnerable populations whose health and well-being might be affected by the proposed cleanup. The HIA was guided by Resident and Tribal

Advisory Committees, individual community advisors, and a Liaison Committee, with representatives from EPA, other agencies, and potentially responsible parties. Focus groups were conducted with Duwamish Tribe members and urban subsistence fishers.

WHOSE HEALTH MIGHT BE AFFECTED BY THE CLEANUP?

Local residents: Two residential neighborhoods, South Park and Georgetown, border the Duwamish River and Superfund site. A high percentage of residents are foreign-born and people of color, particularly in South Park. Average household income in both neighborhoods is much lower than the county average, and poverty rates are higher.

Health status is relatively poor compared to the rest of Seattle, with higher existing rates of child asthma hospitalization, diabetes, cardiovascular disease, and lung cancer. There are also more industrial emissions, contaminated sites, and vehicular pollution than in the rest of the city.

Affected Tribes: Three Native American Tribes are affected by the cleanup. The Duwamish Tribe's ancestral lands include the Duwamish River watershed. The Muckleshoot and Suquamish Tribes are federally recognized Tribes with treaty-guaranteed, usual and accustomed fishing places in the central Puget Sound region. Both Tribes actively manage seafood resources on the Duwamish River.

There are no publicly available health data for these Tribes. However, census and health data for Native Americans in Washington State and King County reveal high levels of health problems and risk factors including poverty, unemployment, infant mortality, smoking, obesity, diabetes, heart disease, cirrhosis, asthma, and mental distress.

Subsistence fishers: Many people fish on the Duwamish River for salmon, which are non-resident fish and considered relatively safe to eat. However, some people catch resident fish and shellfish as a food source. This population includes Asian and Pacific Islanders; a variety of immigrant communities and people of color; low-income, homeless, and food-insecure populations; and urban American Indians and Alaska Natives (aside from the affected Tribes).

Workers in local industries: The Duwamish River Valley is home to Seattle's and King County's largest concentration of industry, including the Duwamish Manufacturing Industrial Center and Port of Seattle. The manufacturing, wholesale trade, transportation, warehousing, and utilities industries in this area employ at least 50,000 workers. In general, these jobs pay good "family" wages.

HOW MIGHT HEALTH BE AFFECTED BY THE CLEANUP?

The proposed cleanup will reduce health risks from seafood consumption and contact with sediments and the shoreline. However, residual contamination in sediment, fish, and shellfish will still be higher than Puget Sound background after cleanup, and EPA predicts resident seafood will still be unsafe for human consumption. The necessary fishing advisories will be more restrictive than elsewhere in Puget Sound, will be required for at least 40 years, and could persist in perpetuity.

- **Contaminant dispersion during construction**

The health concerns related to cleanup construction activity include possible escape of contaminants outside construction zones. The magnitude of this appears low, however, if environmental dredging technologies, best management practices, and skilled operators are employed.

- **Local residents**

Most local residents do not eat resident fish from the river, but many visit beaches. EPA predicts the cleanup will approach but may not meet goals for arsenic contact on some publicly accessible beaches. The existing health risk and any risk after cleanup should be limited and manageable with wash facilities at public beaches.

Construction-related increases in air and noise pollution, and in rail and truck traffic, could affect the

health of local residents. However, with the anticipated construction strategy, updated fuel standards, and standard EPA policies, there should be limited impact on local residents, beyond the existing high levels of pollution and traffic.

Cleanup construction will generate new jobs, with beneficial impacts on health for those employed. It is uncertain whether or how many jobs will be given to local residents.

Environmental improvements from the cleanup will increase aesthetics of the river and surrounding areas. This may spur reinvestment in Georgetown and South Park. Community revitalization could stimulate a number of beneficial phenomena including physical improvement of housing, streetscapes, and open space, growth in community businesses and services, and increased employment and reduced crime.

Gentrification often occurs alongside community revitalization and is already occurring in Georgetown and South Park. Any cleanup-spurred reinvestment will contribute to this trend. Gentrification can bring health-favorable community benefits. However, without intervention, these are most likely to benefit higher-income residents, and harmful impacts are most likely to affect lower-income residents.

- **Affected Tribes**

Tribal health consequences of chemical contaminants are likely to be substantially worse than projected by EPA risk assessment and predictive models. These models only account for biomedical disease outcomes and do not incorporate fundamental aspects of Tribal health and well-being, such as the importance of accessibility to local natural resources, maintenance of cultural traditions, and the significance of self-determination. The EPA risk assessment also does not consider that river-related risks are compounded by existing Tribal health disparities and cumulative risks from chemical and non-chemical stressors.

Furthermore, although the cleanup will create a cleaner environment for all, inequity between the general population and the Tribes may actually increase. Resident seafood consumption will be relatively safe at a rate typical for the general population rate (e.g., one meal per month), but not at the Tribes' seafood consumption rates.

Institutional controls, such as fish advisories, restrict how much seafood can be safely harvested. These restrictions may violate Tribal fishing rights. They also may affect food security, prompting some Tribal members to eat less healthful foods. Physical health

may still be affected, since some Tribal members may harvest fish in spite of warnings, to protect their cultural and spiritual health.

It is highly likely that habitat renewal will benefit Tribal health, because the environment and species of cultural importance will be enhanced. This will allow more ceremonies on the river, as well as pride, ownership, and empowerment, all of which are important determinants of Tribal health.

- **Subsistence fishers**

Fishing practices could be affected substantially during and after active cleanup. Urban subsistence fishing is poorly characterized, but people fish in many local waters, including the Duwamish River, and in spite of advisories and posted signs. Reasons for fishing and for choosing locations include a wide variety of cultural, traditional, practical, and aesthetic influences.

It is very likely that some fishers and their families will be exposed to chemical contaminants in seafood during and after the cleanup. Fishing activity might decrease during active cleanup, but it is likely that some people will continue to fish there. Many alternative locations are also subject to fish advisories, particularly within close travel distances. After the active cleanup, the cleaner and restored habitat may further entice fishing. Although seafood will pose less health risk at that point, the persisting risks could still be substantial for people with high rates of fish consumption.

Some subsistence fishers who are not able to fish elsewhere or purchase fish will likely experience food and nutritional insecurity. A fish diet has health benefits, particularly for children, and these benefits can be lost if fish consumption is reduced. Other protein sources cost more than self-caught fish, leading to economic hardship. A dietary void could be filled with cheaper, less healthful choices.

Social and cultural traditions could be disrupted if fishers reduce or discontinue fishing. There is not enough information to assess how likely this would be, but the loss of social ties could be an important impact on health and well-being.

These potential impacts on subsistence fishers would pose disproportionate harm for lower-income people, people of color, immigrants, and non-English speakers, and particularly for children.

- **Institutional controls**

Institutional controls (ICs) are administrative measures to prevent people and the environment from being exposed to remaining contamination, using legal tools and informational tools such as fishing advisories. Our

assessment of affected Tribes and subsistence fishers identified some important health issues related to ICs. We also identified broader issues that were not considered in the *Proposed Plan* and that could affect health and cleanup costs.

The *Proposed Plan* does not appear to follow EPA guidance to evaluate ICs as rigorously as any other response alternative. For example, the EPA Feasibility Study included hundreds of pages about various cleanup alternatives, but only seven pages about ICs, plus only three pages in the 82-page “Detailed Cost Estimates” Appendix. The estimated cost of ICs is relatively low compared to an example of enhanced community outreach (Palos Verdes Shelf Superfund Site) that was featured in the EPA *Environmental Justice Analysis* accompanying the *Proposed Plan*.

This is consistent with a pattern identified by the U.S. Government Accountability Office (GAO) in a 2005 review of EPA’s IC practices. The GAO determined that EPA has increasingly relied on ICs over time but inconsistently considers all the necessary factors to ensure that planned controls will be adequately implemented, monitored, and enforced.

The implementation of ICs will add a psychosocial stressor for Tribal and subsistence fisher populations that is likely to have health ramifications on top of existing health risks in these populations. In addition, the application of ICs increases already existing inequities among vulnerable populations by expecting them to modify their behavior when cultural, spiritual, or food security reasons prohibit change.

The proposed ICs are a public health intervention, intended to modify health behaviors. Any such intervention should use evidence-based best practices to characterize alternatives, select the intervention, identify possible unfavorable or inequitable outcomes, and plan an evaluation strategy. To date, the EPA has failed to meet standard expectations of public health practice, as well as their own IC guidance.

- **Local workers**

The major potential health impact of concern relates to employment. Employment is one of the strongest favorable determinants of health and well-being. The cleanup will produce construction jobs and expenditures that could benefit the regional economy, although only a limited subset of Duwamish businesses and workers might benefit directly.

It is plausible that the proposed cleanup could add to existing unfavorable pressures on local industries, with net loss of jobs or reduction in hours of employ-

ment. Existing pressures include: an improving regional economy but reportedly unfavorable business environment; international trade and competition with other ports; constraints of the Duwamish area and appeal of alternative locations; encroachment and conversion of industry-zoned land; commercial real estate trends and speculation; and urban development.

Allocation of cleanup costs is still undecided and uncertain. The costs could be substantial relative to business resources, especially for smaller businesses, and could result in job elimination or reduced worker hours. Business perceptions and uncertainties about the cleanup could affect business behavior, with effects on employment. However, both adverse and beneficial effects of cleanup-related perceptions are plausible.

Existing businesses and employment could benefit substantially if the cleanup reversed the constraints and stigma of a blighted river and if this stimulated industry revitalization and economic robustness. The cleanup will probably not lead to substantial industry revitalization on its own. However, in parallel with other efforts, it could stimulate interest in revitalization and create opportunities for industry to build new connections to pursue shared goals of revitalization.

WHAT'S MISSING FROM THIS PICTURE?

Identifying information gaps is an important goal for any HIA, almost as important as identifying health impacts.

- **Institutional controls**

One important gap is the limited planning for institutional controls, as discussed. The health consequences of residual chemical contamination and institutional controls following cleanup are potentially substantial, and these could pose disproportionate harm for the Tribes and lower-income subsistence fishing households. It is not possible to adequately assess these potential health impacts, given the gaps in information.

- **Source controls**

Another important gap in the Plan is the lack of formal connection to a source control plan. The cleanup goals for contaminant reduction, and the certainty of achieving those goals, depend critically on the timing and extent of source controls. It is not possible to fully assess the potential health impacts of residual contamination without knowing the timing and extent of source controls. Adding clear source control goals and objectives to the Plan, and defining required source control programs and actions, could reduce uncertainty and contribute to improved health outcomes by defining requirements to reduce pollutant loading to the site.

OPPORTUNITIES

Seattle is at the cusp of a new era. Beginning with the cleanup, and accompanied by source control and natural restoration efforts, the Duwamish River and surrounding area have a chance to become a regional asset and symbol of pride, rather than an environmental stigma. There will be opportunities to turn river cleanup and restoration into a national model for healthful and sustainable coexistence of industry, Tribes, and community. It will be a challenging task to find the optimal balance between economic, traditional, subsistence, and recreational uses. However, the alternative—turning away from this opportunity—will create challenges and problems of its own. In this report, we provide recommendations to pursue equitable and sustainable revitalization.

We propose that the City of Seattle, King County, and the Port of Seattle convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community. Experiences in other places could provide models for this effort. The Great Lakes restoration efforts offer an excellent model for public-private collaboration. The vision statement of the Council of Great Lakes Industries, representing major industries and businesses, provides an enviable model and goals for other industry coalitions to consider.

EQUITY

It is critical that there be meaningful and collaborative participation with the affected communities in all efforts to prevent harm from the cleanup, maximize benefits, and promote health equity.

The EPA, City, and County each have prominent policies that make commitments to consider equity, race, and justice in decision-making. We call upon each to uphold these commitments in planning the cleanup and related actions and in planning for predictable health effects of those actions. We encourage the Port of Seattle to develop and implement a formal social justice policy.

The City of Seattle and King County are potentially responsible parties for the cleanup, and they are also responsible for protecting and improving the health and well-being of all people in their jurisdictions. At face value, cleaning up the Duwamish River will address both responsibilities. However, without targeted interventions, the proposed cleanup could result in unanticipated harms to vulnerable populations, and continue or even exacerbate existing health inequities.

RECOMMENDATIONS*

For EPA, City of Seattle, King County, and Port of Seattle

Equity assurance

- Ensure equity in all policies and efforts for environment and community development, in accordance with Seattle’s Race and Social Justice Initiative and King County’s Equity and Social Justice Ordinance, and EPA’s Environmental Justice policies.
- We encourage the Port of Seattle to develop and implement a formal social justice policy.
- Establish an Institutional Control Task Force and include a leader from each affected community. The Task Force should use a community-based participatory approach to engage and empower affected populations so that they can participate meaningfully in all stages of any prospective interventions.
- Establish a Revitalization Fund to enhance Tribal empowerment and health, until institutional controls are removed.

Opportunities

- Convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community.

For EPA

Cleanup plan and liability

- Selection of the final remedy (cleanup plan) and the process for allocating liability should attempt to reduce or eliminate uncertainty for affected businesses, whenever possible.

Construction measures

- Negotiate transport routes and associated mitigation measures for cleanup-related truck and rail traffic with potentially affected residents.
- Use modern clean engines or those with best available emission controls, cleanest available fuels, and “green remediation” techniques to minimize air emissions, plus effective noise and light minimization measures during active cleanup.

Jobs for community members

- Provide cleanup job training and placement assistance to local community members.



Photo: BJ Cummings, Duwamish River Cleanup Coalition/TAG

Institutional controls

- Apply institutional controls, including educational signage and washing stations, at local beaches until health protective standards are met.
- Institutional controls should go beyond restrictive and informational actions, such as fish advisories. Interventions should emphasize positive alternatives, such as identifying, encouraging, and providing options for safe fishing and healthful fish consumption. There is a clear need for innovative thinking.
- Demographics and fishing patterns will change over time. Efforts to promote safer fishing should be designed to acknowledge that the target audience is more than just people who currently fish on the Duwamish River and should include people who may fish there in the future.
- All efforts to provide information and promote safe and healthful fishing options should: be culturally appropriate for each audience; be designed to help people make informed choices; and engage and empower people to participate meaningfully in planning, implementation, and monitoring for success.
- Follow EPA guidance for institutional controls, especially to evaluate them as rigorously as other alternatives.
- Evaluate the true health impact of institutional controls to vulnerable populations.
- Develop a robust Institutional Control Program Implementation and Assurance Plan to protect all vulnerable populations who consume seafood from the Duwamish River, to be funded by potentially responsible parties as long as institutional controls are in effect.

* The following chapters and our separate Technical Reports provide more information about each recommendation.

Actions to protect Tribal health

- Collaborate with Tribes to more fully address their health concerns about the river cleanup.
- Restore Tribes' traditional resource use in accordance with Treaty Rights. Institutional controls need to be temporary, not permanent.

For City of Seattle, King County, and Port of Seattle

Local firms and workers

- Selection of firms for cleanup construction and related activities should, as much as possible, give priority to firms and workers based in Seattle or King County.

Community revitalization

- Foster local economic strength and sustainable access to basic needs.
- Enhance human and natural habitat in local neighborhoods.
- Increase community engagement by supporting and funding local grass roots initiatives that build social cohesion.
- Coordinate management of future reinvestment and urban development by formalizing a coalition of agencies and community organizations to monitor and guide new development.
- Preserve affordability and produce affordable housing.
- Promote and protect home ownership.

Photo: Derrick Coetzee





Photo: Courtesy of Duwamish River Cleanup Coalition “Duwamish Alive”

Introduction

More than a century of industrial and urban wastes have contaminated water, sediments, beaches, fish, and shellfish in the lower Duwamish River with a mix of 41 toxic chemicals.

In 2001, the United States Environmental Protection Agency (EPA) placed 5.5 miles of the lower Duwamish River on the Superfund National Priorities List, requiring a Remedial Investigation and Feasibility Study. The Remedial Investigation, including a Human Health Risk Assessment of current cancer and other health risks from toxins in sediment, was finalized in 2010.¹ The Feasibility Study of cleanup alternatives was finalized in 2012. The Human Health Risk Assessment identified four chemicals of most concern for human health: PCBs, cPAHs, arsenic, and dioxins/furans.² The major pathways of concern for human health are resident fish or shellfish consumption and sediment contact. Each pathway poses excessive risks for cancer and non-cancer outcomes, such as cardiovascular, neurological, liver, immunological, and developmental problems. Early Action cleanups have begun or been completed at five extremely contaminated locations prior to long-term cleanup.

On February 28, 2013, EPA released its *Proposed Plan* (Plan) for overall site cleanup. The Plan is accompanied by two appendices, although these are not formally part of the Plan: *Environmental Justice Analysis* and *Source*

Control Strategy. EPA accepted public comment on the Plan until June 13, 2013, and expects to issue a final cleanup order in 2014.

Three partner organizations—University of Washington (UW) School of Public Health, Just Health Action, and the Duwamish River Cleanup Coalition/Technical Advisory Group (EPA’s Community Advisory Group for the site)—have conducted a Health Impact Assessment (HIA) of EPA’s proposed cleanup Plan. This HIA was supported with a grant from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts, plus funds from the UW Rohm & Haas Professorship in Public Health Sciences.

This is the *Final Report* for our HIA. The report is supported by a collection of Technical Reports, which provide detailed information about the HIA methods, assessments, and recommendations. All reports are available on the UW Duwamish Superfund Cleanup HIA website: <http://deohs.washington.edu/hia-duwamish>.

PROPOSED CLEANUP PLAN

EPA selected its proposed cleanup Plan (“5C+”) based on a Feasibility Study of eleven cleanup alternatives published in 2012. The Plan calls for:

- Capping of 24 acres of highly contaminated sediments in place.

1. Human Health Risk Assessment = quantitative process used by EPA to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future.
2. PCBs = polychlorinated biphenyls; cPAHs= carcinogenic polycyclic aromatic hydrocarbons

- Removal of 84 acres of highly contaminated sediments that cannot be capped.
- Enhanced natural recovery of 48 acres of moderately contaminated sediments by adding a thin layer of clean material to “kick-start” the river’s natural sedimentation.
- Monitored natural recovery of 256 acres of relatively low-level contaminated sediments, with sampling to determine if concentrations of contaminants are declining over time.
- Institutional controls: administrative measures to prevent people and the environment from being exposed to remaining contamination, using legal tools such as easements or covenants, and informational tools such as fishing advisories.

The Plan sets cleanup goals for the four chemicals of concern for human health. The goals were chosen to protect health or be equal to Puget Sound background concentrations, whichever is higher. However, the EPA Human Health Risk Assessment and models of future concentrations in the Feasibility Study predict that the Plan’s goals will not be fully achieved. Resident fish and shellfish will probably still be unsafe for human consumption, even after the 17-year period of active cleanup and

WHAT IS HEALTH IMPACT ASSESSMENT?

Health Impact Assessment (HIA) is a systematic process used “to characterize the anticipated health effects, both adverse and beneficial, of societal decisions.... Characteristics of HIA include a broad definition of health; consideration of economic, social, or environmental health determinants; application to a broad set of policy sectors; involvement of affected stakeholders; explicit concerns about social justice; and a commitment to transparency.”³

For this HIA we use the World Health Organization definition of health, “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.”⁴

monitored recovery. In that event, the Plan calls for a study to determine if additional cleanup action or a “technical impracticability” waiver is warranted, requiring an additional EPA order.

WHAT IS THE SUBJECT OF THIS HIA?

EPA’s *Proposed Plan* is the subject of this HIA. This assessment does not examine harms or benefits that might result from alternate cleanup scenarios, although many of the HIA findings and recommendations are probably transferable to whatever remedy EPA selects for its final cleanup decision. Our focus on the *Proposed Plan* does not indicate our approval or disapproval of this EPA-favored cleanup alternative.

WHAT IS THE PURPOSE OF THIS HIA?

The purpose of this HIA is to examine potential unintended and under-considered health impacts—desirable or undesirable—of the *Proposed Plan* and related decisions. The HIA examines whether some people might experience disproportionate impacts: fewer new opportunities or greater health burdens.

We examined potential impacts for four populations that have strong connections to the Duwamish River:

1. Local residents
2. Tribes
3. Non-tribal subsistence fishers
4. Workers in local industries

Figures 1 and 2 show the major potential health impacts and causal pathways that we examined for these population groups, including these major population effects:

- Construction effects
- Restrictions on Tribal rights or practices
- Restrictions on non-tribal fisher practices
- Residential and industry gentrification
- Beneficial effects and opportunities for Tribes and for local communities and businesses

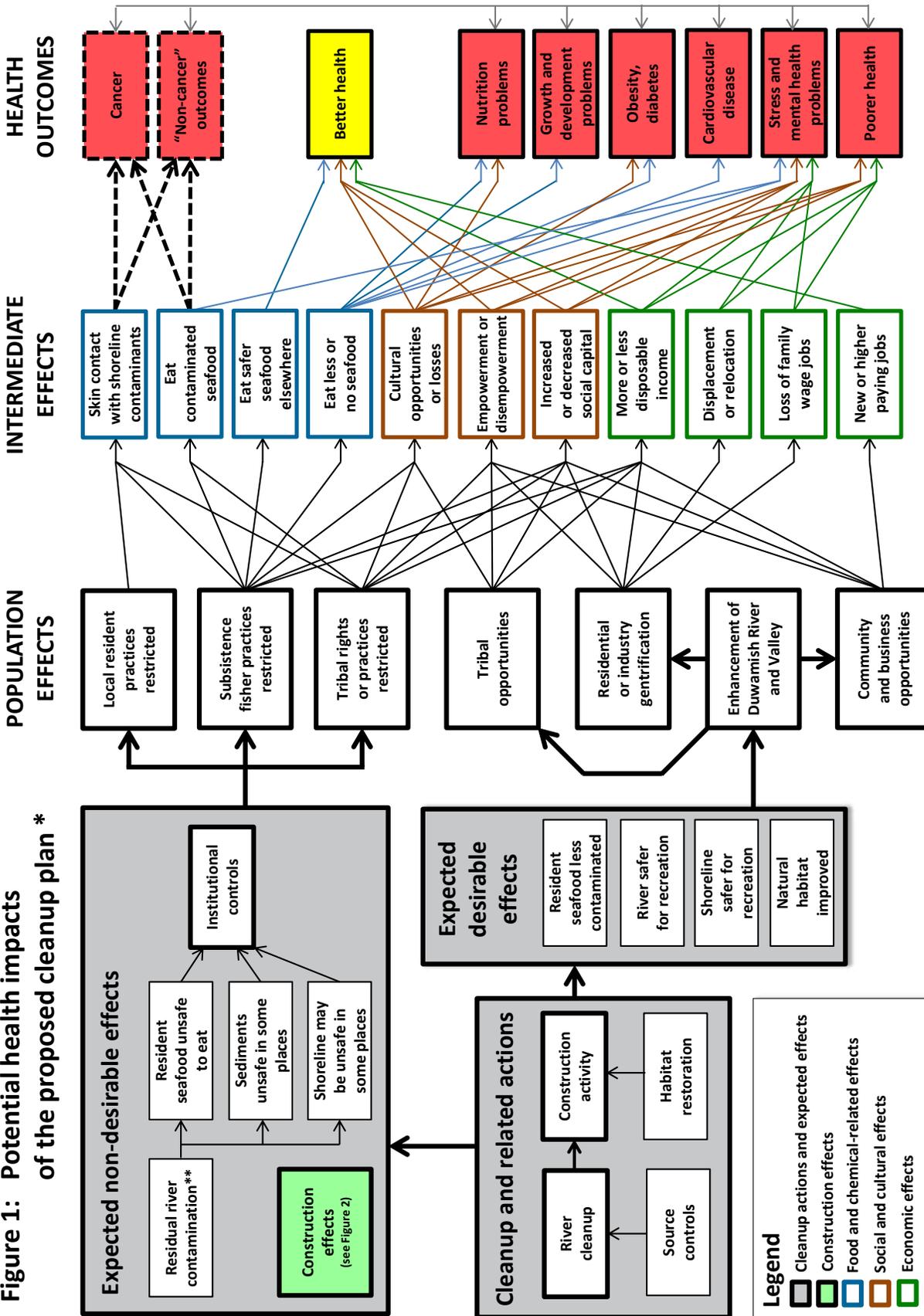
We examined these major intermediate health effects:

- Food and chemical-related effects
- Social and cultural effects
- Economic effects

The figures illustrate the complexity and interactions between these effects and a variety of health outcomes. In contrast, the EPA Human Health Risk Assessment focused on pathways and health outcomes shown in the right upper corner of Figure 1.

3. Bhatia R. *Health Impact Assessment: A Guide for Practice*. Oakland, CA: Human Impact Partners, 2011; copyright © 2011 Rajiv Bhatia
 4. Preamble to the Constitution of the World Health Organization, entered into force in 1948.

Figure 1: Potential health impacts of the proposed cleanup plan *



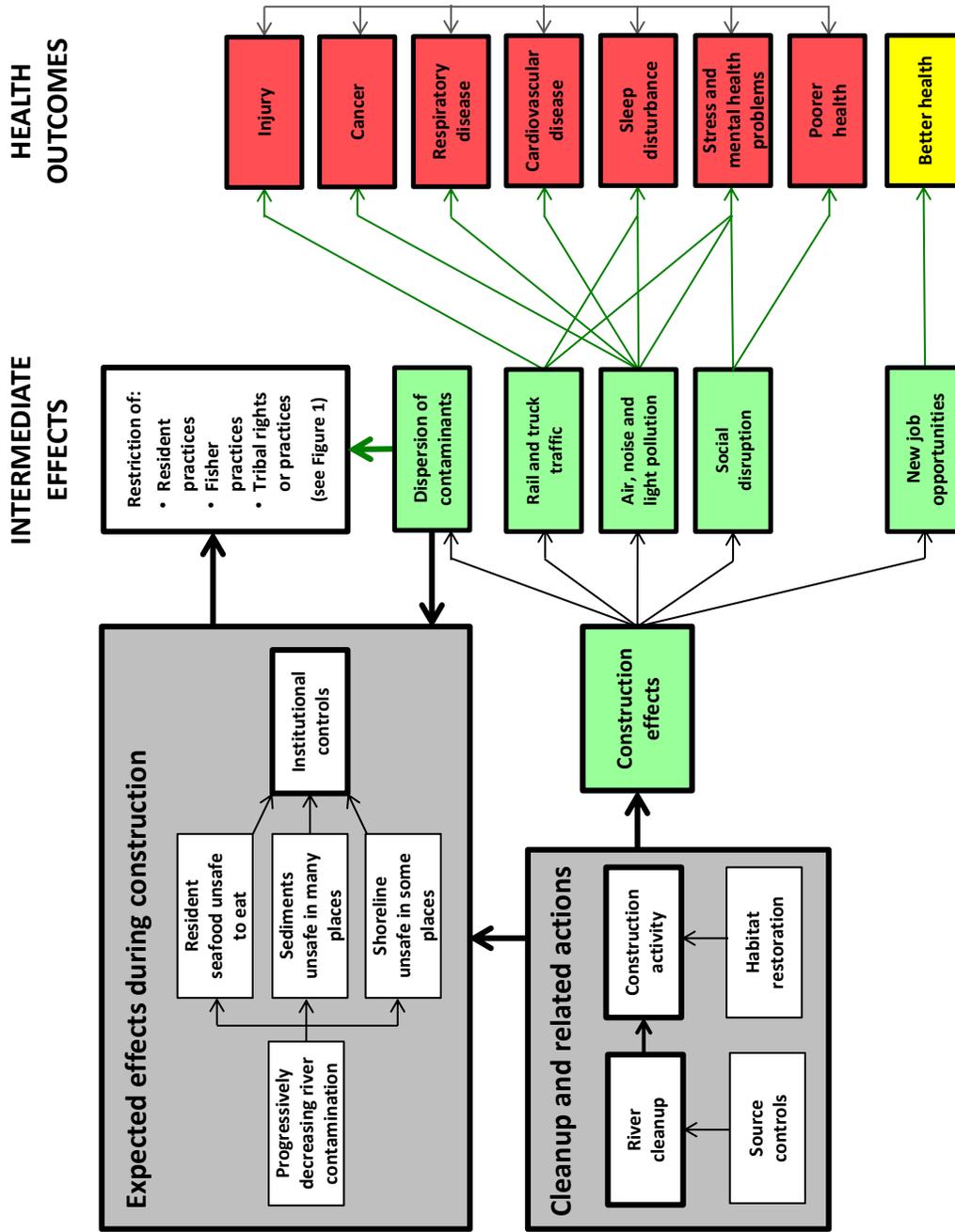
* This diagram should be interpreted in the context of possible cumulative impacts on health attributable to the depicted impacts plus health impacts unrelated to the proposed cleanup. Gray arrows on the right are reminders that causes of poor health can be synergistic.

** "Residual" river contamination = above Puget Sound background.

Legend

- Cleanup actions and expected effects
- Construction effects
- Food and chemical-related effects
- Social and cultural effects
- Economic effects
- Health outcome: desirable
- Health outcome: non-desirable
- Health outcome: non-desirable; identified by health risk assessment

Figure 2: Potential health impacts of proposed construction *



* This diagram should be interpreted in the context of Figure 1, as well as possible cumulative impacts on health attributable to the depicted impacts plus health impacts unrelated to the proposed cleanup. Gray arrows on the right are reminders that causes of poor health can be synergistic.

RESOURCES AND METHODS USED FOR THIS HIA

We relied on guidance from a variety of sources throughout this HIA, including:

- Stakeholder guidance—regular meetings and communication with our advisors:
 - Resident Advisory Committee, with representatives from South Park; Georgetown; Nickelsville, a homeless encampment; Puget Sound Sage, a nonprofit organization; and a former state legislator representing the South Park and Georgetown area and formerly affiliated with the nonprofit, Homesight.
 - Tribal Advisory Committee, with representatives from the Suquamish and Duwamish Tribes. The Muckleshoot Tribe chose not to participate on the committee.
 - Liaison Committee, with representatives from EPA, other agencies, and potentially responsible parties.
 - Non-tribal fishing communities, via semi-structured interviews with individual community advisors and key informants.
- Technical guidance from the Health Impact Project (Katherine Hirono, Aaron Wernham), Habitat Health Impact Consulting (Marla Orenstein), and Decision Research (Jamie Donatuto, Robin Gregory).

We used a wide assortment of information sources for the HIA, including:

- Peer-reviewed literature, published reports, and credible internet-based materials.
- Data obtained from public databases or provided by individual organizations (e.g., Urban Indian Health Institute).
- Semi-structured interviews with selected community advisors and key informants.
- Focus groups: one with members of the Duwamish Tribe; and multiple with non-tribal subsistence fishers.

We conducted the HIA in six steps, which is standard in HIA practice:

- Screening
- Scoping
- Assessment
- Recommendations
- Reporting
- Evaluation

The methods used in each step, including categories and definitions used for effect characterization (assessment), are detailed in the “Methods” Technical Report.

The UW Human Subjects Division approved our interview and focus group procedures. The Duwamish Tribal Council approved procedures and use of information for

the Tribal focus group.

We developed our recommendations in collaboration with many stakeholders. Our community advisors and focus groups guided and informed selection, prioritization, and wording of recommendations. Our Liaison Committee provided advice about wording, feasibility, and best decision-makers to receive individual recommendations.

PRINCIPLES AND VALUES OF HEALTH IMPACT ASSESSMENT⁵

- Democracy: emphasizing the right of people to participate in the formulation and decisions of proposals that affect their lives, both directly and through elected decision-makers.
- Equity: emphasizing the desire to reduce inequity that results from avoidable differences in the health determinants and/or health status within and between different population groups.
- Sustainable development: emphasizing that development meets the needs of the present generation without compromising the ability of future generations to meet their own needs.... Good health is the basis of resilience in the human communities that support development.
- Ethical use of evidence: emphasizing that transparent and rigorous processes are used to synthesize and interpret the evidence, that the best available evidence from different disciplines and methodologies is utilized, that all evidence is valued, and that recommendations are developed impartially.
- Comprehensive approach to health: emphasizing that physical, mental, and social well-being is determined by a broad range of factors from all sectors of society (known as the wider determinants of health).

5. Quigley R, den Broeder L, Furu P, Bond A, Cave B, Bos R. *Health Impact Assessment International Best Practice Principles. Special Publication Series No. 5.* Fargo, USA: International Association for Impact Assessment, 2006.



Photo: Paul Joseph Brown

Effects of the proposed cleanup plan on LOCAL RESIDENTS

Detailed information, including references, for this chapter is in the “Local Residents” Technical Report.

COMMUNITY PROFILE

South Park and Georgetown are residential neighborhoods bordering the Duwamish River and Superfund site. Because of this proximity, residents are at risk for health effects related to the EPA Plan. A high percentage of residents are foreign-born and people of color, particularly in South Park. Average household income in both neighborhoods is much lower than the county average, and poverty rates are higher. In South Park, unemployment rates are 50% higher than the county average, and 78% of children at the local school qualify for free or reduced-price lunch.

CURRENT HEALTH STATUS

Health status is relatively poor in South Park and Georgetown, and for ZIP code 98108 overall, which also includes part of Beacon Hill. Heart disease rates in South Park and Georgetown are 47% higher than the county average, while life expectancy is eight years shorter. In ZIP code 98108, childhood asthma hospitalization rates are more than twice the county average, and rates of lung cancer, diabetes, and death from stroke are all higher. Environ-

mental exposures, such as air pollution, industrial releases, and contaminated sites, are among the highest in the city. However, environmental benefits, such as tree canopy, are less than elsewhere in Seattle.

POTENTIAL HEALTH IMPACTS OF THE CLEANUP

Construction: air and noise pollution

*Direction of effect:*⁶ ADVERSE

Likelihood: Likely

Magnitude: Limited

*Distribution:*⁶ Disproportionate harm from noise for South Park residents; air impact not disproportionate

Health outcomes: Diesel engine emissions contain high concentrations of particulate matter and other pollutants that, if inhaled, can cause or aggravate cardiovascular disease, asthma and other respiratory diseases, or cancer. Noise from construction equipment or vehicles can disturb attention or concentration ability, affect mental well-being, and cause or contribute to stress or other mental health problems. At night, noise or light pollution from construction activity could disrupt sleep patterns, with impacts on physical and mental well-being.

6. The categories and definitions used for effect characterization are described in the “Methods” Technical Report. Distribution refers to differences within the impacted community, and not disproportionate health impacts between the impacted community and the rest of Seattle, which are substantial (see Gould and Cummings, *Duwamish Valley Cumulative Health Impacts Analysis*, 2013).

Assessment: Air pollution is already a significant problem in the Duwamish Valley, produced by emissions from highway traffic and port activity and from industry point sources. Noise is also a significant existing issue, related to the same sources plus the King County International Airport (Boeing Field). Construction activities are likely to generate air pollution, although this will likely be a limited increment beyond existing pollution. The EPA Feasibility Study estimates of cleanup air emissions were based on use of conventional fuels during construction and are probably over-estimated. Updated fuel standards and EPA policies are designed to greatly reduce air pollutants, and the associated health impacts are expected to be limited.

Construction: rail and truck traffic

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Limited

Distribution: Disproportionate harm to Georgetown residents

Health outcomes: Increased truck traffic volume can increase risk of injury from pedestrian or vehicle collisions, or incidents triggered by road wear. Traffic congestion can disrupt community cohesion and quality of life. Increased traffic volume, vehicle idling, and rail freight transport could contribute to local air and noise pollution, as described above.

Assessment: If truck transport of dredged sediments between the river and rail facilities is required, then neighborhood impacts are likely, and could be moderate in magnitude. However, the reported plan to minimize the use of truck transport is expected to limit the magnitude of this impact. Cleanup-related rail traffic is estimated to be 1–3 trainloads per month, a small addition to the 65–85 freight trains per day on local rail lines. These incremental impacts are expected to be of limited magnitude. Cleanup-related truck and rail traffic will primarily affect Georgetown residents.

Construction: job opportunities

Direction of effect: BENEFICIAL

Likelihood: Likely

Magnitude: Limited to moderate

Distribution: Restorative equity effect; benefit to unemployed or lower-income residents

Health outcomes: Employment is one of the strongest favorable determinants of health. Employment, job training, and skill development generate personal income

and increase the likelihood of future employment and income stability. These can contribute to personal and family adaptive capacity, improved healthful practices, better access to and ability to pay for health care, reduced risk for cardiovascular and other major diseases, and extended lifespan.

Assessment: Cleanups at other Superfund sites demonstrate the potential to generate cleanup-related jobs, including for local residents. In 2012, the Hudson River (New York) Superfund cleanup generated 350 jobs, including 210 filled by local residents. There is similar potential for local residents during the Duwamish River cleanup. While jobs will certainly be generated here, with beneficial impacts on health for those employed, whether those jobs will be given to local residents is currently uncertain.

Construction: dispersion of contaminants

Direction of effect: ADVERSE

Likelihood: Possible

Magnitude: Limited

Distribution: Disproportionate harm to fish consumers and beach users

Health outcomes: As established in the EPA Human Health Risk Assessment, chemical contaminants in Duwamish River sediments and beaches can cause cancer and other chronic or developmental health effects.

Assessment: Past dredging performance at other Duwamish River cleanup sites has been mixed, but the most recent and comparable dredging projects are promising in terms of minimizing construction-related dispersal of contaminants. The likelihood that contaminated material will escape outside the construction zone is low if proven and latest environmental dredging technologies, best management practices, and skilled operators are employed. If contaminated material is not spread during dredging, then contamination of resident seafood will also be minimized.

Chemical contamination on beaches

Direction of effect: ADVERSE

Likelihood: Possible

Magnitude: Limited

Distribution: Disproportionate harm to beach users in both communities

Health outcomes: As established in the EPA Human Health Risk Assessment, chemical contaminants in Duwamish River sediments and beaches can cause cancer and other chronic or developmental health effects, via skin contact, inhalation, or ingestion.

Assessment: Beaches throughout the lower Duwamish River have been evaluated. Several publicly accessible beach areas exceed state health standards for direct contact for one or more of the chemicals of concern. EPA predicts that its cleanup Plan will approach but not meet direct contact goals for arsenic on some beaches. There are uncertainties in the predictive model, particularly the potential influence of source controls. The State is discussing whether to make the arsenic standard more protective.

Community opportunities: revitalization

Direction of effect: BENEFICIAL

Likelihood: Possible to likely

Magnitude: Limited to substantial

Distribution: Disproportionate benefit to higher-income residents

Environmental improvements resulting from the Duwamish cleanup will likely increase the real and perceived aesthetics of the Duwamish River and the esteem of areas surrounding the Superfund site. This may spur reinvestment in Georgetown and South Park. The flow of resources into these neighborhoods will likely contribute to evolution of their character. Community revitalization could stimulate a number of beneficial phenomena including physical improvement of housing stock, streetscapes, and open space, commercial growth via development of viable community businesses and services, and social benefits from increased employment and reduced crime. Such revitalization is typically considered “equitable” if it leads to the creation and long-term maintenance of economically and socially diverse communities. *Health outcomes:* Revitalization and improvements in the physical, economic, and social conditions in Georgetown and South Park could beneficially affect the health of local residents. Increased home values and equity could increase residents’ financial ability to maintain and improve their housing and improve overall adaptive capacity. Housing improvements could also reduce health risks in home environments. Community improvements may foster more active lifestyles, increased community interaction, and greater social capital. New local services and amenities could expand resources available to residents and provide employment opportunities. Finally, increased local median incomes have been associated with decreased local exposures to disease.

To secure such health benefits from community revitalization, existing residents must be able to remain in the

improved neighborhoods. Achieving overall health gains from revitalization could hinge on avoiding residential displacement due to economic and social pressures, and sustaining equitable distribution of benefits to both existing and new residents.

Assessment: The HIA team analyzed data on institutional and grass roots programs for promoting equitable revitalization, to identify prospects for influencing future development in Georgetown and South Park. Many programs and tools exist that could foster more equitable revitalization during future reinvestment and development in these communities. However, multiple census-based indicators indicate that gentrification is already in progress and is likely to continue in both neighborhoods. Any cleanup-spurred reinvestment is likely to contribute to that trend. Thus, the health of current Georgetown and South Park residents may substantively benefit from strategic interventions to forestall gentrification and foster equitable revitalization.

Residential gentrification

Direction of effect: BENEFICIAL

Likelihood: Possible to likely

Magnitude: Limited to substantial

Distribution: Disproportionate benefit to higher-income residents

AND

Direction of effect: ADVERSE

Likelihood: Very likely

Magnitude: Substantial

Distribution: Disproportionate harm to lower-income residents

A process of gentrification often occurs alongside community revitalization, fundamentally changing neighborhoods. Gentrification generally involves physical improvements of housing stock, influx of higher-income residents, displacement of original residents, and overall change in neighborhood character that increases social polarity and decreases diversity.

Health outcomes: Changes in housing markets and residential conditions may have pronounced effects on the health of residents. Increased home values and equity will increase financial ability to maintain and improve housing and can improve overall adaptive capacity. Housing improvements may reduce harmful environmental exposures at home. Community improvements can facilitate active life practices, community

interaction, and increased social capital. New local services and amenities can improve resources available to residents and expand employment opportunities. Increased local median income is associated with decreased local exposure to disease.

On the other hand, increased housing costs could displace households into cheaper, lower quality, or more crowded housing, with increased risk for injuries, rodent infestation, infectious diseases, and stress or mental illness. Reduced disposable income could constrain adaptive capacity, healthful practices, and ability to meet basic health needs, all of which increase risks for cardiovascular and other major chronic diseases. Relocation to other lower-cost areas could increase distance to employment options and worsen access to healthy foods, transportation, quality schools, and supportive social networks. Real or perceived barriers between residents and decreased contact among neighbors may foster

isolation, erosion of social capital, and disempowerment among existing residents. Low social and economic capital are independently associated with poor health outcomes and, when combined, contribute to an increased burden of poor health.

Assessment: Census-based demographic and economic data reveal a shift in the past decade toward increasing incomes in South Park and shrinking minority populations in Georgetown. Multiple indicators reveal that gentrification is already in progress and is likely to continue in both neighborhoods. It is likely that any cleanup-spurred reinvestment will contribute to this trend. Harmful impacts are most likely to affect lower-income residents, and benefits are most likely to affect higher-income residents. Strategic interventions to forestall gentrification and foster equitable revitalization could substantially benefit the health of current Georgetown and South Park residents.

Photo: Linn Gould, Just Health Action



RECOMMENDATIONS

For EPA, City of Seattle, King County, and Port of Seattle

Equity policies

- 1. *Ensure equity in all policies, programs, and tools regarding environment and community development, in accordance with Seattle’s Race and Social Justice Initiative, King County’s Equity and Social Justice Ordinance, and EPA’s Environmental Justice policies.***

Consistent with the Seattle initiative and King County ordinance, all policies, programs, and tools should be culturally appropriate and should serve residents regardless of barriers presented by age, language, race, ethnicity, and citizenship status.

- 2. *We encourage the Port of Seattle to develop and implement a formal social justice policy.***

The Port has already made commitments to social responsibility, but we encourage greater specificity and implementation. The Port of Los Angeles, for example, identified environmental justice and stakeholder relationships as two of eleven “material issues” most important to achieving sustainable operations. The Port of Los Angeles uses these routinely to assess and report on sustainability-related programs policies.

For EPA

Cleanup construction and contamination

- 3. *Use proven and latest environmental dredging technologies, best management practices, and skilled operators to minimize the spread of contaminated sediments during dredging.***

Two recent sediment dredging projects on the Duwamish River used GPS-directed environmental dredgers and experienced operators with little to no spread of dredged material offsite. A similar approach, backed by strict monitoring, can reduce the dispersal of toxins into the water and fish tissue during future sediment removal actions.

- 4. *Negotiate transport routes and associated mitigation measures for cleanup-related truck and rail traffic with potentially affected residents.***

Final off-loading and transport routes for dredged sediments have not yet been determined but are expected to avoid using truck transport as much as possible. Most truck traffic, and all rail transport, will likely impact Georgetown residents but can be

minimized by negotiating transport routes and related mitigation measures with affected residents.

- 5. *Use modern clean engines or those with best available emission controls, cleanest available fuels, and other “green remediation” techniques to minimize air emissions, plus effective noise and light minimization measures.***

Using modern engines or engines with best available emission control technology will help reduce emissions. New federal rules have required commercial rail freight and most commercial trucks to upgrade to Ultra Low Sulfur Fuels (ULSF) dramatically reducing harmful diesel emissions. ULSF can also be used in cleanup construction equipment. Biodiesel blends, no-idling, and other EPA green remediation policies may further reduce emissions. Noise minimization measures, similar to those used for the South Park Bridge construction project, will also help prevent health impacts.

- 6. *Provide cleanup job training and placement assistance to local community members.***

Training for cleanup-related jobs, job readiness skills, and job placement assistance programs can help ensure that affected residents benefit from cleanup employment and income opportunities. Examples of successful programs used elsewhere are EPA’s Superfund Jobs Training Initiative and King County’s Brownfields Job Training Program.

- 7. *Apply institutional controls, including educational signage and washing stations, at local beaches until health protective standards are met.***

Several contaminants currently pose low-level health risks to residents who frequently use local beaches. Measures should be taken to inform residents of potential risks and provide wash facilities for hands, feet, shoes, and pets after visiting Duwamish River beaches. These measures should be retained until health-protective standards have been met.

For City of Seattle, King County, and Port of Seattle

Community revitalization

- 8. *Foster local economic strength and sustainable access to basics needs.***

Promotion of local economic security could benefit Georgetown and South Park residents through

expanded employment options, increased ability to access needed goods and services, and greater political power associated with a stronger local tax base. Possible options include:

- Continue Seattle’s Office of Economic Development and community organization support of local business environments in Georgetown and South Park.
- Improve local job security and increase median incomes via employment programs such as the EPA Superfund Job Training Initiative.
- Offset increasing costs of living in Georgetown and South Park by expanding secure local access to quality foods; promote participation in urban agriculture at Marra Farm; ensure availability of nutritious foods from local food banks and schools.

9. Enhance human and natural habitat in local neighborhoods.

With reinvestment in Georgetown and South Park, an influx of residents could emphasize opportunities to enhance neighborhood conditions through public improvements. In particular, the public management of transportation, open space, and natural resource issues could noticeably improve the neighborhoods. Possible options include:

- Create vibrant streetscapes via Seattle’s Complete Streets program.
- Increase public access to the Duwamish River, safe open space (designed according to principles of Crime Prevention Through Environmental Design), and shared recreational area through Seattle’s Shoreline Street Ends program and additional land use conversion programs. If possible, expand public open space along the shoreline at Boeing Plant 2.
- Enhance local ecological services, pollutant source control, and aesthetics through Low Impact Development stormwater systems (swales, rain gardens, etc.) and tree planting and preservation programs.
- Improve aquatic recreation by minimizing combined sewer overflow discharge into the Duwamish River.

10. Increase community engagement by supporting and funding grass roots initiatives that build social cohesion.

There are a variety of grass roots initiatives promoting community revitalization in Georgetown and South Park. Hands-on local service, in parallel with broader institutional programs, may help avoid situations in which vulnerable residents, such as the elderly or those facing language barriers, fail to receive attention

to their needs. In addition, creative efforts in Georgetown and South Park are transcending individual, institutional, and corporate interests to extend the richness of community to all local residents.

11. Coordinate management of future reinvestment and urban development by formalizing a coalition of agencies and community organizations to monitor and guide new development.

A broad palette of institutional and organizational responses must be simultaneously integrated to promote neighborhood revitalization while forestalling adverse effects of gentrification. The EPA endorsed such a coordinated approach in a recent publication, *Creating Equitable, Healthy, and Sustainable Communities*. Other precedents for such proactive and comprehensive response include EPA’s Urban Waters efforts, Green Zones initiatives in California, and the “Let Us Build Cully Park” project in Portland, Oregon.

12. Preserve affordability and produce affordable housing.

If cleanup-spurred reinvestment results in improved housing stock and substantially increased rents in Georgetown and South Park, then ensuring the continued availability of affordable housing may help existing residents remain in the improved neighborhoods. Possible options include:

- Promote local development of affordable housing via land use code incentives, tax incentives, and public funding.
- Facilitate tenant assistance by Seattle Housing Authority and community organizations.

13. Promote and protect home ownership.

If reinvestment results in substantially increased home values in Georgetown and South Park, then higher costs of ownership may prevent some prospective owners from buying homes. Financial difficulties may increase for both existing and new homeowners due to more precarious mortgages and increased tax liability. Possible options include:

- Expand home ownership by low-income families by promoting down-payment assistance, Homestead Community Land Trust, and other programs.
- Address increased tax liability from rising home values via counseling, and existing and new tax deferral, exemption, and relief programs.
- Preserve home ownership through the Seattle Foreclosure Prevention Program.



Photo: BJ Cummings, Duwamish River Cleanup Coalition/TAG

Effects of the proposed cleanup plan on TRIBES

Detailed information, including references, for this chapter is in the “Tribes” Technical Report.

COMMUNITY PROFILE

Three Native American Tribes—the Duwamish, Muckleshoot, and Suquamish—are potentially affected by the Duwamish River cleanup.

The **Duwamish** Tribe’s ancestral lands are throughout Elliott Bay and the Duwamish River watershed. In 1851, the Duwamish people occupied 17 villages and 90 longhouses. The Tribe currently has nearly 600 enrolled members. The Tribe’s current Longhouse is on the Duwamish River, at the site of the Tribe’s historic winter fishing village, a National Historic Site. Chief Seattle was the first signer of the 1855 Treaty of Point Elliott, but city fathers fought a proposed Duwamish reservation. As a result, the Duwamish Tribe currently has neither the federal recognition nor treaty fishing rights granted to other Tribes.

The **Muckleshoot** Tribe is a federally recognized Tribe, composed of descendants of the Duwamish and Upper Puyallup people. The Muckleshoot Reservation, established in 1857, lies along the White River in Auburn. The Tribe currently has about 1,660 enrolled members. The Tribe has usual and accustomed fishing places, guaranteed by the Treaty of Point Elliott and upheld by the 1974 Boldt Decision. The Tribe conducts seasonal, commercial, ceremonial, and subsistence netfishing operations in the Duwamish River.

“Good air, water, food resources, self-sufficiency, involvement anywhere you can help.”

The **Suquamish** Tribe is also a federally recognized Tribe. The Tribe traditionally lived along the Kitsap Peninsula, including Bainbridge and Blake Islands, across Puget Sound from present Seattle. The Tribe has about 950 enrolled members, half of whom live on the Port Madison Reservation. The Tribe has usual and accustomed fishing places, guaranteed by the Treaty of Point Elliott and the Boldt Decision. The Suquamish Tribe actively manages seafood resources just north (downstream) of the Duwamish Superfund site.

CURRENT HEALTH STATUS

There are no publicly available health data that are specific to the Duwamish, Muckleshoot, or Suquamish Tribes. Therefore, we present findings for the American Indian and Alaska Native (AI/AN) population for King County and Washington State (see Table 1).

The AI/AN population shows significantly poorer health and socioeconomic status than the general population for

nearly 80% of the examined parameters. AI/ANs are:

- 2.6 times as likely to be in poverty
- 2.8 times less likely to have a college education
- 1.9 times as likely to be unemployed

AI/ANs in King County are:

- 1.9 times as likely to smoke
- 2.1 times more likely to have diabetes
- 1.7 times more likely to be obese

All three of these factors are associated with heart disease, which is 2.3 times as common in the AI/AN population and is the leading cause of death in the United States for both Natives and the general population. There are also significant disparities in infant mortality rates, mental distress (stress, depression, and problems with emotions), cirrhosis deaths, and asthma.

TRIBAL CONCEPT OF HEALTH

The Native American concept of health traditionally embodies a holistic perspective. One Tribal Advisory Committee (TAC) member described individual health as “being at one with the universe, being in a state of non-conflict.” The well-being of the community is also important, encompassing collaboration, social cohesion, and empowerment. Additionally, health incorporates well-being of the environment, as described by a Duwamish Tribe member, “Good air, water, food resources, self-sufficiency, involvement anywhere you can help.”

The health and well-being of Native peoples are potentially affected in many ways by chemically contaminated sites. In addition to biophysical effects identified in the EPA Human Health Risk Assessment, there can be a constellation of mental, emotional, and spiritual effects related to temporary and permanent changes in the land, ecosystems, and their interactions with culture and community. Even when areas are remediated and made substantially cleaner, residual contamination is still likely to disproportionately affect Tribes.

“It’s our spiritual food so it feeds our soul; so it might poison our body, but then we’d rather nourish our soul.”

POTENTIAL HEALTH IMPACTS OF THE CLEANUP

The proposed cleanup will reduce sediment contamination levels and will therefore decrease seafood tissue concentrations over time. However, residual contamination above Puget Sound background levels, plus restrictions on river usage, could affect health in ways beyond those described in the conventional EPA Human Health Risk Assessment (Figure 1).

Note: The chapters for the Local Resident, Subsistence Fishing, and Worker populations use separate “health outcomes” and “assessment” subsections to summarize potential health impacts. This chapter, however, summarizes potential impacts using an integrated format that was approved by the HIA Tribal advisors and better reflects Tribal concepts of health.

Residual contamination

The conventional EPA Human Health Risk Assessment has shown that the Tribes are disproportionately impacted by the Duwamish River Superfund site’s baseline contamination relative to the general population. In addition, residual risks after cleanup will continue to be substantial and are predicted to exceed Puget Sound background. Tribal health outcomes are likely to be worse than predicted by the EPA risk assessment because:

- The risk assessment approach only accounts for cancer and non-cancer biomedical disease outcomes and does not incorporate fundamental aspects of health and well-being such as the importance of accessibility to local natural resources, maintenance of cultural traditions, and significance of self-determination that are affected by residual contamination.
- Any river-related risks are compounded by existing Tribal health disparities and cumulative risks from both chemical and non-chemical stressors such as poverty, stress, food security, and concerns about self-determination, which were not considered in the EPA risk assessment.

Furthermore, although the cleanup will create a cleaner environment for all, disproportionality and inequity between the general population and the Tribes may actually increase. Resident seafood will be relatively safe to eat at the general population seafood consumption rate of one meal per month, but not at the Tribes’ seafood consumption rates (see Tribes Technical Report for details).

Institutional controls

Institutional controls, such as fish advisories due to residual contamination, restrict the amount of seafood that can be safely harvested by the Tribes. This is likely to affect Tribal population health in three ways:

- Restrictions and man-made despoliation violate Tribal fishing rights, which will lead to substantial disempowerment, an established determinant of health.
- Restrictions can affect food security and may prompt Tribal members to switch to alternative food sources that are not as healthy. This may cause other health problems including but not limited to obesity, diabetes, heart disease, and cancer.
- Restrictions may affect physical health since Tribal members may harvest fish in spite of biomedical warnings in order to protect aspects of their cultural and spiritual health. As expressed by a Swinomish

elder, “It’s our spiritual food so it feeds our soul; so it might poison our body, but then we’d rather nourish our soul.”

The decision to impose institutional controls, such as seafood advisories until recovery is complete, or possibly in perpetuity, will disproportionately affect the Tribes relative to the general population.

Habitat renewal

It is highly likely that more extensive and healthier habitat will improve Tribal health, because the overall environment and species of cultural importance to the Tribe will be enhanced. The Duwamish Tribe focus group reported that the Tribe will have more ceremonies on the river if there is more habitat, resulting in feelings of pride, ownership, and empowerment, all important determinants of health.

Table 1: Health indicators for American Indian/Alaska Native (AI/AN) and general populations in Washington State and King County

Indicators	Washington State		King County	
	AI/AN	General Population	AI/AN	General Population
Sociodemographics				
Poverty (%)	26.3 *	12.1	25.1 *	9.7
College Education (%)	13.2 *	31.0	16.0 *	44.8
Unemployment (%)	16.4 *	7.6	10.9 *	5.7
Mortality				
Cancer mortality per 100,000	170.3	177.7	177.3	165.6
Heart disease mortality per 100,000	185.5	168.5	176.5	152.6
Heart health				
Heart disease %	4.9 *	3.5	6.3	2.8
Smoking (%)	31.3 *	15.9	23.7 *	12.1
Diabetes (%)	11.5 *	7.3	12.2 *	5.9
Obesity (%)	39.0 *	25.6	35.3 *	20.1
Maternal and child health				
Infant mortality per 1,000 live births	9.7 *	5.1	13.2 *	4.5
Low birth weight (%)	7.6 *	6.3	6.9	6.5
Mental health				
Mental distress (%)	19.1 *	9.9	15.7 *	8.3
Wellness				
Cirrhosis deaths per 100,000	31.6 *	9.1	24.3 *	7.8
Asthma (%)	17.3 *	9.2	17.3 *	8.1

Table shows average value for most recent available 5-year period. Sources: US Census, US National Center for Health Statistics, US Behavioral Risk Factor Surveillance System. See table in Tribes Technical Report for details.

* Significant difference between AI/AN and general populations (p<0.05)

RECOMMENDATIONS

For EPA

1. Collaborate with Tribes to more fully address their health concerns about the river cleanup.

The *Proposed Plan* Remedial Action Objective 1 is to reduce to protective levels the human health risks associated with consumption of contaminated Lower Duwamish Waterway resident fish and shellfish by adults and children with the highest potential exposure. Despite the EPA Human Health Risk Assessment's inadequacy in accounting for cumulative risks that may affect the Tribes, it still shows that residual contamination will negatively affect the Tribes' health. One approach to account for Indigenous health concerns beyond a conventional risk assessment is to utilize the Indigenous Health Indicators method established by Donatuto and colleagues (Table 2, Tribes Technical Report). Indigenous Health Indicators may differ between Tribes and must be developed separately. A formal partnership with each affected Tribe is necessary to pursue this approach. Although the TAC already considers current cleanup plans inadequate because of residual risks above Puget Sound background levels, a partnership like this could provide evidence to determine whether the Plan should be more protective for Tribal health.

2. Restore Tribes' traditional resource use in accordance with Treaty Rights: institutional controls need to be temporary, not permanent.

A long-term goal of the Tribes is to fully express their rights under the 1855 Treaty of Point Elliott, which firmly established the right to harvest fish at usual and accustomed grounds and stations. As long as institutional controls are in effect, these Treaty rights cannot be fully expressed. This may result in health effects, including disempowerment, cynicism, and decreased access to harvest. The definition of temporary institutional controls needs to be defined and negotiated with the Tribes.

For EPA, City of Seattle, King County, and Port of Seattle

3. Establish a "Revitalization Fund" to enhance Tribal empowerment and health, until institutional controls are removed.

The Tribal populations suffer significant disparities in health relative to the general population, before even considering ramifications of the *Proposed Plan*. As described, institutional controls are disempowering because they limit established fishing treaty rights granted to the Tribes.

We recommend that the Responsible Parties direct resources to the Tribal communities to redress some of the inequities that will be compounded by institutional controls. A Tribal "Revitalization Fund" for each affected Tribe should be established and funded as long as institutional controls are in effect to help address existing health inequities compounded by the compromised status of the river. Revitalization funds could improve community health through established determinants of health, including empowerment and ownership of the process. While each affected Tribe should control its own fund and select its own appropriate actions, one example from the TAC is using funds to build a new hatchery to enhance salmon stocks. Based on historical and ongoing cumulative impacts, a Revitalization Fund could be used to remedy disparities in housing, transportation, jobs, etc., in order to offset site-related health impacts.

An example of a similar fund is the Harbor Community Benefit Foundation (<http://hcbf.org>). The Foundation was established by a formal agreement between the Port of Los Angeles and community, environmental, health, and labor organizations. The Foundation is funded by the Port of Los Angeles to improve community health, access to open space, and economic opportunities until cumulative impacts from Port activities are reduced.

Photos, left to right: Paul Joseph Brown; BJ Cummings, Duwamish River Cleanup Coalition/TAG; Paul Joseph Brown

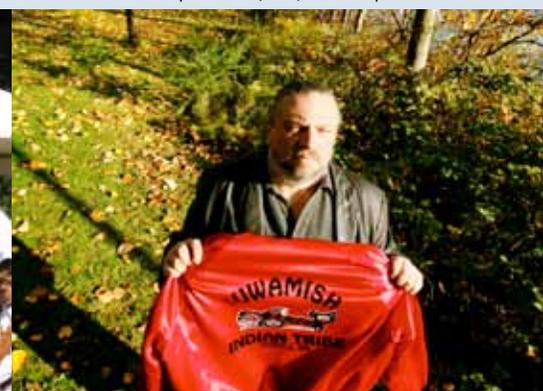




Photo: Paul Joseph Brown

Effects of the proposed cleanup plan on SUBSISTENCE FISHING POPULATIONS

Detailed information, including references, for this chapter is in the “Subsistence Fishing” Technical Report.

Subsistence fishing is defined for this HIA as non-sport fishing performed to provide food occasionally or frequently for the fishers and their friends and families.

COMMUNITY PROFILE

Urban subsistence fishing is important nationally and locally for various reasons. There is little information with which to characterize the local fisher population. Surveys indicate that a large fraction of the local fisher population is comprised of Asian and Pacific Islanders (API), reflecting the large API community in King County. Surveys also document fishing by a variety of immigrant populations and people of color; low-income, food-insecure populations; and urban American Indians and Alaska Natives aside from the affected Tribes.

CURRENT HEALTH STATUS

There are no data available to characterize the health status of subsistence fishers. However, it is known that immigrant, low-income, and food-insecure populations generally face a number of health challenges that affect disease burden. These often include language barriers, unemployment, and transportation barriers. For example, the foreign-born population in King County is three times as likely to speak a language other than English at home,

half as likely to have a high school diploma, more likely to have no health insurance coverage, and more likely to live in poverty.

FISHING PRACTICES

Focus groups and interviews with local non-tribal subsistence fishers suggest that many people fish for a variety of cultural and traditional reasons: for recreation and relaxation, as a convenient and inexpensive source of perceived healthy and culturally relevant food, and as an opportunity to spend time with friends and family. Many of these fishers catch and consume fish from numerous waterways in the region. Popular fishing locations identified through focus groups include Des Moines, Tukwila, Green Lake, Lake Washington, Elliott Bay, Alki Beach, and Snohomish County. People do fish on the Duwamish River, in spite of advisories and posted signs. Reasons for choosing fishing locations vary by population and include convenience, accessibility, cultural and traditional significance, water quality, visual cleanliness of the river and riverbank, and species of fish available to catch.

INSTITUTIONAL CONTROLS

Seafood advisories and posted signs are currently in place along the Duwamish River. They will continue to be used as institutional controls during and after the cleanup to reduce exposure to contaminated seafood.

The EPA's 2013 *Environmental Justice [EJ] Analysis* of the proposed cleanup Plan discussed using a community-based social marketing approach such as one used for the Palos Verdes Shelf Superfund Site. The *EJ Analysis* also described possible "offsets," such as fish trading and sustainable aquaculture projects, to mitigate potential health consequences of residual contamination and institutional controls.

POTENTIAL HEALTH IMPACTS OF THE CLEANUP

Fishing practices and health could be affected during or after active cleanup. Potential health impacts are likely to vary substantially by population. We considered potential impacts in three major areas: exposure to chemical contaminants, food and nutritional insecurity, and disruption of social and cultural traditions.

Exposure to chemical contaminants

Direction of effect: ADVERSE

Likelihood: Very likely

Magnitude: Limited to moderate

Distribution: Disproportionate harm to lower-income and non-English speaking people, and people who fish for social, cultural, or traditional reasons

Health outcomes: The cancer and non-cancer risks of continued fishing are described in the EPA Human Health Risk Assessment.

Assessment: Some communities, including API and low-income populations, have relatively high rates of fishing and fish consumption. During the cleanup, visible evidence of cleanup activity could decrease fishing on the Duwamish River and could reduce consumption of seafood caught from the river. However, it is likely that some people will continue to fish there, because of convenience, preferences, or limited transportation options.

During and after the cleanup, some people who now fish on the Duwamish River may decide to fish in alternate locations, including other local urban waters. It is likely they would continue their level of fishing activity and caught-seafood consumption unless constrained by added travel time or costs. These fishers, and the people with whom they share their catches, will probably experience reduced exposure to toxicants, compared to people fishing on the Duwamish River. However, many alternate locations identified in our focus groups are subject to fishing and fish consumption advisories, particularly urban

waters within close travel distances. Seafood caught and consumed from these alternate locations could still present substantial health risks.

Existing advisories and signs have not dissuaded fishing on the Duwamish River. The institutional controls for the proposed cleanup are not well described, which stands in stark contrast to the extent of assessment and planning conducted for cleanup activities. We discuss this further in the following chapter. Institutional controls have limited likelihood of success, unless they better address the complex cultural context surrounding fishing and seafood consumption in this region. Some of the "offsets" described in the EPA *EJ Analysis* might appeal to some fishing populations; however, our limited focus group experience found mixed or negative responses to some of the options.

After active cleanup, people who currently do not fish in the Duwamish River might begin fishing there because of real and perceived improvement in river safety and visual appeal. Although seafood caught and consumed from the cleaner Duwamish River would pose less risk than at present, the persisting health risks could still be substantial.

These potential impacts will disproportionately affect fishers who: do not know about or understand fishing advisories; do not identify the risk of fishing and seafood consumption as substantial compared to the convenience, dietary, social, or cultural benefits of fishing on the Duwamish River; or have limited options to travel to other, safer waters. These impacts are likely to be disproportionate for lower-income people and people of color.

Food and nutritional insecurity

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Limited to moderate

Distribution: Disproportionate harm to low-income and food-insecure people

Health outcomes: A fish diet has distinct health benefits, including omega-3 fatty acids and other nutrients with protective value against high blood pressure, cardiovascular disease, and stroke. These nutrients also promote healthy brain development and growth in infants and children. Reduced fish consumption could adversely affect health by loss of these benefits. Furthermore, other protein sources are more costly than self-caught fish. People might experience food insecurity or fill a dietary void with less healthful choices.

Assessment: It is likely that some individuals will decrease or even discontinue fishing activities because of visible cleanup activities and expanded fishing advisories. Some people may choose to replace self-caught fish with store-bought fish, leading to increased economic hardship, especially among the region's low-income and food-insecure fishing populations. However, one undesirable consequence of "effective" advisories could be a net reduction in healthful fish consumption by fishers and their families. This reduction could be worsened by replacement with lower cost and readily available foods that are less likely to be healthful than fish.

Disruption of social and cultural traditions

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Limited to moderate

Distribution: Disproportionate harm to people who fish for social, cultural, and traditional reasons

Health outcomes: Disruption of cultural or traditional practices could affect personal and social identity, and create stress or anxiety, with impacts on well-being and mental health. Decreased contact within fishing communities may

foster isolation and erosion of social capital. Low social capital is independently associated with poor health outcomes and, particularly if combined with low income or existing social marginalization, could contribute to an increased burden of poor health. Decreased fishing activity could be replaced with indoor or sedentary activities, with a net decrease in exercise and nature contact, both of which are associated with poorer health. Regular exercise, even at low to moderate levels of exertion, reduces the risk of obesity, hypertension, and cardiovascular disease.

Assessment: In published literature on urban fishers and in our focus groups, commonly reported reasons for fishing include: traditional and cultural significance, particularly eating a self-caught rather than purchased fish; exercise; spending time with family and friends; and relaxation. It is possible that some people currently fishing on the Duwamish River will reduce or discontinue fishing and consuming self-caught fish, rather than traveling to alternate locations, with some loss of social ties. There is limited information to assess how likely this would be, but the health impact could be limited or moderate. The impact would disproportionately affect lower-income people with limited time or transportation.

Photo: BJ Cummings, Duwamish River Cleanup Coalition/TAG



RECOMMENDATIONS

For EPA, City of Seattle, King County, and Port of Seattle

- 1. Institutional controls should go beyond restrictive and informational actions, such as advisories to avoid contaminated fish. Interventions should emphasize positive alternatives, such as identifying, encouraging, and providing options for safe fishing and healthful fish consumption.**

Advisories have repeatedly proven to have limited effect on the targeted fishing practice, locally on the Duwamish River and elsewhere. Efforts to dissuade fishing on the Duwamish River may have the best chance to be truly effective and least discriminatory if people are provided other, healthier options that will directly address and satisfy the reasons that they harvest or consume fish or shellfish.

- 2. There is a clear need for innovative thinking about how to discourage fishing (for resident fish and shellfish) on the Duwamish River and how to promote safe and healthful fishing alternatives. Possible options to explore in consultation with fishing communities include:**

Consider some of the “offsets” identified in the EPA Environmental Justice Analysis for the Duwamish River cleanup.

Our focus groups with local fishers suggest that acceptance and cultural appropriateness of offsets will vary between and within populations. Some of the listed options might appeal to some fishing populations, but we found mixed or negative responses to some of the options.

Provide a sufficient and reliable supply of fish to food banks in the communities where current and prospective fishing populations are located.

One survey of local food bank clients found 40% of client families fished for food, including 8% who fished in the Duwamish River. Providing a reliable source of fish for these lowest-income and food-insecure populations through programs such as SeaShare may alleviate at least their dietary drivers for fishing, and may give them flexibility to be more selective in choosing locations when they fish for other reasons (e.g., cultural tradition, family recreation, etc.).

Establish community supported fishery (CSF) programs— analogous to community supported agriculture (CSA) programs—in communities where fishing populations are located.

As with CSA programs, CSFs allow members to purchase shares of fish and other seafood caught by local fishers. These shares provide members with a regular source of lower-cost fish and shellfish and directly benefit local fishers with financial support.

Build and maintain urban fishing ponds near the affected fishing communities.

Reasons for fishing vary between populations. Many people fish for cultural and recreational reasons in addition to fishing for an inexpensive source of food. Other states have developed urban fishing ponds to provide safe, local fishing locations for urban or land-locked communities. Allowing people to keep and consume the fish they catch would encourage continued fish consumption while maintaining fishing activities. Catch-and-release ponds would also allow for continued opportunities for exercise, nature contact, and socializing. Urban fishing ponds were generally well supported by focus group participants, who agreed that these locations should be aesthetic and relatively natural environments to maximize the appeal for fishers.

- 3. Efforts to promote safe or safer fishing practices should acknowledge that the target audience is more than just people who currently fish on the Duwamish River. The target audience includes people who might fish on the Duwamish in the future. Any intervention effort should include plans to periodically reassess if all appropriate populations are being served.**

A cleaner river after active cleanup may eventually attract people who do not currently fish on the river, either because of misperception that resident fish are then safe or because fishing there is a best or better option in a limited set of options. It is important to note that some minority or immigrant populations that are presently small in number in the Seattle area are projected to grow, and the composition of the urban fisher population may change over time.

4. All efforts to provide information, communicate advisories, and promote safe and healthful alternative options should be culturally appropriate and relevant for each target audience, and should be designed to help individuals make informed choices.

Current and prospective future fishers on the Duwamish River are highly diverse in terms of race, ethnicity, nationality, and language. Their reasons for fishing and fish consumption are equally diverse. There are probably no interventions that will broadly address the perspectives and needs of all groups, without tailoring the intervention for individual groups. Methods to ensure that individuals have the information and awareness to make informed choices could include:

Distribute maps to fishing communities that identify regional fishing locations, the associated advisories or concerns about contamination, and the types of fish available to catch that are safe for consumption.

Fishers could more easily choose safer, less contaminated fishing locations if they have clear descriptive information on other local fishable waters. These maps and other materials would need to account for the different languages and levels of literacy and numeracy in the diverse fishing communities. This could be accomplished by involving members of affected communities in developing, reviewing, and distributing these materials.

Incorporate community engagement efforts to develop outreach and educational strategies around fish advisory awareness.

The methods used for the Palos Verdes Shelf Superfund Site represent one good community-participation

model to consider. We emphasize, however, that the most valuable lessons to learn from this model relate to community engagement and participation, and not the primary focus on fish advisories. This model could be useful for some populations but not others.

Partner with fishing community members to develop specifically tailored risk communication interventions.

The community-engagement model used in Georgia by Derrick and colleagues (2008) is a good example of an effective approach to developing a culturally tailored risk communication strategy to increase knowledge of contamination and fish advisories and improve ability to make informed choices.

5. All efforts to provide information, communicate advisories, and promote safe and healthful alternative options should engage and empower members of fishing populations so they can participate meaningfully in all stages of any prospective interventions, from initial conception and planning through implementation and follow-up monitoring.

The methods used by Burger and colleagues (2013) in New Jersey provide an excellent model for effectively engaging community members as research partners in planning and implementing research, evaluating and interpreting findings, and developing and disseminating risk communication information. Community-based participatory methods can best ensure that interventions will account for the knowledge, beliefs, and cultural, social, and economic needs of fishers and their families. Although these methods are more time and resource intensive than traditional agency or “expert” driven approaches, they are more likely to ensure success.

Photo: Paul Joseph Brown





Photo: Linn Gould, Just Health Action

Institutional controls and health

The assessment of affected Tribes and subsistence fishers identified some important health issues related to institutional controls (ICs). We also identified broader concerns about ICs that could affect health and cost. This chapter offers information and recommendations beyond those provided in the Subsistence Fishing and Tribal chapters. Additional information, including references, for this chapter is in the “Institutional Controls” Technical Report.

INSTITUTIONAL CONTROLS

The models of future river sediment and fish and shellfish tissue concentrations predict that the Plan’s health-protective goals will not be fully achieved. Resident fish and shellfish will probably still be unsafe for human consumption and higher than Puget Sound background levels, even after the 17-year period of active cleanup and monitored recovery. Therefore, the Plan is critically dependent on ICs to protect human health during and after cleanup of the river. The ICs are projected to last at least 40 years and could persist in perpetuity.

ICs are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. They are generally divided into four categories: proprietary controls, governmental controls, enforcement and permit tools with IC components, and informational devices.

The Plan states that ICs for the Lower Duwamish

Waterway (LDW) will use proprietary controls (controls on land use) and informational devices “including fish and shellfish consumption advisories to reduce human exposure from ingestion of contaminated resident seafood. EPA will rely on the existing [Washington State] fish and shellfish consumption advisories...and may implement additional advisories or other measure to provide additional protectiveness. Outreach and education programs will also be used to enhance seafood consumption advisories.”

There is little additional detail in the Plan. However, the Plan does acknowledge that: ICs are “difficult to monitor;” advisories are “not enforceable” and “have historically had limited effectiveness according to published studies and in EPA’s experience;” and ICs raise concern about “the burden placed on Tribes exercising their treaty rights and on other people who fish in the LDW.”

State and local guidelines and advisories exist for many water bodies in Washington State, including the lower Duwamish River. Existing signs along the Duwamish River attempt to inform fishers of these advisories in a variety of languages but have limited effectiveness. For example, the photo above shows people fishing for perch across from a yellow advisory sign on the lower Duwamish River. In addition, advisory signs are reportedly not present at some common fishing areas. Informal and formal surveys have documented that fishers ignore the signs for many reasons.

EPA GUIDANCE FOR INSTITUTIONAL CONTROLS

The EPA is not required to identify exact ICs at the time of a proposed plan or remedy decision, especially if flexibility is appropriate. However, EPA guidance indicates that site managers should ultimately “understand the strengths, weaknesses, and costs for planning, implementing, maintaining, and enforcing ICs;” “evaluate ICs as rigorously as any other response alternative;” “provide adequate opportunities for public participation...and opportunities for comment, such as the Proposed Plan;” and typically include “a preliminary IC evaluation...as part of site investigation efforts...for example, during an RI/FS [Remedial Investigation and Feasibility Study].”

With respect to evaluating ICs as rigorously as other remedial alternatives, it is noteworthy that EPA wrote hundreds of pages in the Feasibility Study considering the merits of various other remedial alternatives, while ICs only covered seven pages in the Feasibility Study and three pages in the 82-page “Detailed Cost Estimates” Appendix. This and summary statements in the *Proposed Plan* are the only official information about ICs made available to the public during the public comment period for the Plan.

EPA policy does not require a complete IC plan as part of a proposed cleanup plan. However, for the LDW Site, the Remedial Investigation could have collected evidence on institutional controls essential for eventual decision-making. It has been known throughout the 11+ years between the Superfund listing and the *Proposed Plan* that: consumption of resident seafood poses a high risk to human health; some people catch and eat resident seafood; and fishing is not deterred by existing advisories and multilingual posted signs. Yet, even after the Feasibility Study indicated that ICs would be essential in almost any conceivable cleanup plan, there were no substantial efforts until recently to count or characterize who fishes in the river or to evaluate the seeming ineffectiveness of existing ICs. It is noteworthy that the EPA *EJ Analysis* recommended measures to mitigate adverse disproportionate impacts of residual contamination and ICs, including possible “offsets” such as fish trading, sustainable aquaculture, or alternative transportation for fishers. However, the EPA assigned *EJ Analysis* findings and recommendations to the status of “modifying criteria,” which means they will not be considered until after public comment.

With this void of information about ICs—and in spite of noting that cleanup “alternatives that rely less on institutional controls are more readily implementable”—EPA selected a favored cleanup alternative for which ICs are essential to achieve health-protective goals.

EPA PRACTICES RELATED TO INSTITUTIONAL CONTROLS

The relative inattention to ICs in the *Proposed Plan* for the lower Duwamish River is not unusual for EPA.

The U.S. Government Accountability Office (GAO) reviewed the extent to which ICs are used at hazardous waste sites and whether controls are properly implemented, monitored, and enforced. The GAO report (2005) reviewed 268 sites and found a general trend where ICs have been increasingly relied upon, with contaminants being left in place rather than being removed completely, even though the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) explicitly prefers permanent removal and treatment compared to more temporary measures. The report also found that remedy decision documents commonly lacked information about: implementation including timing of ICs, responsibility for monitoring of effectiveness, and enforcement responsibility. The GAO recommended that EPA review its IC recommendations, methodologies, and guidance documents in order to ensure that ICs are effective during the time they are needed and that appropriate contingencies are in place for the long term. EPA generally agreed with GAO’s recommendations.

COSTS OF INSTITUTIONAL CONTROLS

The estimated cost of ICs for the lower Duwamish River seems relatively low. This raises concerns that the true cost of cleanup is being underestimated or that the eventual IC plan could be substantially constrained by being designed to fit that IC cost estimate.

ICs were estimated to cost approximately \$15 million over a 50-year period for seafood consumption advisories, public outreach, and education, which is about 5% of the total \$305 million projected for the cleanup. The average annual cost of ICs, \$300,000 per year, is relatively low compared to the example described in the EPA *EJ Analysis*, the Palos Verdes Shelf Superfund Site. The Record of Decision (2009) for that site estimated IC costs of \$1.43 million per year. At this rate, a 50-year period of similar ICs for the lower Duwamish River would cost about \$72 million. Even this estimate is most likely conservative because of the additional need to consider infringement of Tribal Treaty rights.

Furthermore, this only accounts for direct costs and does not consider costs of adverse human health effects. For example, it has been suggested that cost estimates should include the costs of degrading Tribal seafood, which can subsequently lead to poorer health. In the 2007 *U.S. v. Washington “Culverts”* case, the District Court

held that “implicitly incorporated in the treaties’ fishing clause is the right to have the fishery habitat protected from man-made despoliation.” It is outside of the scope of this HIA to calculate health costs; however, they could be substantial.

INSTITUTIONAL CONTROLS ARE A PUBLIC HEALTH INTERVENTION

ICs are an integral and essential component of the *Proposed Plan*. They are essential because the other proposed cleanup actions will not be sufficient to achieve a stated goal of remediation, to “reduce to protective levels the human health risks associated with consumption of contaminated Lower Duwamish Waterway resident fish and shellfish by adults and children with the highest potential exposure.” If the ICs fail, then the overall remediation will fail to achieve the stated goal.

For any proposed public health intervention, it is best evidence-based practice to assess beforehand (and afterward) whether the intervention is likely to be effective, whether it might have unfavorable or unintended consequences, whether there might be better or more cost-effective strategies, and whether and how it will be feasible to monitor if the intervention achieves its goals after it is implemented. This is particularly true for behavioral interventions where unfavorable or inequitable consequences could occur. To date, the EPA has failed to meet standard expectations of public health practice, as well as their own guidance materials.

There is some reasonable doubt about IC effectiveness, as evidenced in EPA’s statements in the Plan about ICs being difficult to monitor and advisories being non-enforceable and having limited effectiveness. The EPA *EJ Analysis* made an important effort to characterize the evidence base related to ICs. However, as noted earlier, EPA designated findings of that analysis as modifying criteria, to

be considered later in selecting the final remedy. Otherwise, there is no substantial evidence base in the RI/FS or *Proposed Plan* to support or refute the likely effectiveness of the proposed ICs. Yet, this is the evidence base that the public had to rely upon, at this last official opportunity for public comment before the final remedy is selected.

Reliance on ICs to remediate a compromised aquatic system inherently raises environmental justice concerns when ICs expect vulnerable populations to change fishing or fish consumption behaviors, even though these may be deeply rooted in cultural traditions and may be important to subsistence or family and community cohesion. The Tribal and Subsistence Fishing chapters in this HIA report identify a number of ways in which the proposed ICs could adversely impact health, in a manner that would disproportionately affect these populations. Furthermore, although there is limited information to characterize their baseline health status, the available information indicates that the Tribal populations and probably a sizable number of subsistence fishers and families have existing socio-economic and health disparities.

Clearly, further EPA evaluation of ICs is warranted, as summarized above for any substantial public health intervention. A meaningful evaluation would assess ICs relative to the cumulative burden of chemical and non-chemical threats to health and differential vulnerabilities in these at-risk populations. This would characterize the potential compounding health risk of ICs, rather than their risk in isolation. This also could identify population-appropriate ways to mitigate those risks. The EPA has established frameworks for cumulative risk assessment and integrated environmental decision making but has not established agency-wide guidelines for either approach. Nonetheless, the concepts are sufficiently well entrenched and resources are available to support applying these concepts in this complicated exposure situation.

Photo: Linn Gould, Just Health Action



RECOMMENDATIONS

For EPA

EPA is stuck between the need to resolve a technological problem (residual contamination due to incomplete cleanup), for which ICs are required, and a health equity problem (risks to vulnerable populations), for which there should be no ICs. In order to better protect human health, EPA should enact measures to protect *all* vulnerable populations as long as ICs are in effect.

1. EPA should follow its own institutional control guidance recommendations:

- Characterize the strengths, weaknesses, and costs for planning, implementing, maintaining, and enforcing ICs.
- Evaluate ICs as rigorously as any other response alternative.
- Develop procedures to coordinate with implementing entities early and often throughout the cleanup process.

2. EPA should evaluate the true health impact of institutional controls to vulnerable populations. Options to consider are:

- Acknowledge that the proposed ICs are a public health intervention, intended to modify health behaviors. Use best, evidence-based public health practices to select, plan, and evaluate such behavioral interventions.
- Conduct cumulative health assessments to accurately account for multiple physical and chemical stressors that affect Tribes and subsistence fishers that make them more vulnerable to contamination. These cumulative risks would illustrate health impacts higher than traditional risk assessments predict.
- Determine a realistic cost estimate of IC programs so that potentially responsible parties understand their future and long-term costs relative to the cost of more cleanup now.

3. EPA should develop a robust Institutional Control Program Implementation and Assurance Plan (ICIAP) to protect ALL vulnerable populations who consume seafood from the Duwamish River, to be funded by potentially responsible parties as long as ICs are in effect.

In acknowledging that ICs will have to be used until residual contamination levels decrease, they should be as temporary as possible. The remedy decision document should refer to the ICIAP with information about implementation, including timing of ICs, responsibility of monitoring effectiveness over time, and responsibility of all parties.

For EPA, City of Seattle, King County, and Port of Seattle

4. An IC Task Force should be established and include a leader from each affected community.

Current and prospective future fishers on the Duwamish River are highly diverse in terms of race, ethnicity, nationality, and language. Based on what was learned in HIA focus groups and key informant interviews, there are at least 15 communities for outreach including but not limited to: the three affected Tribes, urban American Indians and Alaska Natives; food bank clients; homeless communities; Asian Americans and Pacific Islanders, and other immigrant, second-generation, and low-income populations.

5. The IC Task Force should incorporate a community-based participatory approach to engage and empower affected populations so that they can participate meaningfully in all stages of any prospective interventions, from initial intervention and planning through implementation and follow-up monitoring for success.

The preceding Tribal and Subsistence Fishing chapters provide information about community-based participatory approaches. As mentioned earlier, the methods used by Burger and colleagues (2013) provide an excellent model for community engagement. The EPA's *Environmental Justice Collaborative Problem-Solving Model* (2008) is another valuable resource.



Photo: Paul Joseph Brown

Effects of the proposed cleanup plan on WORKERS AND EMPLOYMENT IN LOCAL INDUSTRIES

Detailed information, including references, for this chapter is in the “Workers and Employment” Technical Report.

COMMUNITY PROFILE

The Duwamish River Valley is home to Seattle’s and King County’s largest concentration of industry, including the Duwamish Manufacturing Industrial Center (MIC) and Port of Seattle. The manufacturing, wholesale trade, transportation, warehousing, and utilities industries in this area employ at least 50,000 workers. Employment has been relatively stable in these industries, with signs of recovery since the 2008 recession. On average, these jobs pay good “family” wages, and even the lower-income production jobs tend to pay better than common service occupations.

HEALTH OUTCOMES

There was no readily available information about health status of this worker population. The major potential health impact of concern relates to employment. Employment is one of the strongest favorable determinants of health and well-being. Steady employment with a decent wage allows individuals and families to live in a safe home and safe neighborhood with access to basic services, purchase healthful food, and ensure education for their children. Steady employment and a decent wage can also provide income and time to enjoy pleasures of life, exercise, and be able to deal with unanticipated life challenges.

Good jobs with benefits may provide health insurance which allows access to health care, preventive, and health promotion resources. Together, these factors can reduce the risk of major preventable health problems such as obesity, diabetes, high blood pressure, heart attack, and stroke. Employment and higher income are associated with longer lifespan.

POTENTIAL HEALTH IMPACTS

Any potential effects of the proposed cleanup on workers and employment would not occur in a vacuum. Therefore, we also considered the context within which any cleanup-related effects would occur. Manufacturing, wholesale trade, transportation and warehousing businesses in the Lower Duwamish area face a variety of pressures that could influence their productivity and economic viability and that could stimulate changes in land use analogous to ongoing residential gentrification in local neighborhoods.

Business environment: The regional economy has shown signs of recovery since the onset of the 2008 recession, with lower unemployment rates than in other U.S. cities and higher rates of manufacturing employment. A 2011 survey of state manufacturing executives revealed optimism for their company’s business prospects but very high concern about the business environment, particularly healthcare costs, state and federal policies and regulations, and taxes.

International trade: Seattle is a leader among U.S. ports, but shipping volume has been down in many of the past seven years. The Port of Seattle has made major investments in infrastructure and expanded capacity. However, competition for Asian trade is steep, particularly with ports in Tacoma and British Columbia. Port activity is hindered by longstanding local highway access and traffic issues, which particularly affects exports, most of which come to the Port by truck. Moody's Investor Service recently downgraded its outlook rating for the Port, based on challenges to seaport and airport operations.

Location: The Lower Duwamish area is an essential location for Port- and water-dependent industries, ideal for many others, and desirable but not essential for some. The area is constrained by older building stock, high costs of building replacement, little unused land, low lease turnover and vacancy, traffic congestion and infrastructure issues, and reportedly burdensome city policies and regulations. The closest alternative MIC in Kent offers appealing features, but relocation benefits are balanced against the loss of advantages of the Duwamish and Seattle "close-in" location.

Industrial development: The City of Seattle has made major commitments to sustain industry in the Duwamish MIC, in its Comprehensive Plan and a 2007 zoning ordinance. The Industrial Development District Pilot Program offers mechanisms to resolve regulatory challenges to industrial development. Ongoing industrial lands and transportation studies are examining key issues for industry. Nonetheless, encroachment and conversion of industry-zoned land is an ongoing concern for industry, particularly in the SODO area.

Industrial workforce: Several trends pose challenges for industry: limited availability of skilled labor, aging industrial workforce, relative disinterest in blue collar jobs among younger people, and the high cost of living in Seattle.

Commercial real estate: Seattle is increasingly a national and international target for real estate investors, specifically for industrial and warehouse properties. Warehouse rental costs are steadily increasing. Speculation is likely to drive conversion of some warehouse space to other uses.

SODO area and stadiums: SODO development pressures pose one of the biggest challenges to integrity of the Duwamish MIC. SODO is a subarea of the MIC, and the stadium "district" is technically an MIC "overlay." Development pressures include: the Stadium Place development, immediately north of the MIC; a proposed third athletic

stadium; and a "Vision for Tomorrow" concept plan for the stadium district. Port, MIC, and union representatives have expressed concern (and legal action) about industrial land encroachment and traffic impacts; however, the development proposals have high profile support.

POTENTIAL HEALTH IMPACTS OF THE CLEANUP

It is plausible that the proposed cleanup and related decisions could add to existing unfavorable pressures on local industries, with net loss of jobs or reduction in hours of employment. Alternatively, it is plausible that existing businesses and employment could benefit substantially if the cleanup reversed the constraints and stigma of a blighted river, and if this stimulated industry revitalization and economic robustness. We considered impacts in four major areas: cleanup job creation, cleanup costs and business liability, business uncertainty, and industry revitalization.

Cleanup job creation

Direction of effect: BENEFICIAL

Likelihood: Very likely

Magnitude: Limited to moderate

Distribution: Disproportionate benefits

Assessment: It is not possible to quantify cleanup jobs until the cleanup plan is finalized and logistic planning begins. EPA estimates cleanup costs to be about \$300 million. A 2010 economic impact study by ECONorthwest, conducted for King County, concluded that "as much as three-quarters of spending may be allocated to firms located within King County and 60% allocated to firms in the City of Seattle," with \$377 million direct and indirect economic output in King County. ECONorthwest estimated that a 7.7 year construction period could generate an average of 270 "full year" jobs in King County, including 69 with Lower Duwamish area firms. An estimated 480 jobs would be full-time but part-year.

Much of the direct cleanup jobs and expenditures could be retained in the local economy, if there are intentional efforts to do so. The number of jobs with Duwamish area businesses would be small relative to the overall number in that area, and the healthful benefits would accrue to workers and business owners in a limited subset of businesses. The direct benefits of job creation would probably be limited or none for most businesses liable for cleanup costs. Workers with necessary trade skills or experience are more likely to get these jobs and healthful benefits, than unskilled and lower-income workers. The

Superfund Jobs Training Initiative (see Local Residents chapter) or other training or hiring initiatives could help reduce this potential inequity.

Cleanup costs and business liability

Direction of effect: ADVERSE

Likelihood: Likely

Magnitude: Insufficient evidence; limited to moderate

Distribution: Disproportionate harms

Assessment: In addition to impending cleanup costs, the first four identified potentially responsible parties (PRPs) have spent over \$135 million on studies and early-action cleanups to date (Lower Duwamish Waterway Group, LDWG: City of Seattle, King County, Port of Seattle, The Boeing Company). The EPA has identified at least 111 additional PRPs. LDWG will invite other PRPs to allocate costs in a non-judicial process. Cleanup costs might be compounded by legal costs. However, there will be other funding streams including PRP insurance and the State Toxics Control Account. The public entities can pass their net liability along to taxpayers and utility rate payers, but private businesses must absorb net liability as a cost of business.

It is not possible to estimate the costs for liable businesses. However, the costs could be substantial relative to a business' resources or operating margin. This could result in job elimination or reduced worker hours, with associated impacts on worker health. This would disproportionately harm workers in private businesses, particularly smaller businesses. Less skilled or lower paid workers might be more expendable and could be disproportionately impacted.

Business uncertainty

Direction of effect: ADVERSE

Likelihood: Possible to likely

Magnitude: Insufficient evidence; limited, possibly moderate

Distribution: Disproportionate harms

OR

Direction of effect: BENEFICIAL

Likelihood: Possible

Magnitude: Insufficient evidence; limited to moderate

Distribution: Diffuse; possible disproportionate benefit

Assessment: Business perceptions about the proposed cleanup could affect business behavior, investment, and economic output, and this could influence a business'

ability or choice to sustain a desired level of employment. There is no concrete information about the distribution of perceptions in this situation. However, there is little doubt that businesses and property owners are concerned about a wide range of uncertainties. Examples include uncertainty about cost of liability, the process for allocating liability, possible legal actions, duration and finality of the cleanup, and future liability.

It is not possible to predict the net result of these uncertainties, particularly in the broader context of uncertainties affecting area industries. Any efforts to address uncertainties could have a beneficial effect. Furthermore, existing businesses and employment could benefit substantially if the cleanup reversed the constraints and stigma of a blighted river and if this stimulated industry revitalization and economic robustness.

Both adverse and beneficial effects of cleanup-related perceptions are plausible, with effects on employment and worker health. Any adverse effects would disproportionately harm workers in private and smaller businesses. Less skilled or lower paid workers might be more expendable and could be disproportionately impacted. On the other hand, any beneficial effects of reduced uncertainty would probably be diffuse across area industry, possibly with disproportionate benefit for businesses that have PRP status or perceive themselves at risk.

Industry revitalization

Direction of effect: BENEFICIAL

Likelihood: Possible

Magnitude: Insufficient evidence

Distribution: Insufficient evidence

Assessment: There is no evidence that the proposed cleanup would produce substantial industry revitalization without intentional and planned revitalization efforts. Cleanup-related industry revitalization seems unlikely unless it occurs in parallel with other, more broadly based efforts. Seattle's Industrial Development Pilot Projects are one such effort. The cleanup could stimulate expanded interest in industry revitalization. Eventually, the stigma of a contaminated river will be removed, and the natural environment will be restored, immersed in a functioning industrial setting. Enhancements of the Duwamish River will continue to attract public attention, beyond local neighborhoods and industry employees and owners. This could be an opportunity for industry representatives to build supportive connections beyond their usual stakeholders, to pursue shared goals of revitalization.

RECOMMENDATIONS

For EPA

- 1. Selection of the final cleanup plan and the process for allocating liability should attempt to reduce or eliminate uncertainty for affected businesses, whenever possible.**

We offer these options to consider:

- *Allocation of liability:* It is hopeful that the first four identified potentially responsible parties (PRPs)—the Lower Duwamish Waterway Group (LDWG)—are promoting a non-judicial process to allocate liability and that they plan to invite other PRPs to participate. Ideally, this will engage all willing PRPs, so that exclusion will not feed into uncertainties or adversarial relations between LDWG members and excluded parties.
- *Scope of cleanup:* We purposely focused this HIA on the proposed cleanup plan (“5C+”), and we did not assess alternative cleanup scenarios or source controls. We encourage EPA and the PRPs to consider that uncertainty about finality of the chosen remedy will probably be higher with a heavy reliance on more uncertain and impermanent methods, such as natural recovery and, to a lesser extent, capping. In contrast, uncertainty will probably be lower with increased reliance on permanently removing contaminated sediments and taking measures to prevent recontamination.

For City of Seattle, King County, and Port of Seattle

- 2. Selection of firms for cleanup construction and related activities should, as much as possible, give priority to firms and workers that are based in Seattle or King County.**

Placing a priority on hiring local firms and local workers will maximize the likelihood that healthful benefits of employment will go to local workers, and that indirect and induced economic impacts of the cleanup will further support local employment.

For EPA, City of Seattle, King County, and Port of Seattle

- 3. Convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community.**

We believe there will be opportunities to turn river cleanup and restoration into a model for healthful and sustainable coexistence of industry, Tribes, and community. It will be a challenging task to find the optimal balance between economic, traditional, subsistence, and recreational uses. However, the alternative—turning away from this opportunity—will create challenges and problems of its own. It would be a devastating loss for Seattle and Washington State to suffer any substantial erosion of industry, port capacity, or family-wage employment in the Duwamish Valley.

Experiences in other places suggest that industry does not necessarily fare well with urban revitalization efforts; however a broad-based, collaborative endeavor might be more likely to achieve success than if industry pursues its own path.

In our detailed Technical Report, we describe experiences in other places that could provide models upon which to build a collaborative Duwamish Valley revitalization effort. There are undoubtedly others to consider too. Portland has proposed a river renaissance, and Seattle can probably draw lessons from industry dissatisfaction with that proposal. Chicago offers the example of a city with longstanding efforts to preserve manufacturing in the urban center and plans to renew those efforts. Efforts such as these will undoubtedly give cities the advantage in trying to become one of the proposed national hubs of manufacturing innovation.

The Great Lakes restoration efforts offer an excellent model for public-private collaboration to restore and protect the natural environment while also promoting economic growth and vitality. The vision statement of the Council of Great Lakes Industries, representing major industries and businesses, provides an enviable model and goals for other industry coalitions to consider.

Note: We conducted this assessment of local workers and employment as a desk-based HIA, without ongoing guidance by a population-specific advisory committee or individual advisors. We later invited key public, business, and union stakeholders to discuss our findings and recommendations and consider if modifications were warranted. Two public representatives and a union official participated.



Photo: Paul Joseph Brown

Other considerations

INFORMATION GAPS AND UNCERTAINTIES

Identifying information gaps is an important goal for any HIA, almost as important as identifying health impacts. If the evidence base about possible health effects is incomplete, then decision-makers could make unfounded choices that adversely affect health or create inequities, and that might have been avoidable. Conversely, opportunities to benefit health or to restore equity could be lost if they are recognized too late.

Decision-makers need to know about information gaps in order to consider whether they should gather more information, amend the decision process or timeline, or alter a decision they might otherwise make. It is also challenging for members of the public and other stakeholders to participate meaningfully during a limited time period for public comment, if they do not have a complete picture that allows truly informed consent or comment.

Uncertainties in the proposed cleanup plan

One important gap is the limited planning for **institutional controls**, as discussed in this report. The health consequences of residual chemical contamination and institutional controls are potentially substantial, and these could pose disproportionate harm for the Tribes and lower-income subsistence fishing households. It is not possible to adequately assess these potential health impacts, given the gaps in information.

Another important gap in the Plan is the lack of formal connection to a **source control** plan. The cleanup goals for contaminant reduction, and the certainty of achieving those goals, depend critically on the timing and extent of source controls. It is not possible to fully assess the potential health impacts of residual contamination without knowing the timing and extent of source controls. Adding clear source control goals and objectives to the Plan, and defining required source control programs and actions, could reduce uncertainty and contribute to improved health outcomes by defining requirements to reduce pollutant loading to the site.

Information gaps for affected populations

As we describe in this report, there is little available information about health of the specific affected Tribes, particularly from a holistic perspective that would capture Tribal views of health and well-being. Population monitoring in Washington State and King County, however, reveals that regional Tribes suffer profound disparities in biomedical measures of disease and risk factors. There is also little information about urban subsistence fishing populations.

These gaps in information make it impossible to fully assess the potential health impacts of the proposed cleanup, and particularly institutional controls. It is feasible to collect information that would fill these gaps, and doing so would provide a greater understanding of and ability to address health impacts to these populations.

OPPORTUNITIES

Seattle is at the cusp of a new era. Beginning with the cleanup, and accompanied by source control and natural restoration efforts, the Duwamish River and surrounding area have a chance to become a regional asset and symbol of pride, rather than an environmental stigma. There will be opportunities to turn river cleanup and restoration into a national model for healthful and sustainable coexistence of industry, Tribes, and community. It will be a challenging task to find the optimal balance between economic, traditional, subsistence, and recreational uses. However, the alternative—turning away from this opportunity—will create challenges and problems of its own.

We propose that the City of Seattle, King County, and the Port of Seattle convene a Duwamish Valley Revitalization Task Force with broad stakeholder representation to explore options for sustainable coexistence of industry with Tribes and community. In our detailed Technical Reports we describe local resources as well as experiences in other cities that could provide a foundation upon which to pursue collaborative, equitable, and sustainable revitalization.

EQUITY

It is critical that there be meaningful and collaborative participation with the affected communities in all efforts to prevent harm from the cleanup, maximize benefits, and promote health equity.

The EPA, City, and County each have prominent policies that make commitments to consider equity, race, and justice in decision-making. We call upon each to uphold these commitments in planning the cleanup and related actions and in planning for predictable health effects of those actions. We encourage the Port of Seattle to develop and implement a formal social justice policy.

The City of Seattle and King County are potentially responsible parties for the cleanup, and they are also responsible for protecting and improving the health and well-being of all people in their jurisdictions. At face value, cleaning up the Duwamish River will address both responsibilities. However, without targeted interventions, the proposed cleanup could result in unanticipated harms to vulnerable populations, and continue or even exacerbate existing health inequities.

Photo: Paul Joseph Brown

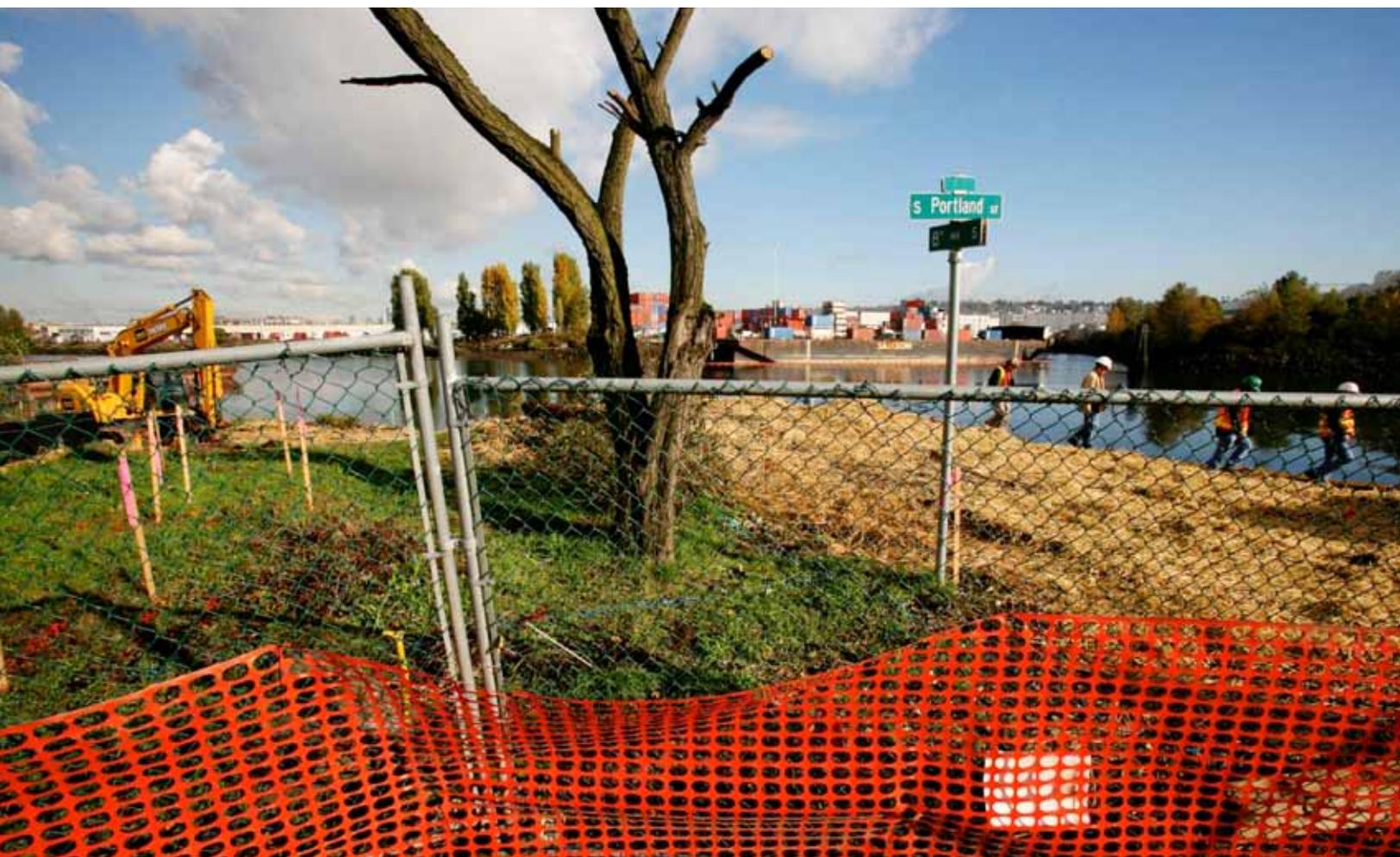




Photo: BJ Cummings, Duwamish River Cleanup Coalition/TAG