Health Impact Assessment

Lower Duwamish Waterway Cleanup





By the University of Washington HIA Graduate Class

Editors: Leann Andrews, Scott Beckstrom, Carlos Camara, Amber Lenhart, Yoli Grandjean

Spring Quarter, 2012









The Lower Duwamish Waterway [Leann Andrews]



Table of Contents

- Executive Summary p. 4
 - Introduction p.6
- Cleanup Construction Impacts p. 10
 - Recommendations p.16
 - Economic Impact p. 22
 - Recommendations p. 32
 - Social and Cultural Impact p. 36
 - Recommendations p. 43
 - Fish Consumption Impact p. 48
 - Recommendations p. 55
 - Conclusion p. 59
 - Acknowledgements p. 61

This paper is a student product generated from a 10-week Health Impact Assessment (HIA) graduate class at the University of Washington School of Public Health and College of Built Environments during Spring Quarter 2012. It uses readily available existing information, incorporates minimal community engagement, and is subject to a number of study limitations. A more comprehensive HIA for the Duwamish River Cleanup Plan is being conducted by Dr. Bill Daniell, UW School of Public Health, in partnership with Just Health Action and Duwamish River Cleanup Coalition/Technical Advisory Group, and is expected to be completed in early 2013. For more information, see http://duwamishcleanup.org

Executive Summary



This Health Impact Assessment (HIA) was conducted by a class of graduate students at the University of Washington (UW). The purpose of this HIA is to examine the potential effects of the Lower Duwamish Waterway Superfund cleanup activities on the health and well-being of selected populations and to make recommendations that mitigate negative health impacts and support the overall health of affected populations.

Background

In 2001, the Environmental Protection Agency (EPA) designated the Lower Duwamish Waterway (LDW) in South Seattle as a "Superfund" site, meaning that it is one of the nation's most toxic hazardous waste sites. Waterway sediment is currently contaminated with over 42 chemicals found at levels above state health standards. These pollutants put people who consume fish, crab, and clams from the waterway at risk for adverse health effects, mainly from polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, arsenic and other metals, and phthalates. It is likely that cleanup activities will include dredging (removal of contaminated sediments), capping (containment of contaminated sediments), and enhanced natural recovery along with institutional controls (EPA, 2010).

Populations

Three populations were identified as most likely to be affected by LDW cleanup activities: Georgetown and South Park neighborhood residents; recreational and subsistence fishermen; and the Duwamish, Muckleshoot, and Suquamish tribes. These populations have characteristics that place them at increased risk for poor health outcomes, for example, higher poverty rates and lower educational attainment among American Indian/Alaska Native, African American, and Hispanic people than white people (Communities Count, 2008). Research has shown that income, education, race/ethnicity, and neighborhood environments can influence our health (Marmot & Wilkinson, 2006).

Methods

An HIA progresses through the following phases (Human Impact Partners, 2011):

Screening > Scoping > Assessment > Recommendations > Reporting > Monitoring

The screening for this HIA was conducted by the University of Washington and partners and other stakeholder groups prior to the involvement of UW students. The scoping phase took place during one class session at the UW, with input from UW faculty and partners, and UW students. The scoping phase resulted in the identification of four priority areas for assessment: Cleanup construction activities; Economic impacts; Social and Cultural implications; and Fish consumption. For the assessment in each of these areas, students used data from a variety of sources, including technical and academic literature, public reports, previous HIAs, field visits, and some stakeholder input.

Findings and Key Recommendations



1. Cleanup Construction Activities

Findings: Noise pollution, air pollution, water quality, and traffic are likely to be affected by cleanup construction activities and may increase health risks for Georgetown and South Park residents.

Recommendations: Separate residents from cleanup construction activities by keeping construction activities in industrial areas as much as possible, create venues for meaningful public involvement and feedback, establish a public notification system to alert residents of increased construction activities, follow established industry best practices for cleanup construction operations.



2. Economic Impacts

Findings: A robust economy is a protective factor for a healthy neighborhood. The LDW cleanup is likely to have short and long-term effects on gentrification, physical environment, employment, and businesses in Georgetown and South Park.

Recommendations: Affordable housing policies, homeownership and community involvement will help address gentrification issues; employment assistance for area residents and widespread job information postings in multiple languages, as well as giving priority to hiring local workers, can help residents find jobs; partnering with existing business coalitions may help mitigate negative economic impacts, and short-term impacts can be addressed with signage, lighting, and way-finding interventions.



3. Social & Cultural Implications

Findings: Local tribes, non-resident fishers, and residents are at risk for deteriorating social and cultural well being due to the effects of the cleanup on their physical environment, how they live, and how they communicate.

Recommendations: Conduct a baseline assessment of spoken languages to identify dominant languages in the affected population and translate messages accordingly, use temporary art from native and local artists to mitigate the adverse aesthetic effects of cleanup construction, mitigate the stress caused by construction by creating community recreation opportunities and public greenspace, use cultural brokers and key informants.



4. Fish Consumption

Findings: Resident fish and shellfish from the Duwamish are unsafe to eat, and the proposed cleanup plan will not change this.

Recommendations: Update the EPA fish consumption rate estimate used for risk assessments; make data on exposure risks easily available and understandable to key populations; include tribal groups as key stakeholders and decision-makers in the cleanup process; if feasible, clean the river to levels seen elsewhere in the Puget Sound.

EXECUTIVE SUMMARY

Introduction



Background

The Green-Duwamish River has been a source of local livelihood for generations. The Lower Duwamish Waterway (LDW), which stretches from Harbor Island at its north end to just south of the Turning Basin in South Seattle, has a history that dates back to 1905, when massive engineering projects began to transform it from a winding estuary to a deep, straight channel. This transformation improved conditions for shipping and industrial use of the area while effectively destroying all but two percent of the natural habitat of the Duwamish estuary over the years of development (Duwamish River Cleanup Coalition [DRCC], 2011).

Today, the LDW is one of the most industrialized waterways in Washington State (DRCC, 2012). In 2001, the U. S. Environmental Protection Agency (EPA) designated the LDW as a "Superfund" site, meaning that it is one of the nation's most toxic hazardous waste sites (DRCC, 2012). Waterway sediment is currently contaminated with over 42 chemicals found at levels above state health standards. These pollutants put people who consume fish, crab, and clams from the waterway at risk for adverse health effects, mainly from polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, arsenic and other metals, and phthalates.

Currently, cleanup activities are focused on a number of early action sites. In October 2010, the Lower Duwamish Waterway Group (LDWG) completed a draft final feasibility study exploring various cleanup options for the LDW. EPA plans to release a proposed cleanup plan for public review and comment in 2012, followed by a record of decision in 2013. It is likely the cleanup activities will include dredging (removal of contaminated sediments), capping (containment of contaminated sediments), and enhanced natural recovery along with institutional controls (EPA, 2010).

Health Impact Assessment

While it is largely agreed upon that cleanup of the LDW has the potential to reduce sources of pollution, reduce health risks for people consuming seafood from the LDW, and enhance the surrounding community environment and economy, there may also be unintended effects of the LDW cleanup. Because of this, a Health Impact Assessment (HIA) is underway. HIA is "a combination of procedures, methods, and tools that systematically judges the potential and sometimes unintended effects of a policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects" (Human Impact Partners, 2011). Typically, an HIA progresses through the following phases:

- Screening Determining whether an HIA is feasible and would add value to the decision-making process.
- **Scoping** Creating a plan for the HIA and identifying priority issues, methods, and participant groups.
- **Assessment** Understanding existing conditions in an area or population and evaluating the potential health effects of the program, policy, or project.
- **Recommendations** Proposing specific actions to improve the program, policy, or project and mitigate any negative health effects.
- **Reporting** Communicating the HIA findings through multiple channels.
- **Monitoring** Tracking the effects of the HIA on decision-making and health outcomes (Human Impact Partners, 2011).

This rapid HIA was conducted by a group of graduate students at the University of Washington (UW). The purpose of this HIA is to examine the potential effects of the Lower Duwamish Waterway cleanup activities on the health and well-being of selected populations and to make recommendations that mitigate negative health impacts and support the overall health of affected populations.

Methods

The screening for this HIA was conducted by the UW faculty and partners and other stakeholder groups prior to the involvement of UW students. The scoping phase took place during one class session at the UW, with input from UW faculty, Duwamish River Cleanup Coalition (DRCC) and Just Health Action (JHA) representatives, and UW students. Participants brainstormed a long list of possible health impacts related to the cleanup. The group then narrowed the list to priority areas by voting. The scoping phase resulted in the identification of four priority areas for assessment:

- 1. Cleanup construction activities
- 2. Economic impacts
- 3. Social and Cultural implications
- 4. Fish consumption

For the assessment in each of these areas, students used data from a variety of sources, including technical and academic literature, public reports, previous HIAs, field visits, and some stakeholder input.

Populations

The scoping process also involved the identification of populations most likely to be affected by the LDW cleanup activities. This HIA focuses on three populations:

- 1. Neighborhood residents in Georgetown and South Park
- 2. Fishermen, both recreational and subsistence
- 3. Tribes, including the Duwamish, Muckleshoot, and Suquamish tribes

Table 1.1 describes some of the demographic information for the residents of Georgetown and South Park.

Community	Race/Ethnicity	Median Household Income	Educational Attainment
Georgetown - pop. 1,287	Whites: 70.4% Blacks: 7.4% Hispanics: 12.2% Asians: 9.8% AIAN: 1.9% NHOPI*: 0.3% Other groups: 6.4% (City of Seattle, 2012)	\$44,869 in 2009 19.4% of pop. below poverty level (City-data, 2012)	39% high school or less (City-data, 2012)
South Park - pop. 3,873	Whites: 44.2% Blacks: 10.4% Hispanics: 37.6% Asians: 15.9% AIAN: 2% NHOPI*: 1.6% Other groups: 20.1% (City of Seattle, 2012)	\$40,878 in 2008 12.2% of pop. below poverty level (City-data, 2012)	70% high school or less (City-data, 2012)

Table 1.1 - Demographics of selected HIA populations

*Native Hawaiian and Other Pacific Islander

Lower Duwamish Waterway Cleanup HIA

In comparison to White residents, American Indian/Alaska Native, African American, and Hispanic community members had a higher risk for poor health outcomes, including higher poverty rates and lower educational attainment. (Communities Count, 2008). Research has shown that income, education, race/ethnicity, and neighborhood environments can influence our health (Marmot & Wilkinson, 2006). Table 1.2 describes the links between these characteristics and health.

Characteristic	Connections to Health
	Compared with adults in the highest-income groups, poor adults are nearly five times as likely to be in poor or fair health.
Incomo	Nearly one in every three poor adults has their activity limited by chronic illness, compared with less than one in 10 adults in the highest-income group.
income	Diabetes is twice as common among poor adults as among those in the highest-income group.
	The prevalence of heart disease is nearly 50 percent higher among poor adults than among adults in the highest-income group (RWJF, 2008).
	Lower educational attainment corresponds to higher proportions of physical inactivity.
Education	College graduates can expect to live at least five years longer than individuals who have not finished high school.
	Compared with college graduates, adults who have not finished high school are more than four times as likely to be in poor or fair health (RWJF, 2008).
	Poor or fair health is much more common among black and Hispanic adults than among white adults.
Kace/emnicity	Racial or ethnic disparities in the likelihood of poor or fair health are seen within each income group (RWJF, 2008).
Neighborhood environment	The physical environment of a neighborhood, including green spaces, sidewalks, bike lanes, exposure to toxic substances, and housing quality impact the health of residents.
	The social environment of a neighborhood, including access to educational, economic, and job opportunities, public safety, social support, and community resources also directly and indirectly influences the health of residents (RWJF, 2008).

Table 1.2: Determinants of Health

References

City of Seattle (2012). Seattle's Population and Demographics. Retrieved May 31, 2012 from http://www.seattle.gov/dpd/Research/Population_Demographics/ Overview/

City-data.com (2012). Georgetown neighborhood in Seattle, WA, 98108. Retrieved May 31, 2012 from www.city-data.com/neighborhood/Georgetown-Seattle-WA. html

City-data.com (2012). South Park neighborhood in Seattle, WA, 98108. Retrieved May 31, 2012 from www.city-data.com/neighborhood/South-Park-Seattle-WA.html

Communities Count (2008). Report Archives - Online Reports. Retrieved from www. communitiescount.org/index.php?page=report_archives

Duwamish River Cleanup Coalition (2011). Green-Duwamish Watershed map: www. duwamishcleanup.org/programs.html#watershedmap

Duwamish River Cleanup Coalition (2012). Superfund Info. Retrieved May 24, 2012 from www.duwamishcleanup.org/superfund.html

Human Impact Partners (2011). A health impact assessment toolkit: A handbook to conducting HIA, 3rd edition. Oakland, CA: Human Impact Partners.

Marmot, M., & Wilkinson, R. G. (Eds.) (2006). Social determinants of health, 2nd edition. New York, NY: Oxford University Press.

Robert Wood Johnson Foundation (2008). Overcoming Obstacles to Health. Retrieved from www.rwjf.org/files/research/obstaclestohealthhighlight.pdf

U.S. Environmental Protection Agency (2010). Lower Duwamish Waterway Cleanup Fact Sheet. Retrieved May 24, 2012 from www.epa.gov/region10/pdf/sites/ldw/ factsheet_oct2010rev.pdf

Cleanup Construction Impact

Introduction and Background

The proposed EPA cleanup construction operations will affect human health in the communities along the Lower Duwamish Waterway. As the cleanup project is still in the planning phase, a number of opportunities exist to identify and minimize the negative health outcomes of the construction process. This chapter explores the potential health impacts of four issues related to construction along the LDW: noise pollution, air pollution, water quality, and transportation and access. Furthermore, health-supporting recommendations are made in response to the identified areas of concern.

The Relationship between Cleanup Construction + Health

Noise Pollution

Noise is typically defined as an unwanted sound or combination of sounds that may adversely affect people (Seidman, 2010). Environmental noise from traffic, trains, aircraft, construction, and industrial activities has been shown to affect the health and well-being of populations exposed to varying levels of "noise pollution." The World Health Organization's (WHO) comprehensive review of community noise and its health effects outlines seven categories of adverse health effects of noise (Berglund, 1999):

Hearing impairment
Interference with spoken communication
Sleep disturbances
Cardiovascular disturbances
Disturbances in mental health
Impaired task performance
Negative social behavior and annoyance reactions

Air Pollution

The largest sources of air pollution during the construction phase are from the burning of diesel fuel in construction and cleanup equipment, and during the transportation of sediment (via truck, rail, or barge). The health effects from air pollution are more serious for sensitive populations including children, elderly, and those with existing chronic lung or heart problems and diseases.

Heavy- duty on-road vehicles (i.e. dump trucks), marine vessels, and construction and mining equipment are the top three sources of diesel particulate matter in Washington State and the Puget Sound Area (Washington State Department of Ecology, 2005). The particles from diesel fuel combustion are very small and are able to travel deep into our lungs and cardiovascular system. The components of diesel particulates make them more harmful than other kinds of particulate matter. Research has found a connection between pollution from diesel engines and the following health effects:

 Worsened asthma symptoms and potential causes of new cases of asthma (Peters et al 2004).

- Lowered immune system's ability to fight off infections such as pneumonia or influenza (Castranova et al, 2001, Yang et al, 2001, Harrod et al., 2003).
- Increased risk of lung cancer and possibly cancers of the soft tissues such as the bladder (Guo et al, 2004, Harriet Ammann and Matthew Kadlec, 2008).

Water Quality

Past and present industrial use along the Lower Duwamish has left myriad contaminated sediments along the river bottom. Of the many existing contaminants, five present significant health concerns: Polychlorinated biphenyls (PCBs), Polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, arsenic, and phthalates. Across all of these pollutants, exposure by the ingestion of contaminated seafood presents the greatest health risk. Direct contact is of lesser, but still significant, concern. The probable links between these contaminants and human health can be seen in Table 2.1, below.

Contaminant	Health Impacts
Polychlorinated biphenyls (PCBs)	Cancer, Immunosuppression, reduced birth weights, decreased gestational age, deficits in neurological development, decreased thyroid hormone levels, dermal and ocular damage
Polycyclic aromatic hydrocarbons (PAHs)	Cancer and pulmonary, gastrointestinal, immune, reproductive, and neurologic developmental effects
Dioxins/Furans	Cancer, immunosuppression, alterations in fetal development, alternations in hormone levels, serious skin disease (chloracne)
Arsenic	Cancer, Nausea, diarrhea, abdominal pain, skin and mucous membrane irritation, anemia, peripheral neuropathy, liver and kidney damage, hyperpigmentation, gastrointestinal damage
Phthalates	Irritation of the eyes, ears, and throat; nausea; vomiting; headache; dizziness; liver and kidney damage; adverse fetal reproductive system development

Table 2.1- Contaminants of the Lower Duwamish and Human Health

[US Environmental Protection Agency, National Pollutant Inventory, and Centers for Disease Control]

Dredging and other water channel construction projects related to the remediation of contaminated sediment have well-documented links to adverse health outcomes. During and immediately after the construction period, elevated levels of re-suspended contaminated sediment are expected (Lower Duwamish Waterway Group, 2009). Although the magnitude of health risk varies with the pathway and duration of exposure, any qualitative increase in risk must be considered as an adverse health impact. The short-term health outcomes of the elevation in suspended contaminated sediments are as follows:

Higher fish consumption health risks including increased probability of cancer, chronic disease, and immune deficiencies
Higher direct exposure risk to beachgoers, construction crews, and recreational users

In addition to the stirring up of polluted sediments, the construction process must also consider the risk of fuel or sediment spills. An event of any significant magnitude could greatly impact food security, waterway access, and contamination-related health risks.

Transportation and Access

Research has demonstrated how neighborhood exposure to motor vehicles has a greater likelihood of higher traffic volumes in the poorest census block groups and around schools in deprived areas. Urban neighborhoods (containing more public transit) had greater traffic equaling more density of major roads. These regions had a higher incidence and risk for pedestrian injury.

Studies show environmental factors associated with greater risks for crashes were more frequent in poor neighborhoods. Greater population density, walking, cycling and public transit used in the poorest neighborhoods enabled exposure for more pedestrians and cyclists to experience traffic related injuries. Variables attributed such injuries involve (Patrick, 2012):



Construction traffic increases congestion, disrupts traffic and waterway access. Not only does this result in wasted time, but also leads to the greater use of fuel consumption and emissions. Air pollutants are also increased with such disruptions. Fine particulate matter (PM2.5) can be defined as tiny particles in the air reducing visibility – causing the air to appear hazy. With increased idling and tailpipe emissions, PM2.5 concentration will increase as well. Stop-and-go traffic heightens air toxic emissions (Levy, 2010). Those who will feel this greatly are the in-vehicle passengers and drivers experiencing stop-and-go traffic. Their exposure to traffic related pollutants will increase greatly.

Existing Conditions

Noise Pollution

While the scope of this HIA does not allow for measurement of actual noise levels in the affected communities, there are existing conditions that contribute to the noise pollution levels in Georgetown and South Park:

- Boeing Field Aircraft noise in the Georgetown and South Park neighborhoods
- •SeaTac International Airport Aircraft noise in the South Park neighborhood
- •Seattle Intermodal Train noise in the Georgetown neighborhood

•East Marginal Way and Duwamish industrial areas - Noise from road traffic, trucks, and heavy machinery

Air Pollution

The Puget Sound Clean Air Agency (PSCAA) characterizes the Duwamish Valley as an urban industrial area with air pollution impacts from industrial sources and diesel emissions. PSCAA currently monitors levels of fine particulate matter in South Park and the Duwamish Valley. In the past, they have also monitored sulfur dioxide in the Duwamish Valley as well as nitrogen oxide and carbon monoxide in Georgetown (Puget Sound Clean Air Agency, 2012). PSCAA records show over 200 registered industrial sources of air pollution in the Duwamish Valley. Industrial sources are highly regulated and well controlled. The air monitors in the Duwamish Valley and South Park show that air quality in the area is well below federal health based standards and PSCAA's health goal for fine particulate matter. In fact, in Washington State, residential wood smoke is the largest source of fine particulate matter.

However, monitors represent air quality at a larger scale (neighborhood or larger). Air quality could be worse at smaller scales. One prominent example is near roadways or high traffic industrial areas such as ports. South Park and Georgetown residents have complained about trucks passing through, idling in their neighborhoods. Additionally, the Washington State Department of Ecology has identified diesel exhaust as the most harmful air pollutant to public health in Washington. One of the main reasons for this is its strong link to cancer (Washington State Department of Ecology, "Diesel Information"). Even though the area meets federal health based air quality standards, the Duwamish Cleanup Project should take steps to reduce air pollution from diesel exhaust.

Water Quality

Although surface sediments of the channel are an identified Superfund site, the current Lower Duwamish Waterway water quality does not typically pose a significant health threat for those coming into contact with the river (Lower Duwamish Waterway Group, 2009). However, a number of Combined Sewer Overflow (CSO) outfalls are present along the LDW. The CSOs discharge during heavy rain events and can present unsafe levels of bacterial, pathogenic, and chemical contamination for short-term durations.

The potential for water quality degradation during dredging operations is highest near areas of extensive sediment removal; areas highlighted in orange in figure 2.1 are especially vulnerable.



Figure 2.1- Areas Vulnerable to Water Quality Degradation During Construction

Transportation and Access

The Lower Duwamish is a prime location for all forms of community transportation and access. Not only is it an industrial site, but a destination for King County Metro buses, carpools and vanpools, the Light Rail, Sounder Transit, pedestrians and cyclists. It has been noted in numerous public documents that signage, access to transit facilities, sidewalk network, and bicycle infrastructure require much improvement (South Park, 2012, Georgetown, 2012). Metro transit is regularly used by commuters for work as well as sporting events.

The few green spaces available to the community are heavily trafficked. Varieties of recreational activities are abundant, many involving the development and use of the shore. Parks, picnic and bird watching areas will also be affected. Boating and fishing are two main interests for these surrounding neighborhoods (Duwamish M & I Centers, 2012). Motor-boat launches, informal fishing locations, and wetlands will all be impacted by noted and un-noted construction activities of the FS.



Findings

Examination of the existing communities and stakeholders, current planning and engineering documents, possible construction sequencing, and the physical setting of the Duwamish has revealed a number of specific areas in which the clean-up construction project may affect human health. The findings of this inquiry are explained below:

Noise Pollution

The Duwamish Waterway Cleanup construction activities are likely to increase noise pollution in the Georgetown and South Park neighborhoods, placing those communities at increased risk for the adverse effects mentioned above. Table 2.2 explains the categories of health effects that neighborhood residents are most likely to experience related to cleanup construction activities. Some neighborhood residents have characteristics that put them at a disadvantage when it comes to their overall health and well-being, which can result in poorer health and more incidence of disease in these groups.

These characteristics (determinants of health) include race and ethnicity, socio-economic status, and neighborhood environment and economic characteristics. For example, non-Hispanic black and Hispanic people have a higher prevalence of obesity, pre-term births, asthma, and diabetes than non-Hispanic whites in the US (CDC, 2011). These disparities in health are also connected to income and socio-economic status, with a higher percentage of non-Hispanic black and Hispanic adults living below the federal poverty level than non-Hispanic whites (CDC, 2011). Neighborhood conditions, including housing quality, air quality, and transport options, also influence the health of residents (Marmot & Wilkinson, 2006).

Air Pollution

The current Feasibility Study does not adequately discuss air pollution. Instead, it focuses on greenhouse gases and the size of the carbon footprint of the various cleanup options. It recommends some best management practices to reduce greenhouse gases. Some of these best practices would also reduce other air pollutants such as "reducing idling" and "using low-sulfur fuels." However, once EPA has developed a more detailed cleanup plan, better practices for reducing air pollutants besides CO2 can be further understood.

Water Quality

The EPA has well-established construction guidelines for the safe removal of contaminated sediment by environmental dredging (Blocker, 2011). Beyond these institutional best practices, the Lower Duwamish Waterway Group has committed to adaptive management and monitoring throughout the planning and construction process as a means of achieving projective objectives and protecting community health simultaneously (Lower Duwamish Waterway Group, 2011). In light of these recognized protocols and relatively low health risks of physical exposure to contaminated sediments, impact to water quality during the construction period does not present a grave concern to public health.

Transportation and Access

Contaminants found at the Duwamish site are only transmitted through soil and direct contact (not air). Therefore hazardous waste is well contained through the regulated precautions taken. While people do bike and walk in this area, according to the Draft Feasibility Study (LDW, 2009) human contaminants risks from sediment are low. Risks from contamination are higher from people eating sea life located in the waterway (this is not the case for Salmon, which apparently move quickly through the water-way).

Table 2.2- Health effects of Noise and Vulnerable Populations

Health Effects of Noise	Populations Affected
Sleep disturbance Uninterrupted sleep in important for good physical and mental health. Environmental noise often disturbs sleep, resulting in mood changes, decreased overall performance, increased blood pressure, increased pulse, and other physiological changes with chronic exposure. Residents may also experience depressed mood and/or decreased alertness after a night of disturbed sleep (Goines, 2007).	Georgetown residents Ethnically diverse South Park residents Ethnically diverse Children Long-term effects uncertain
Cardiovascular effects Noise pollution can cause short-term changes in circulation including blood pressure, heart rate, cardiac output and blood vessel constriction, as well as stress hormones. It is likely that persistent noise stress increases the risk of cardiovascular disorders including high blood pressure and heart disease (WHO, 2012).	Georgetown residents Ethnic groups already at increased risk for cardiovascular illness; low socio-economic status residents South Park residents Ethnic groups already at increased risk for cardiovascular illness; low socio-economic status residents Children Long-term effects unclear
Impaired task performance: Loss of productivity in adults Noise has negative impacts on cognitive performance. A reduction of the day and night noise level was shown to improve recall and reading performance, attention, and memory. These adverse impacts of noise on cognitive performance can lead to a reduction in the productivity at work and the learning performance at school (WHO, 2012).	Local workers Local students South Seattle Community College
Impaired task performance: Learning impairment in children Children chronically exposed to loud noise show impairments in attention, memory, and learning to read (WHO, 2012). Noise also affects problem solving, motivation, school performance, and social and emotional development (Goines, 2007).	Local students Concord International School
Negative Social Behavior and Annoyance reactions Noise pollution can cause a range of negative reactions including anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation, or exhaustion. Annoyance and related social behaviors are subtle, indirect, and difficult to measure (Goines, 2007).	Georgetown residents South Park residents

Transportation

The site area is home for commercial, residential, industrial, and recreational use. The FS only mentions how the cleanup will mostly occur on the river, not discussing the effects on actual roadways (LDWC, 2010).

Pedestrian /Cyclists: While the LDW is a primary industrial area "land ownership within most of its corridor are consistent with the characteristics of an active industrial water way" (LDWG, 2009), the fenced-lined industrial facilities make it difficult for cyclists and pedestrians to travel throughout industrial neighborhood. This area has poor surface conditions on side streets and a lack of connectivity between existing bike routes and trails.

Vehicles: Potential time for vehicle traffic disturbance could occur during the shipment and delivery of containers/supplies, and the movement of machinery for the cleanup to and from the site (Boeing Environment, 2010).

Commercial/Recreational boat traffic: Commercial/Recreational river transportation will be affected the most (e.g. boating, kayaking, fishing and beach play). Several

public parks and publically accessible shoreline areas also may be closed due to the risk of contaminated soil (DRCC, 2009).



CLEANUP CONSTRUCTION

Recommendations

On the whole, cleaning up the Lower Duwamish Waterway will have long-lasting human health benefits. The physical process of the clean-up will have a number of adverse human health impacts, however. To mitigate or eliminate these negative effects, the following health-supporting recommendations are proposed:

Noise Pollution

With Georgetown and South Park residents already at risk for adverse health effects from noise pollution, the Duwamish Waterway Cleanup activities should consider the following recommendations to lessen their contribution to environmental noise and related health impacts:

- 1. Limit cleanup construction activities to hours recommended by the community to minimize noise-related sleep interruption.
- 2. Route trucks and other equipment away from neighborhoods and schools when possible.
- 3. Establish an alert system to let community members know of changes in cleanup construction activities that may cause excess noise in their area.
- 4. Ensure affected populations have regular opportunities to give feedback on the cleanup construction activities through public forums.
- 5. Establish a phone line and web page for residents to use for immediate feedback and complaints about excess noise.

Air Pollution

Recommendations for reducing health effects from construction phase air pollution fall into four categories: reducing exposure through separation, reducing emissions through management of operations, improving technology, and using clean fuels.

- 1. **Reducing exposure through separation –** Health can be minimized by reducing resident's exposure to pollution by providing space between where activities occur and residents live, work, and play.
- Truck routes should avoid residential areas as much as possible. It is especially important to avoid schools, daycare centers, hospitals and nursing homes.
- Cleanup planners should place staging areas for dredging and construction operations in industrial areas. This
 may mean preferring one side of the river over the other to avoid residential areas or transporting sediments to an
 appropriate off-loading point.
- Studies show that air pollution resembles background levels about 100 to 500 meters from the roadway (Alex A. Karner, et al, 2010). Construction activities should occur at least 500 meters from schools, daycare centers, hospitals, nursing homes, and residential areas when possible.
- Creating a vegetation buffer. Urban trees can help improve air quality by catching and storing pollutants (Nowak et al, Center for Urban Horticulture).

2. Management of Operations – Another way to reduce air pollution is to use operations management best practices.

- Reduce idling as much as possible.
- Transportation routes should minimize truck transportation and maximize rail transportation. In the northwest, rail load and unloading should not require much idling (anti-idling policies should be included in contracts). Additionally, one diesel locomotive can transport several more sediment containers than a truck. So, even if a rail engine is older than a 2007 truck engine, the overall process will have less diesel emissions.
- Maintenance. Well-maintained equipment has lower emissions.
- Limiting nighttime operations. Studies show that nighttime near roadway air pollution travels much further (instead of 100 to 500 meters). Contracts for cleanup and construction operations should limit the amount of nighttime operations.

- 3. Technology Newer diesel technology vastly reduces air pollution. EPA should include requirements in cleanup and construction contracts that all on-road and construction equipment meet 2007 or up to date standards. Companies can either retrofit or replace equipment older than 2007.
- Retrofit Diesel particulate filters can reduce particulate matter emissions by 90% or more. Other tailpipe technology and flow through filters can reduce emissions (Clean Air Task Force). Additionally, equipment can be fitted with technology that allows the operation of heat/air conditioning, lights, and other amenities without running the engine (Washington State Department of Ecology, 2009).
- Replace When it is not possible to retrofit equipment, it should be replaced with equipment from 2007 or later.

Grants can provide funding for equipment retrofits and replacements. Some even make these grants available to private fleets. These grants are available through Washington State Department of Ecology, Cascade Sierra Solutions, the West Coast Collaborative, and various sources of federal funding. For more information and updated opportunities, visit Washington State Department of Ecology at http://www.ecy.wa.gov/programs/air/ cars/DieselGrantPage.htm and http://www.ecy.wa.gov/programs/air/cars/diesel_exhaust_ information.htm or contact them via phone at (360) 407-6800.

- 4. Fuel- The amount of sulfur in diesel fuel is one of the most important factors determining the amount of air pollution from fine particulate emissions (Kittelson and Abdul-khalek, 1999).
- Ultra-low sulfur diesel (ULSD) reduces pollution and can improve the effectiveness of retrofit technologies. ULSD has been required since 2007 for on-road equipment, 2010 for non-road equipment, and 2012 for marine vessels.
- Alternative fuels can also provide pollution reductions. Project engineers should look at biodiesel, emulsified diesel, Compressed Natural Gas, Liquefied Natural Gas, Liquefied Petroleum Gas, and propane as possible alternatives. Reductions will depend on the equipment, use and project should these fuels should receive a case-by-case evaluation (U.S. Environmental Protection Agency).

Water Quality

The EPA has a well-established guideline for risk management in contaminated sediment sites. Although some of the following recommendations are covered by EPA protocol, it is important to reiterate that no two projects are identical and these suggestions serve:

- 1. Use appropriately suited environmental dredging technology to minimize sediment resuspension.
- 2. Follow all established Best Management Practices for workplace safety, hazardous materials transportation, and construction sequencing.
- 3. Prepare an emergency response plan to contain potential spills.
- 4. Continuously monitor water quality levels throughout construction area before, during, and after cleanup.
- 5. Inform community stakeholders of all potential risks related to construction activities.
- 6. Strive to maintain community waterway access during construction, when possible.



Transportation

While the FS only discusses cleanup affecting the waterway, there is no information in relation to truck traffic transporting sediment from the site. More detail is needed as to the effect of the many roadways in the area. Though the documentation alludes to minimal disruption, many aspects of transportation are still not taken into account:

- 1. The current method of waste disposal raises concerns for hazardous material contamination. It would be beneficial if cranes load sediment directly into rail cars on barges, moving those railcars directly from barge to land-based rail tracks. This would avoid transfer into and out of trucks. Minimizing cross contamination and additional traffic disturbances.
- 2. In order to more accurately assess patterns and frequency of traffic disturbance, more detail is needed in relation to the number of trucks used for transport as well as the time of day and predicted route. Trucks should be re-routed away from neighborhoods and main thoroughfares.
- 3. High traffic recreational areas (South Park, 2012, Georgetown, 2012) disturbed from site transportation should be not only restored to their normal condition, but meliorated. Other nearby recreational spaces should be identified and improved so they may be used as an equal alternative in place of closed current recreational locations. This will greatly contribute and improve to sense of community for the Duwamish Valley Vision. (DRCC, 2009).

Pedestrians/Cyclists

4. Poor surface conditions on side streets, lack of route connectivity, and fence-lined industrial facilities make local mobility a hazard. With increased traffic and congestion, these existing conditions will only worsen. Connectivity between bike and pedestrian routes need to either be re-routed and/or improved, and a long-term plan should be established and integrated along with the Green Belt Connection - suggested by the Duwamish River Cleanup Collation. (DRCC, 2009)

Vehicles

- 5. The affects for Metro Traffic, including the Light Rail need to be addressed in the FS. This is paramount for commuters. Advisories regarding ride time changes and traffic notices should be posted at all Metro hub locations advising the public to take notice of changing traffic conditions.
- 6. Increase community signage for alternate routes and traffic delay times. Parking needs to be re-designated to other unaffected areas (South Park, 2012, Georgetown, 2012). Site related vehicles should be routed away from the proximity of local business and industry so that there is minimal impact to the economic growth and development of the area (e.g boat rentals, restaurants, farmer's markets, etc.).



Overarching Recommendations

There are four major recommendations for construction phase cleanup operations that cut across air, noise, traffic, and sediment control including the following:

1. Keep industrial activities in industrial areas:

The Duwamish River is an active industrial area that provides important economic

benefits to the city of Seattle. However, maintaining as much separation as possible between industrial activities and residential areas provides a potential mitigation for health effects from air pollution, noise pollution, and increased traffic. As specific activities our designed, EPA should ensure that activities avoid residential areas as much as possible. This may include:

- Offload sediment on the side of the river with the least residential area.
- Keep trucks out of residential neighborhoods.
- Design routes that minimize the use of trucks and maximize the use of rail.

2. Meaningful public involvement:

EPA has already established a priority to involve the public early and often. As the Cleanup progresses, EPA should emphasize their tenet to keep the public involved often. We recommend that the EPA continue to hold regular public meetings so the community has an opportunity to identify problems. Additional venues for community feedback could include a website or hotline telephone number. Finally, an EPA staff person should be assigned to address and respond to community complaints in a timely fashion.

3. Public notification:

The construction phase will occur over the better part of a decade. The scope and intensity of activities will change over time. Additionally, there are many facets of the cleanup operations that remain undefined. We recommend that the EPA notify the community when cleanup activities will increase or start in a new area, especially locations close to residential areas. This information should include further detail in response to how long activities will occur pertaining to each area and the potential magnitude of effects. For example, the number of trucks used per day for transportation of sediment needs to be specified. Notification should include providing translations of key messages into the major languages spoken in the area.

4. Use of best practices:

Dredging and other cleanup activities have well-established best practices to

prevent environmental damage. Many of these same practices also prevent or minimize potential health effects associated with the cleanup construction activities. EPA should ensure that all contractors involved in the cleanup are following industry standards, best practices, and state, federal, and local regulations. This would include (but is not limited to) dredging activities, equipment maintenance, spill prevention and control, management of storm water.



References

Agency for Toxic Substances & Disease Registry. "Polycyclic Aromatic Hydrocarbons (PAHs) What Health Effects are Associated with PAH Exposure?" Environmental Health and Medicine Education < http://www.atsdr.cdc.gov/csem/ csem.asp?csem=13&po=11> (16 May 2012).

Alex A Karner, Douglas S Eisinger, and Deb A. Niemeier. "Near-Roadway Air Quality: Synthesizing the Findings from Real-World Data." Environ. Sci. Technol. 44 (2010): 5334-5344.

Bergen, B., Nelson, W., Mackay, J., Dickerson, D., & Jayaraman, S. (2005). Enivronmental Monitoring of Remedial Dredging at the New Bedford Harbor, MA, Superfund Site. Environmental Monitoring and Assessment, 257-275.

Berglund, B., Lindvall, T., & Schwela, D. H. (Eds.) (1999). World Health Organization Guidelines for Community Noise. Retrieved from http://whqlibdoc.who.int/hq/1999/ a68672.pdf

Blocker, S. (2011, August 8). Final Decision and Response to Comments for Boeing Plant 2 Sediments, Duwamish Sediment Other Area and Southwest Bank. Retrieved May 8, 2012, from US Environmental Protection Agency- Region 10: http://www.epa.gov/region10/pdf/sites/bp2/dsoafinal-decison-rtc-0811.pdf

Boeing Environment: Health and Safety. 2010. http:// www.boeing.com/aboutus/environment/duwamish/ factsheets/LowerDuwamishWaterway.pdf (Accessed on May 10, 2012).

Castranova V, MA JY, Yang HM, Antonini JM, Butter worth L, Barger MW, Roberts J, MA JK. 2001. "Effect of exposure to diesel exhaust particles on the susceptibility of the lung to infection. Environ Health Perspect 109 (Suppl 4): 609-12

Center for Urban Horticulture, University of Washington. <http://www.cfr.washington.edu/Research/fact_ sheets/29-UrbEconBen.pdf> (5 May 2012). As cited by Gies E. (2007). The health benefits of parks. The Trust for Public Land.

Centers for Disease Control and Prevention (2011). CDC health disparities and inequalities report - United States, 2011. Morbidity and Mortality Weekly Report, 60s.

Clean Air Task Force. "Technology Solutions." Diesel. http://www.catf.us/diesel/solutions/ (6 May 2012).

Department of Ecology, State of Washington. Shorelines and environmental assistant program. February 2011. http://www.ecy.wa.gov/programs/sea/fed-permit/pdf/ UpperDuwamish_AddlInfo.pdf (Accessed on May 18, 2012).

DRCC-Duwamish River Cleanup Coalition. Duwamish Valley Vision Map and Report. 2009. http://www. duwamishcleanup.org/uploads/Duwamish%20Valley%20 Vision%20Report%202009.pdf (Accessed on May 19, 2012). Duwamish M & I Centers: Duwamish Way-finding and CTR Report. February 2012. http://www.duwamishtma.org/ wp-content/uploads/2012/01/I.-Duwamish-MI-Centers-Overview.pdf. (Accessed on May 12, 2012).

Georgetown - Duwamish TMA: Duwamish Way-finding and CTR Report. February 2012. http://www.duwamishtma.org/wp-content/uploads/2012/02/III.-Georgetown.pdf (accessed on May 12, 2012).

Goines, L., & Hagler, L. (2007). Noise pollution: A modern plague. Southern Medical Journal, 100, 287-294.

Guo J, Kauppinen T, Kyyronen P, Heikkila P, Lindblohm ML, Pukkala E. 2004. Risk of esophageal, ovarian, testicular, kidney and bladder cancers and leukemia among Finnish workers exposed to diesel or gasoline exhaust. Int J Cancer. 111(2): 286-292.

Harriet Amman and Matthew Kadlec. Washington State Department of Ecology Air Quality Program. Concerns about Adverse Health Effects of Diesel Engine Emissions White Paper. Publication NO. 08-02-032 Dec. 2008.<http:// www.ecy.wa.gov/pubs/0802032.pdf > (6 May 2012).

Harrod KS, Jarmillo RJ, Rosenberger CL, Wang SZ, Berger JA, McDonald JD, Reed MD. 2003. Increased susceptibility to RSV infection by exposure to inhaled diesel engine emissions. Am J Repir Cell Moll Biol 28 (4): 451-463.

HEI Panel on the Health Effects of Traffic-Related Air Pollution. 2010. Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. HEI Special Report 17. Health Effects Institute. Boston, MA. <http://pubs.healtheffects.org/getfile.php?u=553> (6 May 2012).

IADC/CEDA . (2008). Environmental Aspects of Dredging . New York: Taylor & Francis.

Kittelson, DB, Abdul-Khalek, I. 1999. Formation of Nanoparticles During Exhaust Dilution, EFI Members Conference: Fuels, Lubricants Engines, & Emissions, January 18-20. http://www.me.umn.edu/centers/cdr/reports/ OtherEFI.pdf> (17 Nov 2008).

LDWC-Lower Duwamish Waterway Cleanup. Planning for Cleanup. October 2010. http://www.epa.gov/region10/ pdf/sites/ldw/factsheet_oct2010rev.pdf (Accessed on May 15, 2012).

LDWG Lower Duwamish Waterway Group. "Lower Duwamish Waterway Group." Feasibility Study Draft Executive Summary. April 24, 2009. http://www.ldwg.org/ assets/fs/draftfs/executivesummary_draftfs.pdf (accessed May 8, 2012).

Levy J, Buonocore J, Stackelberg K. Evaluation of the public health impacts of traffic congestion: a health risk assessment. October 2010. http://www.ehjournal.net/content/9/1/65#sec8. (Accessed on May 19, 2012).

Lower Duwamish Waterway Group. (2011, August 1). Lower Duwamish Waterway Group. Retrieved May 8, 2012, from Key Elements for Optimizing the Cleanup of the LDW- Tech Memo: http://www.ldwg.org/assets/fs/LDWG_Key%20Elements%20 Tech%20Memo_to%20Agencies%208-1-11.pdf

Marmot, M., & Wilkinson, R. G. (Eds.) (2006). Social determinants of health, 2nd ed. New York, NY: Oxford University Press.

National Research Council. (2007). Sediment Dredging at Superfund Megasites: Assessing the Effectiveness. Washington DC: National Academies Press.

Nowak D, Crane D, and Stven J. Air pollution removal by urban trees and shrub in the U.S. USDA Forest Service, Northeastern Research Station 5 Moon Library, SUNY-ESF, Syracuse, NY 13210 USA, Urban Forestry & Urban Greening. http://www.fs.fed.us/ne/newtown_square/publications/other_publishers/ ne_2006_nowak001p.pdf (5 May 2012).

Patrick Morency, Lise Gauvin, Céline Plante, Michel Fournier, and Catherine Morency. Neighborhood Social Inequalities in Road Traffic Injuries: The Influence of Traffic Volume and Road Design. American Journal of Public Health: June 2012, Vol. 102, No. 6, pp. 1112-1119. doi: 10.2105/AJPH.2011.300528

Peters JM, Avol E, Berhane K, Gauderman WJ, Gilliland F, Jerret M, Kunzli N. London S, McConnell R, Navidi B, Rappaport E, Thomas D, Lurmann F, Roberts P, Alcorn S, Funk T, Gong H Jr., Linn Ws, Cass G, Margoli H. 2004. Epidemiologic investigation to identify chronic effects of ambient air pollutants in Southern California. California Air Resources Board.

Puget Sound Clean Air Agency. "2010 Air Quality Data Summary." April 2012. <http://www1.pscleanair.org/news/library/reports/2010_ AQDS_Report.pdf >. (17 May 2012).

Puget Sound Clean Air Agency. "South Park Air Monitoring." Puget Sound Clean Air Agency. <http://www1.pscleanair.org/programs/community/ southpark/air_monitoring.aspx>. (17 May 2012).

Seidman, M. D., & Standring, R. T. (2010). Noise and quality of life. International Journal of Environmental Research and Public Health, 7, 3730-3738. doi: 10.3390/ijerph7103730.

South Park - Duwamish TMA: Duwamish Way-finding and CTR Report. February 2012. http://www.duwamishtma.org/wp-content/uploads/2012/02/IV.-South-Park.pdf (accessed on May 12, 2012).

U.S. Environmental Protection Agency. "Arsenic Compounds" Hazard Summary-Arsenic Compounds. http://www.epa.gov/ttn/atw/hlthef/arsenic.html (14 May 2012).

U.S. Environmental Protection Agency. "Fuel" National Clean Diesel Campaign. http://www.epa.gov/cleandiesel/technologies/fuels.htm> (6 May 2012).

U.S. Environmental Protection Agency. "Health Effects of PCBs" Polychlorinated Biphenyls. http://www.epa.gov/osw/hazard/tsd/pcbs/pubs/effects.htm (14 May 2012).

Washington State Department of Ecology. "Focus on Diesel Exhaust." February 2009. Publication no. 06 02-018 (rev.2/09).< http://www.ecy.wa.gov/pubs/0602018.pdf> (6 May 2012).

Washington State Department of Ecology. "2005 Emissions Inventories for diesel fine particulates –Statewide and Selected Urban Counties and Areas." Diesel Exhaust Information. 2005. http://www.ecy.wa.gov/programs/air/pdfs/diesel_2005.pdf (6 May 2012).

Washington State Department of Ecology. "Diesel Information." Air Quality. http://www.ecy.wa.gov/programs/air/cars/diesel_exhaust_information.htm> (6 May 2012).

Washington State Department of Health. (2003). Public Health Assessment- Lower Duwamish Waterway. Tumwater, WA: WA State Department of Health.

World Health Organization (2012). Health effects of noise. Retrieved from http://www.euro.who.int/en/what-wedo/health-topics/environment-and-health/noise/factsand-figures/health-effects-of-noise

Yang H-M, Antonini JM, Barger MW, Butterworth L, Roberts JR, Ma JKH, Castranova V, Ma JYC. 2001. Diesel exhaust particles suppress macrophage function and show the pulmonary clearance of Listeria monocytogenes in rats. Environ Health Perspect 109(5):515-521.



Economic Impact



Introduction

The Duwamish River has been a source of economic vitality in the Pacific Northwest for over a century. Businesses and individuals as far as Alaska have depended on the LDW's numerous activities: industry, recreation, subsistence fishing, and transportation. Recognized for its assets by a wide spectrum of stakeholders, the rapid expansion of industrial enterprises spreading southward from King Street over the mud flats in the mid-twentieth century was supported and prioritized by Seattle's City Planning Commission (Langloe, 1946). In a 1946 report on the development of industrial sites in the Duwamish-Green River Valley, the planned redirection of the river was viewed as necessary to ensure economic growth in the area, saying, "These improvements transformed the lower Duwamish River from a winding obstruction to orderly progress into several miles of navigable waterways and provided substantial areas of suitable and well located sites for the city's expanding industries" (Langloe, 1946). However, these "improvements" also came at an expense to human and environmental health. As the industrial enterprises flourished and the dense urbanization of Seattle occurred, the Duwamish became filled with a variety of toxic pollutants (Ith, 2004).

In addition to industry, the banks of the Duwamish are also part of the vibrant residential neighborhoods of South Park and Georgetown, the last areas in Seattle where median-income residents can afford median-priced housing (Rhodes, 2006). Georgetown covers over 1,750 acres, with 80% of this area dedicated to industrial uses like manufacturing, warehousing, communication, utility, or transportation facilities. South Park is also a mixed residential and industrial area of roughly 240 acres, 75% of which is in industrial use. Both neighborhoods are characterized by the close proximity between residences and industry. As a result of the high level of industrial activity in the area and poor historical oversight of waste management practices, environmental and human health in this area have been suffering. Deemed a Superfund site by the Environmental Protection Agency, the LDW cleanup plan must reconcile competing interests in the area's economic, environmental, and human health.

DRCC proposes a vision for the cleanup derived by a group of over 500 Duwamish Valley stakeholders. The vision includes: increasing living wage jobs through the impending cleanup work via partnerships with local businesses, schools, governments, and training programs; advancing a new 'green' economy with living-wage jobs and economic development through the proposed Duwamish cleanup and restoration; and enhancing healthy recreation and eco-tourism opportunities; among other goals (DRCC, 2012).

While the benefits of the cleanup are numerous, the effort will also bring short and long term economic changes to the immediate area and Seattle as a whole. These changes will undoubtedly have an impact on the health of individuals who live and work near the river.

Together, Georgetown and South Park have a much higher percentage of people of color than Seattle on average, as well as a greater proportion of low-income individuals. These populations are at greater risk of being marginalized and displaced during and after the cleanup. The cleanup may not only affect the affordability of housing but also the feasibility of offering lower-wage jobs and operating businesses in the area. Both South Park and Georgetown have active communities strongly rooted in their neighborhoods, and the cleanup must prioritize the ability of existing residents to continue to live and work in the place they call home. In this section, we explore many economic determinants of population health, including employment, commerce, and gentrification and outline the potential economic and health impacts of the Duwamish River cleanup. We provide recommendations below for using the improved health of the river to augment the health and well-being of individuals who reside and work in the area.

The Relationship between Economics + Health

in the last decade, public health researchers have widely recognized that economic and social capital are important determinants of population health. "Low social capital and low economic capital at the individual level are independently associated with poor health outcomes, and combined they seem to contribute to an increased burden of poor health" (Ahnquist, 2012). The 2011 Centers for Disease Control graph below depicts the percentage of adults over the age of 25 reporting fair or poor health in the United States, stratified by socioeconomic status. (CDC, 2011)



Figure 3.1. Percentage of adults in the U.S. reporting fair or poor health, stratified by SES

Rates of illness for U.S adults in their 30s and 40s with low income and lower education are comparable to those of affluent adults in their 60s and 70s (Adelman, 2008). Individuals in lower socioeconomic strata experience higher incidence rates of low birth weight, cardiovascular disease, hypertension, arthritis, respiratory illness, diabetes, and cancer (Adler, 2002). Other research shows that communities with lower average socioeconomic status have lower quality housing, lack opportunities for outdoor activities, and lack access to fresh fruits and vegetables (Srinivasan, 2003).

According to the Robert Wood Johnson Foundation, "health begins where we live, learn, work, and play" (2010). Where someone lives is an important determinant of health and is also a root cause of health inequities. James Krieger summarizes the connection best in the powerful documentary series Unnatural Causes:

"Place matters. That's where someone works, where they go to school, or where they live, because place determines what someone's exposed to in terms of a whole host of factors that can affect their health. So place matters because it determines what kind of physical or chemical agents you might be exposed to. It matters what kind of social environment you are exposed to. It matters if there's a lot of violence or crime in your neighborhood. It matters if it's easy to go for a walk in your neighborhood or find healthy foods. Who your neighbors are and the way you interact with your neighbors can also affect your health. So place ultimately is a critical determinant of health."

-James Krieger, Epidemiologist, from Unnatural Causes (Lee, 2008)





In the United States, many neighborhoods are segregated by race, ethnicity, and income (Policy Link, 2007). This segregation limits access to healthy foods and safe and walkable streets, and also exposes people to poor air and soil quality. Often, people of color and low-income populations disproportionately bear "high crime rates, underfunded schools, insufficient services, poor transportation and housing options, and other harmful attributes that compromise individual and community health" (Policy Link, 2007). The Georgetown and South Park neighborhoods are no exception to this pattern. Thus, the complex interactions between social and individual determinants of health demand that equity be an explicit criterion by which to assess the Duwamish River Cleanup plans.

A great deal of literature supports the implementation of activities related to the Duwamish cleanup that consider the associations between space, place, and health:

Space refers to where a location is (Tunstall, 2004) and includes the geometric area as well as the spatial distance in residential distribution (Curtis, 1998). When neighborhoods are segregated in residential space, community support networks and cultural and moral beliefs weaken. Space can also include the socially constructed space or linkage seen as "the medium and outcome of social relations" (Curtis, 1998).

Place refers to what a location is (Curtis, 1998). It is the interpretation of spaces, aiming to "provide accounts of the peculiar social and physical attributes" of specific locations (Curtis, 1998). The social sense of place includes the meanings and significance individuals and groups ascribe to particular places. In addition, sense of place is dependent on an individual's place or position in the world and how they experience the place; "a person's socioeconomic status helps to shape his/her experience of places just as places of residence influence a person's opportunities for activity and experience" (Kearns, 1993).

Community is one product that emerges from place and space. Cohesive communities are communities in which (Office of the Deputy of the Prime Minister, 2005):

- All communities have a common vision and a sense of belonging.
- The diversity of people's backgrounds and circumstances is appreciated and positively valued.
- Those from different backgrounds have similar life opportunities.
- People from different backgrounds and circumstances develop strong and positive relationships in the workplace, schools and neighborhoods.

The following four environments describe characteristics of place and community cohesion that influence health (Policy Link, 2007). When each environment is strong, residents' health improves; but if these factors are not present, residents' health declines. Our analysis and subsequent recommendations address many of the factors of the economic environment listed in Table 3.1.

Table 3.1: Four environments that encompass characteristicsof place and community cohesion that influence health

Economic Environment	Social Environment			
 A robust economy is a protective factor for a healthy neighborhood. Features of a solid economic environment: Commercial investment Living-wage jobs with health benefits Safe workplaces Businesses that provide healthy food option for all residents Diverse and quality businesses (including banks, restaurants) Homeownership Qualities that weaken the economic environment: High rates of residents with low-wage jobs, no benefits, and unsafe working conditions Racial and economic segregation 	 Creating and experiencing strong community empowers individuals to advocate for themselves and for others. Positive social environments allow for: Knowledge, skill, and information sharing Leadership development to increase the community's "capacity for mobilization, civic engagement, and political power" Communities able to make decisions on the physical spaces of their neighborhoods, including investment in parks, schools, etc. 			
Physical or Built Environment	Service Environment			
 A well-designed built environment protects the health of all residents. Built environments that support health include: Parks and other green spaces Full-service grocery stores and farmers' markets Safe, walkable streets with sidewalks and less motor vehicle traffic Convenience to transportation, including public transit and safe and active transportation options Good accessibility to daily services (shops, schools, jobs) Houses removed from polluting businesses and highways Adequate, healthy, and affordable housing Urban design that supports physical activity 	 Equitable distribution and access to services is a protective factor for health. Healthcare facilities staffed by culturally competent staff Police and fire protection Little crime Active streets and sidewalks Schools, parks, and recreational facilities available to individuals and families Water and sewer systems Facilities for neighborhood meetings Safe, reliable, and clean mass transit Culturally competent public health providers Churches, social clubs, and block groups 			

[Policy Link, 2007]

ECONOMIC IMPACT

Theoretical Frameworks

The social ecological model (SEM) provides one framework with which to approach an evaluation of the health effects of the Duwamish River cleanup on diverse stakeholders. The SEM serves as "an overarching framework, or set of theoretical principles, for understanding the interrelations among diverse personal and environmental factors in human health and illness" (Jamner, 2000). Borrowing largely from systems theory, the SEM demonstrates the dynamic interplay among individuals, groups, and their social and physical environments.



Figure 3.2: The Social Ecological Model

During formative research, we identified nine immediate and intermediate impacts of the cleanup plan and three determinants of health related most closely to the economic effect on health:

- 1. Livelihood
- 2. Housing
- 3. Community, political factors, and public services

We conceptualized the potential economic impact on these health determinants using the causal pathway shown in Figure 3.3 on the following page, borrowing from principles of the social ecological approach.

The model illustrates the causal pathways between Duwamish cleanup and numerous determinants of population health and highlights immediate and intermediate impacts related to the cleanup.



Figure 3.3- Proposed causal pathway between economic impacts of the Duwamish River cleanup and three primary determinants of population health.

Findings

Gentrification

Gentrification is defined as "the transformation of neighborhoods from low value to high value" (Center for Disease Control and Prevention, 2009). The restoration or renewal of low-income neighborhoods often results in an influx of upper-income residents who are less sensitive to increases in rents and property values. The demographic change often results in the displacements of original low-income residents.

When the extreme environmental hazards from the Duwamish River are reduced, the neighborhoods of Georgetown and South Park may become more desirable residential locations within Seattle, particularly given the relatively high housing costs throughout most of the city currently, and the relatively low cost of housing costs in lower Duwamish communities. Indeed, it could be argued that gentrification is already occurring in these neighborhoods. Such changes can have both positive and negative impacts on community cohesion and other determinants of health.

To assess the potential for increased gentrification in South Park and Georgetown due to the cleanup project, we considered demographic and physical neighborhood attributes to make recommendations for the prevention and monitoring of potential gentrification and displacement over the course of, and particularly, after the cleanup project. Demographic considerations included current population income and demographics and current population renters versus homeowners. Attributes of the physical environment include current housing stock, current zoning, and current neighborhood planning.

ECONOMIC IMPACT

Population demographics

The demographics of current residents partially determine their vulnerability to displacement. Table 3.2 below outlines key demographic breakdown of South Park and Georgetown. Both the racial diversity and the large proportion of renters make the residents in South Park and Georgetown particularly vulnerable to displacement.

Neighborhood	Population	Race Breakdown	Average Household Size	Renters vs. Homeowners
Georgetown	1,177	Whites: 70.4% Blacks: 7.4% Hispanics: 12.2% Asians: 9.8% AIAN: 1.9% NHOPI: 0.3% Other groups: 6.4%	1.98	Owner occupied housing: 34.2% Renter occupied housing: 57.4%
South Park	3,873	Whites: 44.2% Blacks: 10.4% Hispanics: 37.6% Asians: 15.9% AIAN: 2% NHOPI: 1.6% Other groups: 20.1%	2.97	Owner occupied housing: 41.2% Renter occupied housing: 47.0%

Table 3.2.	Demographics of	⁻ Georgetown	and South Par	k Neighborhoods
------------	-----------------	-------------------------	---------------	-----------------

[City of Seattle, 2012]

Physical environment

The built environment and zoning regulations in many ways influence the likelihood of displacement of current residents due to gentrification. If property values increase as a result of the cleanup, then new development is likely to replace older housing. Therefore a greater proportion of older housing indicates that a neighborhood's physical environment may change quickly. Newer units are likely to be less affordable and to have long-term impact, with useful life for new housing ranging from 50-100 years.

Similarly, zoning patterns help determine whether new development is feasible and what it is likely to look like. If land is zoned for higher density than is currently built, then new development is more likely to occur. Developers will take advantage of this increased capacity and ultimately provide a greater quantity of available housing.

Newer developments generally rent and sell for higher prices than older housing, therefore existing residents can expect to see increased rent and land prices as a result of new development. This can ultimately negatively affect the health and well-being of existing low-income residents, resulting in less expendable income for food, healthcare, and other services. Ultimately increased housing prices can lead to displacement of low-income residents, which may have negative impacts on health by disrupting social support networks and access to jobs and services.

The existing housing stock and zoning regulations for the South Park and Georgetown neighborhoods were examined to assess the potential for new development in those neighborhoods. King County assessor records, though incomplete, indicate that the existing housing stock in both neighborhoods is relatively old. South Park consists of primarily single family housing, the majority of which dates from the early 1930s, with some construction in late 1960s as well. Multi-family housing complexes follow a similar pattern. In Georgetown the majority of housing was built from late 1960s onward.

Of this housing stock, the older multi-family complexes are potentially more likely to be torn down and redeveloped, potentially displacing those residents. Redevelopment of older single-family housing lots depends on housing quality, and well-maintained single-family homes may actually retain and increase in value negating any potential profit from rebuilding.

The residential zoning in each neighborhood is highly weighted towards single-family detached housing (SF5000). In addition there are a few areas with low-rise (2-3 story) multi-family housing designations. In general, the area is not zoned for density. Low-density zoning combined with relatively small individual lot sizes means that there is little incentive for new large-scale residential developments. However, low-density also results in a relative scarcity of housing. If housing prices increase, there is a greater possibility for displacement of low income residents due to the lack of extra capacity (higher density) for new housing.

Zoning regulations in Seattle are determined by the city Department of Planning and Development as well as through the Department of Neighborhoods. Neighborhood planning is an important process through which residents can shape the zoning controls and future development in their communities. Individual neighborhood and community groups can create their own plans and have them ratified by the City Council. This is a way for communities to have direct input on planning and policy changes affecting their neighborhoods.

South Park's neighborhood plan dates to 1998. The plan seeks to preserve SF5000 zoning and retains all existing housing areas as housing, with the exception of areas along the commercial corridor on 14th Street. The plan also seeks assistance in enforcing housing codes and regular maintenance in multi-family complexes and includes a small component to build more affordable housing. However, the mechanisms such as market-rate incentives and housing assistance programs are vague and specific goals are minimal (for instance, an increase of 20 units, over half to be built by Habitat for Humanity). This neighborhood plan encourages single-family housing but discourages density. The downside of maintaining low-density, single-family zoning patterns is that if property values rise, the amount of housing is fixed and housing prices can rise quickly. Whether this happens fundamentally comes down to the willingness of existing homeowners to sell or rent for higher prices.

The Duwamish Cleanup holds a variety of opportunities for growth for the surrounding neighborhoods. The increased beauty and recreation of the area could attract higher income residents and in turn raise rents, property taxes, and mortgages. Unfortunately, this change in a neighborhood often leads to displacement of longtime businesses and residents. As described above, where people work and live significantly impacts their health. Being pushed further away from Seattle's economic opportunities has the potential to make Seattle residents less healthy.

This type of displacement has occurred in Seattle before. One example is Seattle's Central District. In 1990, there were nearly three times as many black residents as white. By 2000, the number of white residents surpassed the number of black residents for the first time in 30 years (McGhee, 2006). Higher income white residents have moved into the Central District, displacing lower income black residents who have identified with this community for a long time.

However, displacement due to gentrification is far from inevitable. The EPA, the City of Seattle, and the Duwamish Cleanup leaders have the unique opportunity to improve the health of the river, while also improving the health of the residents. Our recommendations for preventing displacement and the ill health effects that come with it are centered on preserving affordable housing and involving the local community in zoning and development policies. These recommendations are outlined on the following pages.

Employment

A literature review of academic, grey, and popular literature confirms that construction or cleanup projects stimulate short- and long-term employment growth in the immediately affected region. Most of these projects recruit from a local labor pool and train inexperienced hires on project-specific tasks. Further, the American Recovery and Reinvestment Act of 2009 has ensured the provision of many jobs for local residents. Examples of this include the following:

- 1. Pacific Gas and Electric has been tasked with cleaning up Shell Pond in Contra Costa County, California. The company received 300 resumes from local residents and forwarded 45 qualified applicants to their various subcontractors, after a sorting and screening process. The cleanup project will involve multiple phases and hiring will subsequently occur in matching phases. The first round of interviews took place in September 2011, for administrative positions, and interviews for laborers, drivers, and equipment operators will continue when the project is restarted (Pacific Gas & Electric, 2012).
- 2. Middletown, Ohio is the home to an upcoming Brownfield improvement project. In April 2012, cost and employment projections concluded that for the \$2 million dollar project, the town would see influx of 40 new jobs (Middletown Journal, 2012).
- 3. The Hudson River cleanup project is similar in nature to the Duwamish cleanup, with the EPA and General Electric collaborating with the New York State Department of Environmental Conservation to remove PCB contamination from the river. The first phase of the project has completed and was assessed by an independent team of scientists. The second phase began in June 2011. In sum, a one-point-five mile stretch of the river will be dredged. GE will be paying for the second phase and is responsible for the remaining cleanup with EPA oversight. News reports on the project specify that 500 new jobs were created because of the project, although they do not specify whether all jobs were given to local residents nor do they provide a listing of job classifications (EPA, 2012).
- 4. In Idaho, the Department of Energy began a cleanup project at the Idaho National Laboratory site. Jobs were created with funding from ARRA, and "more than 100 positions have been posted between the two contractors and the local small businesses supporting them." Job postings were listed on the cleanup project's website, and training for new hires was provided (DOE, 2009).
- 5. The San Francisco Housing Authority not only complied with Section 3 guidelines, but broadened their mandate as well. Construction contracts over \$25,000 are now make efforts toward the following goals:
- 30 percent of new hires will be low-income;
- 25 percent of the total workforce will be tenants of the San Francisco Housing Authority; and
- Minority or woman business enterprises will make up 20 percent of the aggregate of outside firms (Policy Link).

The Duwamish River cleanup project is a particularly interesting case study, because the river itself contains eight percent of all jobs in the county, most of which are "good blue-collar jobs" (Seattle Times, 2012). A local editorial in the Seattle Times insists that solutions for the river cleanup should continue to accommodate such jobs. City Executive Dow Constantine has also noted that the cleanup must accommodate the present industry, because "we need to generate the wealth that allows us to do it" (Seattle Times, 2012).

This potential influx in local jobs comes at an appropriate time for residents, especially those in the construction, who have been disproportionately affected by the economic downturn. While ARRA has helped with the provision of many jobs for local residents, such funding has not been sufficient to undo the effects of the economy on employment rates or large construction projects. Within the last several

years, the construction industry in general has seen huge worker layoffs or suspensions of cleanup projects. Other unanticipated projects have also slowed down cleanup efforts and suspended jobs.

An HIA from Humboldt County contains a useful list of "Economy Indicators," inclusive of an exhaustive list of jobs and other relevant information. They capture the industry type, job title, entry level wage, hourly mean, projected 2004 – 2014 percent employment change, and the education and training needed for all manners of project jobs (humanimpact.org, 2012). The list could be used by other project managers to make projections about labor needed and positive impacts job creation will have on the local economy.

Business

The effect of the EPA cleanup on business health and vitality is closely related to employment concerns. Cleanup plans must acknowledge the dynamics and interactions of existing businesses in the area to retain existing business as well as to attract new compatible business development. The majority of business activity located in South Park and Georgetown is industrial: processing and manufacturing of materials, industry-related transportation and facilities, fabrication, assembly, treatment or wholesale distribution of manufactured products, and production or storage of industrial related bulk materials (City of Seattle, 2007). The industrial businesses in this area are strategically located to take advantage of the transportation that the area offers, including proximity to Boeing Field, water passage on the Duwamish, downtown Seattle commerce and the large industrial base of the Duwamish, and the large employment base of the Seattle area (City of Seattle, 2007). Most manufacturing firms along the Duwamish opened their doors decades ago, preceding the metropolitan development around them.

In addition to industry, other types of businesses are located in this area. Many of the businesses in the retail and service sectors are important to the overall health of the industrial area as they are located in the area to serve employees of the industrial firms, specifically including banks, labor organizations, food stores, service stations, uniform stores, pharmacies, and eating and drinking establishments. In addition, many businesses serve the service and repair needs of the industrial area and the downtown area, such as cleaners, and auto and truck repair and service (City of Seattle, 2007). A few of these businesses meet the service needs of the local communities, such as beauty salons and attorneys, and are located near residential populations in South Park and Georgetown. Many businesses also serve community-wide social and health functions.

The EPA cleanup poses threats to business in the area as the industrial employment sector here generates more economic impacts than other types of businesses (BST Associates). As the cleanup is a long process, the risks posed to business will change over time.

Short Term Effects

Industrial businesses will likely cope during the cleanup somewhat easier than retail businesses. By using flexible delivery hours, alternate truck routes, and working with customers, industry will be able to make adjustments in order to retain business function. Alternatively, due to the fixed location of restaurants plus retail and personal services, other businesses will likely lose patrons that are unable and/or unwilling to travel to their site. The cleanup may prevent Boeing employees and other businesses' lunchtime access to restaurants and other services; the reconfiguration of King County Metro bus routes may also reduce options for travel and increased congestion will reduce the number of discretionary trips, which will cause a decline in economic health in the area.

Long Term Effects

As ability and desire to access the water increases after the cleanup, it is likely that the industrial use of the river will be challenged, through competing uses, inability to conduct operations, safety hazards to pedestrians. Ultimately, it is expected that property values will go up in this area, endangering the existing businesses' ability to retain their properties.



Recommendations

Employment

To improve employment opportunities for local residents, ensure equitable access to employment listings, and to sustain employment growth after the cleanup:

1) Ensure that job postings are circulated in multiple languages and through multiple mediums.

Businesses have primary responsibility and can partner with community-based organizations such as the YWCA Greenbridge and Got Green. This high-feasibility activity would increase access to cleanup jobs, improve livelihood, and reduce displacement. While it would require the use of translators and taking initiative to circulate job postings widely, it would not be very time or resource intensive.

2) Make emerging jobs and sectors clear to the public.

Full HIA authors or other stakeholders could, similar to the situation in Humboldt County, create an itemized list of expected jobs, wages, project job growth, and education or training needed for each job. This should include immediate cleanup-specific jobs as well as localized jobs that will be influenced by the cleanup project (e.g. temporary food stalls). It could also include wages or required training with current and possible future employers. This strategy anticipates availability of different categories of jobs and ensures workers with varying educational backgrounds have access to jobs. Creating an itemized list will require prior knowledge or research of job categories, as well as associated wages and training requirements, so the feasibility of this recommendation is medium to high.

3) Invest in an employee transition assistance program, so that short-term employees receive assistance in finding new employment opportunities.

Businesses and local CBOs should partner with community-based organizations that specialize in employment assistance, such as the YWCA, WorkSource Seattle & King County or Got Green, to create a referral system to CBOs for employees reaching the end of their contracts. They can also provide employees with a standard letter of reference and upon employee departure and provide a resource list in appropriate languages for other work opportunities. If plugged into already existing system, this could increase livelihood and reduce displacement.

Business

1) Engage business coalitions in the cleanup.

Even before cleanup efforts begin, businesses must develop a shared vision of business and retail areas. The business community must have control over both the current and long term development of their neighborhood. The EPA, the South Park Business Coalition and the Georgetown Business Coalition can work together to reduce displacement and maintain community culture and cohesion. The feasibility of this recommendation is low to medium.

2) Maintain access to business throughout the cleanup.

The City of Seattle should enhance signage, way-finding and lighting; improve bike route connectivity, crosswalks, sidewalks and transit facilities. A website interface could be created that allows residents to track the cleanup effort and will also help make the changes transparent to residents.

3) Draw people from outside the neighborhood to the local businesses during the cleanup.

Neighborhood and business groups can organize events that encourage Seattle residents to travel to the Duwamish area for dinner, hold art walks that facilitate local artists interfacing with the public, or bicycle tours of cleanup efforts. This would promote community cohesion as well as business revenue, and is of medium feasibility.

4) Coordinate industry and businesses in scheduling cleanup activities.

EPA should keep dredging and other activities consistent and predictable in order for businesses and residents to schedule around delays. This medium feasibility recommendation would improve business revenue.



Gentrification

(adapted from the CDC Gentrification and Displacement Prevention Guidelines)

1. Create affordable housing for all incomes.

The City of Seattle, Housing Developers/Planners, Community organizations specializing in housing such as the Low Income Housing Institute, YWCA, Plymouth Housing, etc. can:

Develop mixed-income communities that offer a variety of housing prices including single and multifamily units.

- Follow Smart Growth Principles: http://www.smartgrowth.org/about/principles/principles.asp?prin=3
- Utilize the Quality Growth Toolkit developed by the Atlanta Regional Commission as a tool for implementing mixed-income housing: http://www.atlantaregional.com/html/387.aspx

Adopt inclusionary zoning policies

- Maintain a percentage of the rental or for-sale units in housing developments for low- and moderateincome residents. In return, developers can receive cost offsets as compensation for their affordable housing contributions: http://www.policylink.org/Projects/IZ/.
- The City of Seattle currently offers land use incentives for developers to include affordable housing in new development. However many of these incentives are only available in high-rise density zones. To maintain affordable housing in the less-dense neighborhoods of South Park and Georgetown may require developing specific incentives for those zones. This could be accompanied by a zoning density increase. Detailed plans for this area should be conducted with the full participation of existing residents and community groups.

Review development proposals to determine whether the changes could cause displacement.

- Identify smart growth incentives (e.g., tax breaks and credits) for planners, developers, and local governments. For example, see the Brownfield Tax Incentives: http://www.epa.gov/brownfields/html-doc/taxfs_2.htm
- This action would be very feasible in terms of cost-effective long-term change, but takes significant planning.

2. Approve policies to ensure continued affordability of housing units and the ability of residents to remain in their homes.

The City of Seattle, business (for the job creation piece), Community organizations specializing in housing such as the Low Income Housing Institute, YWCA Greenbridge Learning Center, Plymouth Housing, etc., Community organizations specializing in employments such as YWCA, Got Green, King County Jobs Initiative, etc. should:

- Consider homeownership programs.
- Consider code enforcement policies that assist residents with home improvements.
- Consider implementing rent controls.
- Preserve federally subsidized housing programs.
- Consider location-efficient mortgages that provide competitive rates and low down payments to those who want to live in "location-efficient communities" that are convenient to resources and reduce the need to drive: http://www.locationefficiency.com/.
- Increase individuals' assets to reduce dependence on subsidized housing.

This would be feasible if partnered with community organization already doing similar work.

3. Involve the local community.

EPA, City of Seattle, Duwamish Cleanup Coalition should allow the community to provide input into the design and redevelopment of their neighborhoods, educate the community on their available options, and create organized bodies and partnerships that develop programs to mitigate gentrification. The Duwamish Cleanup Coalition is already doing much of this work, so this recommendation is feasible.

ECONOMIC IMPACT

Conclusion

The Duwamish Cleanup offers the unique and exciting opportunity to improve the health of the environment and with careful planning, improve the health of the residents and neighborhood businesses. The South Park and Georgetown neighborhoods in particular offer affordable housing that is rare to find in the rest of Seattle. An increase of jobs and job training offered to local residents paired with preservation and increase of affordable, multi-family housing, will allow residents and businesses to stay and thrive in the neighborhoods in which they are rooted.

Summary of Recommendations

Employment

1) Ensure that job postings are circulated in multiple languages and through multiple mediums.

2) Make emerging jobs and sectors clear to the public.

3) Invest in an employee transition assistance program, so that shortterm employees receive assistance in finding new employment opportunities.

Business

1) Engage business coalitions in the cleanup.

2) Maintain access to business throughout the cleanup.

3) Draw people from outside the neighborhood to the local businesses during the cleanup.

4) Coordinate industry and businesses in scheduling cleanup activities.

Gentrification

1. Create affordable housing for all incomes.

2. Approve policies to ensure continued affordability of housing units and the ability of residents to remain in their homes.

3. Involve the local community.

References

Adelman L. (2008) Unnatural Causes: Amazing Facts About Health.

Adler, N., Newman, K. (2002) Socioeconomic Disparities in Health: Pathways and Policies, Inequality in education, income, and occupation exacerbates the gaps between the health "haves" and "have-nots." Health Affairs. Vol. 21, No. 2.

Ahnquist, J., Wamala, S., Lindstrom, M. (2012) Social determinants of health -- A question of social or economic capital? Interaction effects of socioeconomic factors on health outcomes. Social Science & Medicine. Vol. 74, p. 930-939

Center for Disease Control and Prevention. (2009). Health Effects of Gentrification. Retrieved 5 19, 2012, from Center for Disease Control and Prevention: http://www.cdc.gov/ healthyplaces/healthtopics/gentrification.htm

Center for Disease Control and Prevention. QuickStats: Percentage of Adults Aged >25 years Reporting Fair or Poor Health, by Age Group and Income. 2011.

City of Seattle (2007) Department of Planning and Development. Seattle's Industrial Lands: Background Report.

City of Seattle. (2012). Seattle's Population & Demographics. Retrieved May 19, 2012, from City of Seattle: http://www. seattle.gov/dpd/Research/Population_Demographics/ Overview/

Curtis, S; Jones, R. (1998) Is There a Place for Geography in the Analysis of Health Inequality? Sociology of Health & Illness. Vol. 20, No. 5. p. 645-672.

Duwamish River Cleanup Coalition. (2012) A Living River Is Up to You. Retrieved May 12, 2012, from www. duwamishcleanup.org

Ith I. The Road Back. The Seattle Times. 2004.

Jamner MS, Stokols D. (2000) The Social Ecological Paradigm of Wellness Promotion. Promoting human wellness: new frontiers for research, practice, and policy. Berkeley: University of California Press Kearns, RA. (1993) Place and Health: Towards a Reformed Medical Geography. The Professional Geographer. Vol. 45, No. 2, p. 139-147.

Langloe, L. (1946) Duwamish River and Seattle Industry. In: City Planning Commission, ed. Seattle.

Lee, E. (2008) Unnatural Causes: Place Matters. San Francisco, CA: California Newsreel.

McGhee, H. Jr. (2006). Gentrification, Integration or Displacement?: The Seattle Story. Retrieved 5 19, 2012, from Black Past: http://www.blackpast.org/?q=perspectives/ gentrification-integration-or-displacement-seattle-story

Office of the Deputy Prime Minister. Community Cohesion: Seven Steps, A Practitioner's Toolkit. (2005) Retrieved from http://www.communities.gov.uk/documents/ communities/pdf/151834.pdf.

Policy Link. (n.d.). Local Hiring Strategies. Retrieved 5 19, 2012, from PolicyLink: http://policylink.info/EDTK/ LocalHiring/default.html

PolicyLink. (2007) Why Place Matters: Building a Movement for Health Communities. Policy Link

Rhodes, E. Mayo, J. (2006). Local News. Retrieved May 19, 2012, from Seattle Times: http://seattletimes.nwsource. com/html/localnews/2003130153_homeappreciation160. html

Robert Wood Johnson Foundation. (2010) A New Way to Talk About the Social Determinants of Health. Princeton, NJ

Srinivasan, S., Fallon, L.R., Dearry, A. (2009) Creating Healthy Communities, Healthy Homes, Healthy People: Initiating a Research Agenda on the Built Environmentand Public Health. American Journal of Public Health. Vol 93, No. 9. p. 1447.

Street Smart. Duwamish Way-Finding and CTR Report.Date accessed: http://www.duwamishtma.org/wp-content/ uploads/2012/02/III.-Georgetown.pdf

Tunstall, HV; Shaw, M; Dorling, D (2004). Places and Health. Epidemiology Community Health. Vol. 58, No. 1, p. 6-10.





Introduction

Human wellbeing is defined as a state characterized by health, happiness and prosperity. The social and cultural wellbeing of communities impact the individuals within them, their quality of life and community cohesiveness. Social support, sense of belonging, and experience of participation contribute to the social and cultural wellbeing of a community. Environmental changes can present challenges to communities' social and cultural wellbeing by affecting their physical environment, how they live and how they communicate with one another. As the Duwamish River cleanup will affect a number of communities, it will be important to consider the ways to sustain or improve the wellbeing of impacted communities during the cleanup.

A number of communities will be affected by the Duwamish River cleanup. These include local tribes, non-resident fishers and residents from adjacent neighborhoods (e.g. Georgetown and South Park). The social and cultural impacts assessed for this cleanup are tribal wellbeing, the effects of art, cultural identity, recreation and green space, and language barriers.

The Relationship between Language, Recreation, Art and Health

Language Barriers

The impacted populations identified by this HIA encompass a variety of natives and immigrants from various cultural origins that speak different languages including but not limited to Chinese, Spanish, Vietnamese, Swahili, etc. Language homogeneity is a basic component for effective communication. Without effective communication, the needs, characteristics and unique heterogeneity attributable to a cultural or ethnic group cannot be fully understood (Health Canada).

In the US, several studies have found associations between language barriers and multiple health outcomes. A 2005 study by Flores et al. showed that Limited English Proficiency (LEP) parents were three times more likely to have a child with fair or poor health status. There was a clear dose-response relationship with increasing severity of parents' LEP. In addition, research carried out on a Latino minority population found an association between language concordance and positive health outcomes, such as reduced anxiety and depression and improved feelings of belonging (Perez et al., 1997).

A common concern among most of these studies was the significant role played by language barriers. While it might not be a direct risk factor for health outcomes, it is a practical indicator of important risk factors such as diminished access to healthcare services, health insurance, communications with healthcare providers or clinical staff and misunderstanding of prescription medications (Kirkman-Liff B. and Mondragon D., 1991).

Though the cleanup process is geared towards achieving positive health outcomes, individuals affected by LEP will encounter difficulty accessing and understanding and this information. Not having resources provided in their language can lead to these communities feeling unvalued and disempowered, ultimately resulting in increased stress level or depression. Disempowerment in this context includes non-English speaking populations. These populations can feel excluded from decision-making process or risk reduction strategies if notices are not in their native language.

Consequently, these psychological stresses (i.e. depression) could be risk factors for more chronic health outcomes, particularly cardiovascular diseases (Xu T et al., 2011).

For several years, the EPA and other community organizations have been efficient in translating notices and signage into common community languages. Therefore, we do not anticipate language barriers to majorly impact the physical and mental wellbeing of the communities during the cleanup. In addition, the Duwamish River Cleanup Coalition (DRCC), EPA's Community Advisory Group, has hosted a series of public workshops engaging the communities to help develop new strategies for controlling exposures to contamination, particularly from fish consumption. Unfortunately, these efforts have not proven very effective, as people still continuously fish on the Duwamish River. Alternative communication strategies and options should be developed to inform local tribes on the health risks they face by consuming fish from the Duwamish River. One example is to use art as a tool to communicate health information, incorporating health risk topics into community activities such as neighborhood parties and game competitions.

Art and Wellbeing

Art is widely accepted by mental health professionals as having a positive effect. The American Art Therapy Associations lists 44 graduate programs at major US Universities with specialties in Art Therapy. Local governments have a long history of incorporating art into major construction projects. In 1973 King County became the first county in the nation to adopt a "1% for art" program dedicating art funding for most capital projects (King County Archives). The City of Seattle adopted a similar ordinance the same year. In 1974 Washington State enacted legislation dedicating half of 1 percent to funding art (Washington State Arts Commission). Required arts funding in capital improvement



Art surrounding a construction site in Capital Hill, Seattle [Derek Low]

projects has a wellestablished history, contributing to social cohesion and mental wellbeing.

Art can be used to mitigate both and longshort term effects of the Duwamish River cleanup. Long-term construction can have a significant

effect on the mental wellbeing of individuals who live in or frequent the area. Public art can reduce negative effects of construction on mental health. Allowing local individuals to create and display art can positively affect mental wellbeing. The Capital Hill light rail station is a prime example of how art was used to mitigate the construction impact of the community. In addition to general improved aesthetics and art for the sake of art, art can increase social cohesion by incorporating the history of the area and improved cultural understanding. The Mapping Capitol Hill project demonstrates how history can be integrated to increase cultural understanding and social cohesion.

Art can also incorporate health information. This has a two-fold impact by providing aesthetic and creative wellbeing as well as teaching health information that can positively community condition. HIV-30.org is an excellent example of incorporating important health information

into art. In addition to using temporary art to mitigate construction impacts, permanent art installations can be used to increase social cohesion, mental wellbeing and social health.

bage 37

SOCIAL AND CULTURAL IMPAC

Recreation, Greenspace and Wellbeing

Current environmental conditions along the Duwamish River do not allow for many safe and attractive green or recreation spaces for the community residents, tribes, or non-resident fishers, especially along the waterfront. Industrial sprawl has reduced the amount of "soft" surfaces, creating a landscape of machinery, concrete waste, storage yards and fences right up to the edge of the shoreline. Much of this sprawl has crept into public spaces, such as right-of-ways and shoreline street ends, leaving them unattractive and feeling private. The few patches of greenspace that do exist on the shoreline may have contaminated soils, water and air. Children are particularly vulnerable to the lack of safe greenspaces in Superfund site because of their outside play and the fact that they are growing and developing among environmental hazards (Landrigan et al., 1999).

The current conditions of the Superfund site, as well as the Duwamish River Cleanup Project, will greatly affect human well-being. While the Cleanup Project will help improve safety and public perception over time, the construction process is expected to last many years and the stress of construction can take a toll on mental wellbeing, particularly for residents. Stress may contribute to the onset of illness and may affect physical and psychological well-being, which in turn may predispose the residents to greater vulnerability to additional life stresses (Miller, 2007). Conversely, the ability to cope with stress can play a large part in the healing of many physical, mental, and behavioral health problems (Taylor & Stanton, 2007) and facilitate healthy family and social relationships (Sachser, Dürschlag & Hirzel, 1998). Providing green and recreation space may help mitigate this stress by:

- Providing the opportunity for increased physical activity and therefore reducing stress and increasing mental wellbeing (Sallis, Millstein & Carlson, 2011)
- Increasing a sense of community (Sullivan, Kuo & DePooter, 2004)
- Strengthening neighborhood social ties (Coley, Kuo & Sullivan, 1997)
- Decreasing crime and fear (Kuo & Sullivan 2001b)
- Increasing sensory stimulation, creativity and excitement about daily living (Louv, 2005)
- Assisting in mental fatigue recovery (Kuo & Sullivan, 2001a)
- Increasing the ability to cope with life adversity (Kuo, 2001)

Over one hundred studies confirm that one of the main benefits of spending time in nature and greenspace is stress reduction (Kahn, 1999). Studies have also shown that greenspace promotes healthy child development (Taylor & Kuo, 2006) and may reduce symptoms of Attention Deficit Hyperactivity Disorder (ADHD) (Faber & Kuo, 2009 and Kuo & Taylor, 2004). Additionally, studies have found that experiencing nature has a powerful influence on the rehabilitation of people greatly affected by a crisis and may reduce crisis effects (Ottoson & Grahn, 2008). This may be particularly relevant for a Superfund site, where daily exposure to multiple physical, environmental, and emotional stresses could be viewed as crisis conditions.



Photo showing one of the only shoreline greenspaces in Georgetown. [Leann Andrews]

Culturally Distinct Aspects of Wellbeing

Tribal Wellbeing

Social and cultural factors affecting the health of the Duwamish Cleanup stakeholders are of particular concern for local indigenous populations. The Duwamish, Muckleshoot, and Suguamish tribes traditionally relied on natural resources from the Duwamish River as a source of subsistence. Through the decades following European colonization of the Pacific Northwest, social and cultural changes affecting the tribes have resulted in both beneficial development as well as adverse effects on their health. The following section briefly reports the current social and cultural influences affecting the health of tribal stakeholders associated with the Duwamish Superfund Cleanup, addresses appropriate means of ongoing assessment of the potential health effects on these stakeholders, and proposes recommendations for increasing benefits and decreasing adverse effects of the Cleanup for these groups.

Existing Conditions

In order to discern the potential effects of the planned Cleanup on the health of tribal stakeholders, it is necessary to understand the current conditions within which changes will occur. The Urban Indian Health Institute (UIHI), a division of the Seattle Indian Health Board (SIHB), has provided a useful general description of these conditions in their recently published Community Health Profile. The profile documents health conditions of the American Indian/Alaskan Native (Al/ AN) population living within the SIHB service area in King County, WA. The report highlights

Table 4.1: Health Issue Prevalence

Health Issue	Prevalance in Al/ AN Population	Prevalence in General Population		
Asthma	17.3%	8.1%		
Heart Disease	6.3%	2.8%		
Smoking	23.7%	12.1%		
Obesity	36.3%	20.1%		
Diabetes	12.2%	5.9%		
Infant Mortality	13.2%	4.5%		
Teen Birth	10.4%	3.7%		

[Urban Indian Health Institute, 2011, Community Health Profile, Seattle Indian Health Board. Seattle, WA.]

statistics that reveal several socially- and culturally-related health issues of especial concern for local tribes.

Social determinants of health (SDOH) including education, income, and unemployment, among other factors, have been shown to greatly influence wellbeing. Such determinants may interact with biological or genetic factors to affect individual behaviors, yield physical, psychological, or emotional health outcomes, and potentially transfer effects through generations. Comparing such social factors between AI/ANs and the general population in King County, it is observed that a higher percentage of AI/ANs (18.3%) who are 25 or older report not holding a high school diploma or GED than those in the general population (8.2%). In the same sample, 16.0% of Al/ANs have completed undergrad or graduate degrees, compared to about 44.8% of the general population. With regard to economics, a larger proportion of AI/ANs in the service area have income below the federal poverty level (25.1%) than those in the general population (9.7%), and AI/ANs also report higher unemployment (10.9%) than in the general population (5.7%). Cumulatively, these educationand economics-related issues constitute a significant burden on tribal health, and along with other factors, yield substantial disparities in health between the indigenous and general populations in King County (UIH, 2011).

The current differences in health status between Al/ANs and general population of King County are striking. Comparing mortality between AI/ANs and the general population, AI/ANs report higher rates of death due to common health issues. The two most prevalent causes of mortality are cancer and heart disease for both groups. However the rates of mortality from these causes are higher for AI/ANs (177.3/100,000 due to cancer; 176.5/100,000 due to heart disease) than for the general population (165.6/100,000 due to cancer; 152.6/100,000 due to heart disease). The third most prevalent cause of death among AI/ANs in King County is unintentional injury. The local rate of mortality due to unintentional injury for Al/ANs (79.3/100,000) is much higher than in the general population (32.4/100,000) (UIHI, 2011).

Beyond mortality, AI/ANs in SIHB service area also face other critical health challenges more often than the general population. Table 4.1 presents a comparison of the respective prevalence rates for various health issues in King County.



Lower Duwamish Waterway Cleanup HIA

Findings

Given the background health conditions highlighted above, indigenous stakeholders are particularly vulnerable to potential health effects of the Duwamish Superfund Cleanup. As described in other portions of this HIA, the Duwamish Superfund Cleanup will involve cleanup actions and institutional controls that will interfere with tribal subsistence fishing in the Duwamish. It is clear that such interference will result in further imposition on the tribes' social cohesion and cultural practices founded on subsistence practices, and it is generally understood that such effects may results in changes in physical and mental health. At the current stage of planning for the Cleanup, this is key general knowledge.

Eventually, however, more precise assessment of the effects of the Cleanup on social and cultural aspects of tribal health will necessitate consideration of how particular project-related changes in health might be identified and interpreted. Adequately characterizing the specific mechanisms and intensity of tribal effects of the Cleanup project will require more investigation than simply quantifying readily foreseeable outcomes of intended project work and institutional controls. In keeping with their distinct cultures, which historically were more holistically tied to the river, the local tribes hold constructs of health and wellbeing that are uniquely reliant on the Duwamish River and its resources. Accordingly, the tribes may manifest effects of changes to the River, within their lived experiences, in ways that are not readily foreseen by project proponents or members of other cultural groups.

As found in the HIA completed as a portion of the National Environmental Policy Act review of the Bureau of Land Management's proposal to permit expanded North Slope Oil Development (BLM, 2007), indigenous tribes traditionally reliant on subsistence practices have sustained uniquely significant mental and physical health consequences from ongoing development, acculturation, and adaptation to alternative means of livelihood. The North Slope HIA cited studies that linked polar region modernization and acculturation with increases in indigenous metabolic disorders, cardiovascular diseases, cancer, and social pathology such as domestic violence, alcohol and drug abuse, and suicide. Though indigenous income and mortality rates have improved with ongoing development, vast disparities remain between indigenous North Slope residents and the general US population, with mortality rates and rates of assault, domestic violence, and unintentional or intentional injury or death remaining dramatically higher than in the US as a whole (BLM, 2007).

In general, the North Slope HIA found that ongoing development would likely exacerbate existing health problems in the indigenous stakeholder community. However, it was also determined that the extent of physical and social pathology resulting from development would largely be determined by the balance of positive and negative outcomes in terms of wellness as perceived by the indigenous stakeholders. As ongoing development threatens the foundations of indigenous concepts of wellbeing and ways of life on the North Slope, a fear is that even the impressively resilient indigenous populations may reach turning points at which gradual shifts in organization and social cohesion attain threshold levels that begin to dramatically harm population health (BLM, 2007).

To avoid such harm, the North Slope HIA forwarded an understated but powerful recommendation that decision makers controlling the ongoing development enter into agreements to regularly confer, going forward, with a health advisory group representing the local indigenous stakeholder interests. To the degree that such consultation yields collaboration and consideration of distinctly tribal perceptions of health, it could yield very effective mitigation of the potential health risks from development.

Considering Indigenous Indicators of Health

Toward advocating such distinct models of wellness for indigenous peoples, Jamie Donatuto has worked with University of British Columbia and the Swinomish Indian Tribal Community of Washington State in research addressing the prospect that health and risk are truly situational and culturally defined rather than generalizable (Donatuto et al, 2011). Noting "a need to develop a more multi-dimensional and culturally meaningful definition of health in aboriginal communities," the study team has worked to identify measures of health in the context of environmental changes as experienced by the Swinomish.

To discern specifically Swinomish concepts of how contamination of subsistence resources in the Salish Sea affects health, researchers have used interviews, mental modeling, and flowcharts to depict tribal perceptions of wellbeing. Common themes in the perceptions have been noted as components of health, and indicators have been identified that represent groups of the most commonly mentioned components. Through years of such research, five indicators and attendant components of community health and wellbeing have been compiled, as listed in Table 4.2 (Donatuto, 2010). These health indicators do not merely mirror the components of traditional risk assessment, but rather reconstitute the defining framework of tribal health to reflect community concerns, structures, and values.

Indicator	Components
Community Cohesion	 Participation and cooperation Roles Familiarity
Food Security	AvailabilityAccessSharing
Ceremonial Use	 Ceremonies and gatherings Giving thanks Feeding the spirit
Knowledge Transmission	TeachingsEldersYouth
Self Determination	HealingRestorationDevelopment

Table 4.2: Indicators of Swinomish Health in Relation to the Salish Sea

[Donatuto, 2010. White Paper: Key Indicators of Tribal Human Health in Relation to the Salish Seal



Cultural Identity and Wellbeing for Non-Tribal Subsistence Fishers

Cultural and ethnic identity has been shown to be associated with a person of color's increased self-esteem and positive well-being (Smith and Silva 2011). This has been particularly evident within the different ethnic groups that are aggregated as "Asian Americans." Recent immigrants may continue to perform certain activities in the United States in order to dampen the enormous culture shock they may face (Cartledge 1999). These activ¬¬ities help to smooth the transition to a dramatically different way of life.

Fishing is an activity that not only has economic significance but cultural significance as well in certain Asian American populations. For Hmong immigrants, fishing was a way of life in their homeland (Bengston et al. 2008). Continuing this activity in the US provides a valuable connection to their homeland. Fish consumption, along with other dietary patterns, can be more resistant to change than other cultural practices, and thus an important method of maintaining cultural identity (Cartledge 1999).

Furthermore, fish themselves act as important symbols in religions like Buddhism and are key ingredients in traditional Chinese medicine (Reis and Hibbeln 2006). Denying these groups the ability to fish can lead to a variety of negative outcomes, such as a decrease in self-esteem, loss of social cohesion, which can ultimately affect health (Cartledge 1999).

Unfortunately, little is known about the non-tribal subsistence fishers around the Duwamish River. From a previous study on fish consumption among Asian Americans in Seattle, those who fish for themselves tend to be of Mien, Hmong or Laotian descent, and respondents tended to be first generation immigrants (Secheng et al. 1999). From anecdotal evidence we have heard from stakeholders, they have observed that the Duwamish fishers tend to be of Southeast Asian descent with limited English proficiency. While we have focused on Asian American subgroups, there may be non-tribal populations of other cultural backgrounds that find fishing to be culturally significant as well. Because much remains unknown, further research on the demographics of the fishers needs to be conducted. This may be difficult to do since the population may want to stay undetected. Their reasons may be similar to those of the Hmong fishers in Minnesota and Wisconsin, who felt discriminated against and harassed by park personnel and other recreationists because of their racial/ethnic background (Bengston et al. 2008). If this is occurring with the fishing population in Seattle, then they may feel wary about talking to any authority figures or other outsiders. Therefore, working with a cultural broker or a key informant who has the population's trust may be useful in establishing a relationship between the parties conducting the cleanup and the fishing population.

Furthermore, while acknowledging that the fish from the Duwamish River contains contaminants harmful to human health, we must also be mindful that fishing may be an activity that this population may find difficult to refrain from because it is so closely tied to their cultural identities. Therefore, a need to find alternative culturally meaningful activities or develop methods that allow this population to continue to fish and prevent them from consuming fish exists. For this to happen, a robust, trusting partnership will need to be created by the responsible agencies and this population. This will also allow this population to have a voice in the decision making process in the cleanup and be aware of the health impacts the cleanup would have on them. By ensuring that future steps taken are culturally appropriate, we are more likely to be successful in retaining the well-being that individuals have due to a strong sense of ethnic identity.

Recommendations

Language Barriers

Feelings of helplessness, uncontrollability, powerlessness and low self-efficacy could be reduced by eliminating structural obstacles preventing individuals from active participation in decision making processes at the level of neighborhoods, communities, and organizations (Killian R et al., 2003). Two approaches to addressing the communication gap due to language barriers are:

- Increase the number of language-congruent encounters. 1.
- 2. Continue to provide translations of signs and notices Provide some form of interpretation.

In order to ensure ultimate protection of these non-English speakers from exposure to contaminants during and after the cleanup, it is important to establish effective communication with them in their native languages. This will also have positive impacts on their wellbeing and feelings of belonging and also maintain the effectiveness of the clean -up remedies (i.e. compliance with institutional controls).

A baseline action is to find out the dominant languages spoken among the impacted communities. In addition, through extensive stakeholder involvement, information on other minority languages can be gathered. The aim is to identify among the communities as many languages as possible and incorporate these languages into public notices and meetings particularly for institutional controls and updates on the cleanup process. Also, use of art for risk communication should incorporate art-forms that identifies with some of the cultures of community members. This will further increase feelings of belonging among the communities.

Recreation, Greenspace and Wellbeing

- 1. Mitigate the stress caused by construction by creating community recreation opportunities
- Require funding mitigation put towards public recreation places such as additions to the community recreation center, providing beach access in low risk areas, trails, and greenspace.
- Any shoreline restoration construction to be opened up to the public, involving community groups and residents to assist in planting, cleanup etc.

2. Mitigate the stress caused by construction by creating public greenspace.

- Work with the City and public entities, community groups, • tribes and residents to develop greenspaces in the shoreline communities on already existing public properties (e.g. rightof-ways, shoreline street ends, under bridges etc.)
- Work with the commercial and residential property owners to create a continuous public beach where feasible, and access to water along the shoreline in low risk areas



Recommended shoreline greenspace [Leann Andrews]



bage 43

Art and Wellbeing

1. Use temporary art to mitigate the adverse aesthetic effects of construction.

2. Add permanent art installations to increase community wellbeing.

Considerations for art projects:

- Prioritize local residents and local employees in selecting artists.
- Prioritize local community and ethnic groups, particularly tribes, in selecting artists.
- Prioritize and encourage art that incorporates health information.
- Prioritize and encourage art that promotes social cohesion through history and increased understanding and knowledge about the area and local communities.



Recommended use of temporary art instead of conventional construction treatment [Derek Low]

Tribal Wellbeing

In light of the groundbreaking research, described above, currently evolving regarding the Swinomish indicators of community health, it is clear that much could be done to understand indicators of health particular to the tribes that are stakeholders regarding the Duwamish Cleanup. Formalized consultation agreements are already in place addressing the affected Tribes' technical advisory roles regarding planning and implementing the Duwamish Cleanup. However, the effectiveness of such commitments to consultation, in meaningfully shaping implications of the Cleanup with respect to Tribal health, will hinge upon the responsiveness of cleanup officials to nuanced health issues of particular concern to the Tribes. Such responsiveness would be aided by deeper and clearer understanding of distinct tribal perceptions of wellbeing. Thus, such understanding should be developed by conducting a formal process to derive and officially recognize appropriate tribal health indicators for the indigenous stakeholders, via an approach modeled on the work currently occurring with the Swinomish Tribe.

Cultural Identity and Wellbeing

- 1. Research the demographics of the non-tribal subsistence fishers on the Duwamish River, as well as their behaviors, attitudes and beliefs towards fishing.
- 2. Collaborate with the fishers to determine alternative culturally appropriate methods to fish harvesting from the Duwamish.

Summary of Recommendations

Recommendations	Sub points/ Action Steps	Affected Population	Target Audience	Long/ Short Term	Potential Funding Sources
Increase the number of language congruent encounters, continue with translations	Identify different types of languages spoken in the community, communicate project info in languages	Immigrants, residents, non- resident fishers, business owners	Public agencies, designers, stakeholders, public	Short (project length)	
Adopt alternative means of communication e.g. art	Find out activity interests of community members and incorporate health risk communications into such activities.	Immigrants, residents, non- resident fishers, business owners	Public agencies, community organizations, designers, stakeholders, public	Short (project length)	
Commit to formally developing, recognizing, and carrying forward, in technical consultation with the affected Tribes, tribal indicators of health beyond standard risk assessment parameters.	Conduct process to derive tribal health indicators, facilitated by Swinomish and University of British Columbia specialists.	Tribal stakeholders	Public agencies, responsible parties, stakeholders	Short/ long	
Temporary art during construction	Prioritize local and native artists. Prioritize art that incorporates health information, and social cohesion.	All	Public agencies, responsible parties	Short	Community neighborhood arts, National endowment for the arts. Artsfund. Private funding. precedence for 1% for Arts for KC and COS projects. Artists self-funded
Permanent art installations	Prioritize local and native artists. Prioritize art that incorporates health information, and social cohesion.	All	Public agencies, responsible party	Long	See above
Conduct further research on the behaviors, attitudes, and beliefs of the non-tribal subsistence fishers on fishing	Use cultural brokers or key informants increase trust researchers and the population	Non-tribal subsistence fishers	Responsible parties, university	Short/ Long	Research grants, university projects
Collaborate with fishers to determine culturally appropriate alternatives to fishing	Use cultural brokers or key informants increase trust researchers and the population	Non-tribal subsistence fishers	Responsible parties, public agencies	Long	
Create community recreation opportunities	Allocate funding towards recreation places such as community center, beach access in low risk areas	Community residents	Responsible parties, public agencies	Short/ long	Friends of Shoreline Street Ends, Parks Levy funds, Seattle Parks Foundation, Neighborhood Opportunity Funds, SDOT
Create public greenspace opportunities	Develop public greenspace on public ROW, shoreline, shoreline street ends	All	Responsible parties, public agencies	Short/ long	See above



References

Bengston, David N., Michele Schermann, Maikia Moua, and Tou Thai Lee. "Listening to Neglected Voices: Hmong and Public Lands in Minnesota and Wisconsin." Society and Natural Resources 21, no. 10 (2008): 876-890.

Bureau of Land Management. 2007. Northeast NPR-A Supplemental IAP/EIS.

Cartledge, Daniel. "Socio-cultural Considerations of Fish Consumption" in Comparative Dietary Risks: Balancing the Risks and Benefits of Fish Consumption. 1999. Accessed May 13, 2012. http://www.tera.org/Publications/

City of Seattle, Office of Arts and Cultural Affairs. "Public Art Ordinance." Retrieved from: http://www.seattle.gov/arts/publicart/ordinance.asp

Coley, R. L., Kuo, F. E., and Sullivan, W. C. "Where Does Community Grow?: The Social Context created by Nature in Urban Public Housing." Environment and Behavior 29, no. 4 (1997): 468-494.

Donatuto, J. L. 2010. White Paper: Key Indicators of Tribal Human Health in Relation to the Salish Sea. Prepared in fulfillment to Swinomish Action Agenda Goal 4, Objective 1 for EPA grant #981-90-03-00 in coordination with the Puget Sound Partnership.

Donatuto J.L., Terre A. Satterfield and Robin Gregory. "Poisoning the Body to Nourish the Soul: Prioritising Health Risks and Impacts in a Native American Community." Health, Risk & Society 13, No. 2 (2011): 103–127.

Faber, T. A., and Kuo, F. E. "Children with Attention Deficits Concentrate Better After Walk in the Park." Journal of Attention Disorders 12, no. 5 (2009): 402-409.

Flores G, Bauchner H, Feinstein A. R. and Nguyen, U.S. "The impact of Ethnicity, Family Income, and Parental Education on Children's Health and Use of Health Services." American Journal of Public Health 89, No. 7 (1999): 1066-1071

Kahn, P. H. The Human Relationship with Nature: Development and Culture. Cambridge, Mass: MIT Press, 1999.

Kilian R, Lindenbach I, Löbig U, Uhle M, Petscheleit A, and Angermeyer MC. "Indicators of empowerment and disempowerment in the subjective evaluation of the psychiatric treatment process by persons with severe and persistent mental illness: a qualitative and quantitative analysis." Social Science & Medicine 57 (2003): 1127–1142.

King County Archives, Record Group 403. "Arts Commission Administrative History." Retrieved from: http://www.



kingcounty.gov/operations/archives/researching/ ArtsCommission403.aspx last updated Dec. 17 2008

Kirkman-Liff B and Mondragon D. "Language of Interview: Relevance for Research of Southwest Hispanics." Am J Public Health 81 (1991): 1399–1404.

Kuo, F.E. "Coping with Poverty: Impacts of Environment and Attention in the Inner City." Environment and Behavior 33, no.1 (2001): 5-34.

Kuo, F.E. and W.C. Sullivan. "Aggression and Violence in the Inner City: Effects of Environment Via Mental Fatigue." Environment and Behavior 33, no. 4 (2001): 543-571.

Kuo, F. E., and Sullivan, W. C. "Environment and Crime in the Inner City: Does Vegetation Reduce Crime?" Environment and Behavior 33, no. 3 (2001): 343-367.

Kuo, F. E., and Taylor, A. F. "A Potential Natural Treatment for Attention-deficit/hyperactivity Disorder: Evidence from a National Study." American Journal of Public Health 94, no. 9 (2004): 1580-6.

Landrigan, P. J., Suk, W., and Amler, R. W. "Chemical wastes, children's health, and the Superfund basic research program." Environmental Health Perspectives 107 (1999): 423–427.

Louv, R. Last child in the woods: Saving our children from nature-deficit disorder. Chapel Hill, NC: Algonquin Books of Chapel Hill, 2005.

Miller, T. W., and Annual Meeting of the American Psychological Association. "Trauma, change, and psychological health in the 21st century." American Psychologist 62, no. 8 (2007): 889-898.

Ottoson, J., and P. Grahn. "The role of natural settings in crisis rehabilitation: How does the level of crisis influence the response to experiences of nature with regard to measures of rehabilitation?" Landscape Research 33, no. 1 (2008): 51.

Perez-Stable, E.J., Napoles-Springer A. and Miramontes, J.M. "The Effects of Ethnicity and Language on Medical Outcomes of Patients with Hypertension or Diabetes." Medical Care 35 (1997): 1212-1219

Reis, L.C. and J.R. Hibbeln. "Cultural symbolism of fish and the psychotropic properties of omega-3 fatty acids." Prostaglandins, Leukotrines, and Essential Fatty Acids 75 (2006): 227-236.

Sachser, N., Dürschlag, M., and Hirzel, D. "Social relationships and the management of stress." Psychoneuroendocrinology 23, no. 8 (1998): 891-904.

Sallis, J. F., Millstein, R. A., and Carlson, J. A. "Community design for physical activity." In Making Healthy Places edited by A. Dannenberg, H. Frumkin and R. Jackson, 33-49. Washington D.C.: Island Press, 2011.

Sechena, Ruth, Connie Nakano, Shiquan Liao, Nayak Polissar, Roseanne Lorenzana, Simon Truong, and Richard Fenske. (1999, May 27). "Asian and Pacific Islander Seafood Consumption Study." UW Center for Ecogenetics and Environmental Health. (27 May 1999) http://depts.washington.edu/ceeh/ downloads/Seafood_study.pdf.

Smith, Timothy B. and Lynda Silva. "Ethnic identity and personal well-being for people of color: a meta-analysis." Journal of Counseling Psychology, 58 no. 1 (2011): 42-60.

Sullivan, W. C., Kuo, F. E., and DePooter, S. F. "The fruit of urban nature: vital neighborhood spaces." Environment and Behavior 36, no. 5 (2004): 678-700.

Taylor, F.A., and Kuo, F.E. "Is Contact with Nature Important for Healthy Child Development? State of the Evidence." In Children and Their Environments edited by C. Spencer and M. Blades, 124-140. Cambridge, UK: Cambridge University Press, 2006.

Taylor, S. E., and Stanton, A. L. "Coping Resources, Coping Processes, and Mental Health." Annual Review of Clinical Psychology 3 (January 01, 2007): 377-401.

Urban Indian Health Institute. 2011. Community Health Profile. Seattle Indian Health Board. Seattle, WA.

Washington State Arts Commission. "Art in Public Places - 1/2 of 1%." Retrieved from: http://www.arts.wa.gov/public-art/ percent.shtml

Xu T, Li W, Teo K, Wang XY, Liu LS, Yusuf S: Association of psychological risk factors and acute myocardial infarction in China: the INTER-HEART China study, Chinese medical journal 2011, 124:2083-2088



Introduction

For centuries, the LDW was a source of life to a diverse ecosystem of sea life and the tribal populations who relied on it (Duwamish Alive). At the start of the 20th century, industry claimed the LDW, releasing dangerous toxins into the water and sediment. These toxins have accumulated in the fish, meaning that human consumption of resident seafood and shellfish from the LDW increases the risk of a host of negative health outcomes. There are fewer health concerns about eating migratory fish, namely salmon, from the LDW, but there are still recommended limits on consumption levels.

Nonetheless, human reliance on and connection to the LDW remains. Certain populations continue to eat fish from the LDW, despite the health risks. Many more communities remain historically and geographically connected to the LDW and would benefit from it as a healthy source of seafood.

The current EPA proposed cleanup plan will not bring the LDW to a level of decontamination that makes it safe for human consumption of fish and shellfish. This chapter outlines the health benefits that could be gained from bringing the LDW to levels of decontamination that allow for safe consumption of resident fish and shellfish. In addition, we examine the importance of understanding and involving communities with connections to the LDW in future regulation, risk communication, and decision-making to optimize health.

There are three communities that will be most affected by the EPA's proposed cleanup of the Duwamish River. The neighborhoods around the LDW are home to Seattle's Georgetown and South Park residents and represent predominantly low-income and ethnic minority populations. In addition to these neighbors, many low-income and immigrant populations travel to the LDW from throughout the area for subsistence fishing. Lastly, three Native American tribes (two federally-recognized and one unrecognized) have tribal treaty rights or historic fishing ties to the river (UW SPH, JHA, DRCC, 2012).



A beach and park along the LDW in the South Park neighborhood of Seattle [Kate Cole]

The Relationship Between Fish Consumption + Health

Over a century of contamination from industry, storm water drainage, and upland runoff has polluted the Lower Duwamish Waterway sediments with known endocrine disruptors and neurotoxicants. A Human Health Risk Assessment (HHRA) conducted by the EPA determined that four primary chemical contaminants - arsenic, dioxin, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) - pose the areatest human health risks associated with exposure to contaminated sediment, shellfish, and fish (U. S. Environmental Protection Agency 2007). The HHRA concluded that PCBs contribute the most to this risk. Chronic exposure to arsenic, a known human carcinogen, can lead to liver injury, peripheral neuropathy and vascular damage, dermatological changes, and lung and skin cancer. Dioxins, a broad category of chemicals including known carcinogens, can cause detrimental reproductive health effects and harmful effects in developing fetuses, immune system damage, and some cancers. PAHs, another broad category of chemicals formed during combustion, can also increase cancer risk. Lastly, PCBs, which the HHRA concluded contribute the most to increased health risks at the Superfund site, are listed as probable carcinogens by the International Agency for Research on Cancer and can also lead to behavioral and learning problems in children. These toxicants are known to accumulate in fish and shellfish and can have direct negative health impacts in humans who consume fish.

Existing Conditions

Current patterns of fish consumption

The combination of poverty, inaccessibility of healthy food sources, and a traditional diet high in seafood, makes catching and eating seafood from the Duwamish more common for certain populations. There is no ongoing monitoring of who is eating from the LDW, but multiple small surveys indicate that certain populations are eating from the LDW. In her survey of food bank clients in Rainier Valley and South Park, Schmidt found that 16 of 199 (8%) interviewees ate fish from the Duwamish (Schmidt 2011). A 2007 study by Mayfield found 152 anglers fishing in the LDW, catching resident fish and shellfish for consumption by themselves and their families (Mayfield 2007). The study notes that these findings are consistent with studies dating from the 1980s. In addition to recreational fishing the Muckleshoot Tribe operates a significant commercial fishing operation on the LDW.

The current fish consumption estimates used by the EPA and the Washington State Department of Ecology for calculating safe levels of exposure to these toxic contaminants are much lower than actual rates of consumption among recreational anglers, some immigrant populations, and area tribes. The EPA estimates that only 28% of the US population consumes seafood, at an average of 17.5 grams of fish per day (EPA 2002). The current Ecology estimate used for setting water safety standards in Washington is an effective rate of 27 grams of fish per day (WA Ecology, 2012). Certain populations eat fish at much higher rates and in much larger quantity. Fish consumption surveys of the Suquamish, Squaxin Island and Tulalip Tribes reported seafood consumption levels of 213.9g/day, 72.9g/day and 72.9g/

day respectively (The Suquamish Tribe, 2000). Assessments of environmental quality and contamination of seafood should take consumption patterns of various groups into account. Another survey of Asian Pacific Islanders found they ate fish a rate of 110 grams per day (Human Health Focus Group, 2008). While some of this fish is storebought, research shows that low-income, people of color are more likely to be subsistence fishers and thus more susceptible to local pollution (National Environmental Justice Advisory Council 2002).



Smaller studies of populations with connections to the LDW correspond with these findings. Schmidt's study of low-income, food-insecure populations in the Rainier Valley and South Park found a 98% fish consumption rate, and almost half (40%) ate fish caught by themselves or family (Schmidt 2011).

Recognizing that tribes often have much higher rates of fish consumption, the EPA uses a special tribal fish consumption estimate. However, an article in the Seattle P.I. reveals that the current tribal fish consumption figures being used in EPA's review of the Duwamish are not based on either the Muckleshoot or the Suquamish, but rather the Tulalip tribe, which has lower rates of fish consumption and is not a regular consumer of fish from the LDW. "The agency (EPA) isn't using the consumption rate of a tribe that does fish in the Duwamish, and opting instead for a lower consumption rate by a tribe that doesn't fish there (Brown 2007). Using these artificially low rates of consumption may allow for an acceptance of higher levels of toxics in the fish because it masks the potential exposure in certain high fish consuming populations.

Tribal traditions of fishing in river

Currently, the Muckleshoot and the Suquamish have fishing rights at the Duwamish River. The Duwamish Tribe, who do not have tribal rights to the river because they are not federally recognized as a tribe, still fish in the area. The Muckleshoot, who have a large commercial fishing operation, which includes a contract with Safeway (Brown 2007), harvest from the Upper Duwamish Waterway (UDW). The Duwamish fish in the LDW but prefer more "traditional" methods of fishing and do not have commercial tribal fishing rights because they are not a federally recognized tribe (ATSDR, 2001).

Despite present day legal regulations, the LDW is an area that has been a historical fishing ground for many tribal groups prior to industrialization. The current fishing restrictions and limitations are ones that have been imposed upon tribal groups due to industrial contamination. Currently, the projected models state that contamination levels in the river will not be low enough to make resident fish safe for human consumption. For many tribal groups there is not an acceptable substitute for fish that come from the Duwamish which may hold historical, cultural, and spiritual significance.



A South Park mural portrays the human connection to the LDW salmon population. [Kate Cole]

The Washington Department of Fish and Wildlife (WDFW) and tribal fisheries are engaged in a "Co-Management" of fisheries resources, with tribes regulating the fishing of their members and WDFW regulating non-tribal fishing (Washington Department of Fish and Wildlife). The 1968 federal court case U.S. v. Oregon ruled that the state does not have the authority to regulate tribal fishing except in the case of conservation. Tribes with fishing rights in the LDW are autonomous decision makers in the management of their fisheries and should continue to evaluate risks and benefits to human health to make informed policy and management decisions on behalf of their members.

In order to make informed health decisions with respect to the LDW, tribal groups must have access to relevant and transparent environmental monitoring data throughout the cleanup and post clean up periods. Tribal groups and other key stakeholders should have access to environmental monitoring data and technical assistance in its interpretation. Some populations are subject to higher environmental health risks and burdens than the general population and the risks associated with these "unique exposure pathways" should be taken into consideration in the monitoring and assessment of exposure via seafood consumption (Burger and Gochfeld, 2011). For example, the Muckleshoot expressed concern about occupational exposure to contaminants for their members that engage in commercial fishing (ATSDR, 2001).

Efficacy of institutional controls (ICs)

In addition to informing those with connections to the LDW about its safety, it is also important to protect the general public from consuming fish from the LDW. Institutional controls are legal and administrative controls such, as policies, which help regulate and/or protect people and natural resources. The EPA defines them in regards to a Superfund site as, "non-engineered instruments, such as administrative and legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy" (EPA). The current ICs for the two communities are only those set by the Washington Department of Fish & Wildlife (WDFW) only pertain to when and how an individual can fish. The Muckleshoot and Suguamish Tribes work with each other and the WDFW on commercial fishing regulations (Personal correspondence). Currently there are no ICs, aside from small warning signs (see photo), to prevent people from consuming polluted fish from the LDW.



A sign posted at a South Park beach warning people not to consume fish from the LDW. [Kate Cole]



The EPA states that, "ICs should be used at all sites where contamination is left in place as part of a final remedy that does not allow for unrestricted use and unlimited exposure" (EPA, 2012). Based on the recommendation by the EPA it is clear the LDW will need ICs due to the fact that there will still be contaminants left over. There are four types of ICs: Government controls, Proprietary controls, Enforcement tools and Informational Devices (EPA, 2012). Government control examples include zoning, laws regarding well drilling or water usage, and legal authorities involving licensing or permitting processes. Proprietary controls are legal instruments placed in the chain of title for the subject real property that convey a property interest from the owner to a second party, for the purpose of imposing restrictions on land and/or water use (EPA, 2012). Enforcement tools include the Federal, State, or Local Governments and can direct a property owner to refrain from using a property in specific ways. Informational Devices notify the public of land use restrictions. (See figure 5.1 to see how ICs are evaluated and chosen.)

ICs are most effective when they engage and are guided by the community. One example comes from another Superfund river cleanup. In Augusta-Richmond County, GA, a study was done on ICs to help inform the dangers of consuming fish near a Superfund cleanup site. Many low-income community members engaged in subsistence fishing from the river (Derrick, et al.). Rather than simply institute strict laws, a community advisory board, consisting of residents and experts, developed a risk communication intervention tailored to the area residents. The end result was that participants showed improved knowledge and behavior change related to trimming fish, consumption by pregnant women and children, and consumption of large fish (Derrick, et al.). The IC in this example was a risk communication intervention that involved the local community to help better inform the residents of the health risks of consuming contaminated fish, as well risk reduction techniques for cooking and eating contaminated fish in safer ways.



A sign posted at a South Park beach warning people not to consume fish from the LDW. [Kate Cole]



Figure 5.1

EPA diagram for evaluating institutional controls. [U.S. EPA, 2012]

Notes:

Design Phase – Involves evaluating the need for and appropriateness of an institutional control, determining the type of control needed, and identifying the third parties necessary to successfully implement IC.

<u>Construction Phase</u> – Involves negotiating, drafting, and recording legal documents to transfer property interest from property owner to third party (i.e., creating industrial use only easement held by the state environmental agency).

<u>O & M Phase</u> – Involves implementing visibility measures to ensure that the community is informed about the IC (i.e., recording with Dig Safe, adding to state web page, etc.) and inspecting and enforcing IC.

Like engineering controls, ICs can work well, work somewhat, or not work.

Food Security and Nutrition

The neighborhoods surrounding the LDW, the tribes who traditionally fished from it, and immigrant communities who currently practice fishing to supplement their diets are all affected by "food insecurity." Food insecurity exists when people lack the physical and economic access to "sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life" (FAO, 1996). Nutritionists and public health experts are increasingly recognizing that poor nutrition is not simply a byproduct of poor choices, but rather that the environment plays a major role in a community's food security and thus diet (Walker et al 2010). When healthy food is hard to get, people are less likely to eat it. One measure of a neighborhood's food environment is whether it is a "food desert," defined by the US Department of Agriculture (USDA) as a low-income area with little access to a full-service grocery store. The communities surrounding the LDW are classified by the USDA as food deserts (USDA food desert locator).



South Park lacks a full-service grocery store. Instead, the neighborhood relies on a corner store. The produce section sells only lemons and limes. [Kate Cole]

Food insecurity is correlated with a host of negative health outcomes. Food insecure communities have increased incidence of nutrition-related chronic diseases, such as diabetes and heart disease (Seligman et al, 2010). Specifically, American Indians have much higher rates of obesity, diabetes, and heart disease than the general population, which researchers link in part to the loss of their traditional diet and increased poverty (Goetz 2012). The negative health consequences go beyond poor nutrition; children from food insecure households are twice as likely to have general health categorized as "fair" or "poor" compared to food secure-children (Cook et al, 2004). The health effects of food insecurity are compounded by the stress the insecurity produces. Mothers and their children living in food insecure situations have higher rates of anxiety, mental illness, and behavior problems (Whitaker, 2006).

Seafood is not just a traditionally important food for many populations, but also an important source of nutrition. Fish is high in polyunsaturated fatty acid (PUFA) required for brain development, normal growth, cell development, and inflammatory disease prevention (Simopolous 1991). Fish consumption is recommended for the prevention of vitamin A, zinc and iron deficiencies (Roos et al. 2007). Because fish is a primary source of protein for American Indian populations, some researchers have cautioned that advising against fish consumption to protect people from toxic exposures may have nutritional and social harms that counter some of the risks of toxic exposures (Wheatley and Wheatley 2000).

A safer LDW poses an opportunity for a renewed source of inexpensive, high-nutrition food for food-insecure populations living near the LDW, as well as for tribes that have traditionally eaten from the river. However, this health benefit will only be accomplished by cleaning the area to a level that makes it safe to eat from, which is not proposed under the current cleanup plan.

FISH CONSUMPTION

Findings

During and following the cleanup of the Duwamish Superfund site, there are three potential effects on fishing and fish consumption that could lead to health effects. First, more effective institutional controls and increased barriers to fishing could lead to a decrease in consumption of fish from the LDW. With a decrease in consumption of contaminated fish and shellfish, human exposure to arsenic, dioxins, PCBs, and PAHs would also decrease, leading to a lower risk of diseases and cancers. Lower fish consumption could potentially also lead to an increase in food insecurity for the communities already eating from the LDW. This has the potential to increase stress about where to access low-cost food, and could lead affected individuals to choose inexpensive, unhealthy food alternatives that contribute to obesity and nutritional deficiencies. Inhibited fishing could also mean decreased participation in cultural traditions and a loss of identity for tribal communities.

If ICs and other barriers are not effective at decreasing fishing during the cleanup, fish consumption rates could remain at the current level. Following the cleanup, people may perceive the fish to be safe for consumption, and consumption levels could even increase as more urban fishers move to the Duwamish River to fish. While this continuing or increased consumption of fish would be associated with intake of healthy fatty acids and nutrients and the ability of tribal communities to continue traditional cultural practices, it would also lead to continued or higher exposure to contaminants with deleterious health effects.

Lastly, if the EPA amended its cleanup plan to bring the LDW to a level where resident fish are safe for human consumption, there would be a host of positive health benefits. Under the current plan, the risk of cancer due to PCBs fish tissues among people who consume Duwamish River fish will be between 1 and 10,000 and 1 in 100,000, still outside the standards of the Model Toxics Control Act (Lower Duwamish Waterway Group

2010). Those already consuming fish from the LDW would have a decreased exposure to toxics and thus a decreased risk of cancer and disease. Communities living near the LDW, tribes who traditionally fished in the LDW, and subsistence fishers, would all see a potential increase in food security. This could lead to a decrease in nutritionrelated chronic disease as well as a decrease in the chronic stress associated with food insecurity. This increased fishing could also have economic and political implications for tribes that have fishing rights to the LDW. The potential negative health effects from this can be mitigated through negotiation and regulation, and we do not believe they outweigh the health benefits of a river that is safe to eat from.



1. Update EPA fish consumption rate estimate used for risk assessments:

Certain populations - subsistence fishers, tribal groups, and immigrant populations - eat fish at a much higher rate than the current EPA and Ecology estimates of fish consumption used for setting water quality standards and safety guidelines. By considering these high-fish-consuming populations, the EPA will be able to make more accurate estimates of human health risks resulting from the fish tissue contamination levels they set.

2. Provide environmental monitoring data as it becomes available that represents the exposure of key populations to allow for autonomous, informed decision making.

The EPA should conduct continuous monitoring of the safety of fish in the LDW as well as who is fishing from the river and make these data available to the public in an accessible and culturally appropriate manner. The monitoring of seafood should focus on contaminants that have been identified as posing the greatest risks to human health, PAHs, PCBs, arsenic and dioxins. This monitoring should be extended beyond the Duwamish itself to include areas downstream of the river including Elliott Bay as the cleanup process may affect the safety of those who consume seafood harvested downstream from the Duwamish.

3. Conduct ongoing research and exploration of demographics and fishing beliefs and behaviors of the population of Duwamish Waterway fishers:

Little data currently exists about the behaviors and health status of the populations who fish and consume fish in the Duwamish Waterway. These groups are likely to have very different cultures, fishing behaviors, and health profiles, and more information is needed to develop appropriate risk assessments and effective risk messaging.

4. Put in place improved institutional controls and safer fishing alternatives:

The EPA should institute better institutional controls to counteract the potential impression that the LDW is safer to eat from after the cleanup. The EPA should work with the communities who have traditionally fished from the LDW to design institutional controls and communication plans that are culturally appropriate and have community buy-in. Methods and procedures may include community meetings, educational interventions, more effective and culturally-relevant messaging (not just posted advisories), social media outreach, harm reduction education, and alternative sources of safe, clean fish.

5. Include tribal groups as key stakeholders and decision-makers in the cleanup process:

Tribes with traditional connections to the river should be brought to the table as key stakeholders and decision-makers throughout the cleanup and recovery process. This is important not only for informed decision-making, but also to help these tribes feel buy-in and increased trust in the process.

6. Clean up the river to levels that make it safe to eat from:

The current EPA plan will not bring the river to a level that makes it safe for fish consumption. Since it is unlikely that consumption of Duwamish Waterway fish will stop, we recommend that the EPA raise their standards of cleanup to Puget Sound background levels to make it is safe for humans to consume fish from the river. We also recommend that the river be cleaned to a level such that non-resident fish are safe to eat at current levels, such as is the case in other waterways in the Puget Sound. Since none of the EPA's proposed alternatives presented in the Feasibility Study would reach background levels of these contaminants, it is impossible at this time to assess the cost and feasibility of this recommendation. Ultimately, these actions have the greatest ability to increase health benefits and decrease risks. However, we recognize that the EPA has stated that realization of the preliminary remediation goals for PCB and dioxin exposure from human seafood consumption is "not technically feasible."



References

Agency for Toxic Substances & Disease Registry. 2010. "ATSDR-PHA-HC-Lower Duwamish Waterway-p1" Last modified May 6, 2010. http://www.atsdr.cdc.gov/hac/ pha/pha.asp?docid=1312&pg=1.

Brown, Paul J. 2007. "Will it be safe to eat fish from the Duwamish?" Seattle P.I., November 26. Available at: http:// www.seattlepi.com/news/article/Will-it-be-safe-to-eat-fishfrom-the-Duwamish-1256893.php

Burger, J., & Gochfeld, M. 2011. Conceptual environmental justice model for evaluating chemical pathways of exposure in low-income, minority, native American, and other unique exposure populations. Am J Public Health, 101 Suppl 1: S64-73.

Cook, J.T., et al. 2004. Food insecurity is associated with adverse health outcomes for infants and toddlers. Journal of Nutrition. 134(6):1432-1438.

Derrick, Corliss G., et al. 2008. A Fish Consumption Study of Anglers in an At-Risk Community: A Community- Based Participatory Approach to Risk Reduction. Public Health Nursing 25: 312-318.

Duwamish Alive. 2011. "History." Accessed May 21, 2012. http://www.duwamishalive.org/history/.

FAO. 1996. Declaration on world food security. Rome: World Food Summit, FAO.

Suquamish Tribe. 2012. "Nutrition a pressing concern for Native Americans." Last modified 2012. http://www. suquamish.org/HealthyLiving.aspx.

Human Health Focus Group. 2008. Oregon fish and shellfish consumption rate project. Oregon Department of Environmental Quality.

Just Health Action, Duwamish River Cleanup Coalition. 2012. Duwamish River Superfund Cleanup Health Impact Assessment: Screening Summary. Seattle: University of Washington School of Public Health.

Lower Duwamish Waterway Group. 2010. Draft Final Feasibility Study: Executive Summary. Seattle.

Mayfield, D.B., Robinson, S., & Simmonds, J. 2007. Survey of fish consumption patterns of King County (Washington) recreational anglers. J. of Exposure Analysis and Env Epi. 17:604-612.

National Environmental Justice Advisory Council. 2002. Fish Consumption and Environmental Justice. Washington, DC: Environmental Protection Agency.

Roos N, Wahab MA, Chamnan C, Thilsted SH. 2007. The role of fish in food-based strategies to combat vitamin A and mineral deficiencies in developing countries. J Nutr. 137(4):1106–1109.

Seligman H.K., Laraia B.A., and Kushel M.B. 2010. Food insecurity is associated with chronic disease among low-income NHANES respondents. Journal of Nutrition. 140(2): 304-310.

Schmidt, Anna. 2011. An evaluation of fish consumption and environmental concern in low income and food insecure populations in Seattle. University of Washington student thesis.

Suquamish Tribe. 2000. "Fish consumption survey of the SuquamishIndianTribeofthePortMadisonIndianReservation of the Puget Sound Region." http://www.deq.state.or.us/ wq/standards/docs/toxics/suquamish2000report.pdf

U.S. Department of Agriculture. "Food Desert Locator." Cited May 16, 2012. http://www.ers.usda.gov/data/ fooddesert/fooddesert.html.

U.S. Environmental Protection Agency. 2002. Estimated per capita fish consumption in the United States. Washington DC: US Environmental Protection Agency.

U.S. Environmental Protection Agency. 2007. "Lower Duwamish Waterway Superfund Site Community Resources." Region 10: The Pacific Northwest. Last updated November, 2007. http://www.epa.gov/region10/pdf/sites/ Idw/factsheet_hhra_era_summary_nov2007.pdf.

U.S. Environmental Protection Agency. 2011. "Institutional Controls." Last updated December 12. http://www.epa. gov/superfund/policy/ic/

U.S. Environmental Protection Agency. 2012 "Institutional Controls For Final Remedies." Last updated April 11. http://www.epa.gov/osw/hazard/correctiveaction/pdfs/ workshop/ic_slides.pdf

Walker, R.E., Keane, C.R., & Burke, J.G. 2010. Disparities and access to healthy food in the United States: A review of food deserts literature. Health and Place. 16(5):876-884.

Washington Department of Ecology. 2012. "Reducing toxics in fish, sediments, and water." Cited on May 16, 2012. http://www.ecy.wa.gov/toxics/fish.html

Washington Department of Fish and Wildlife. 2012. "Constraints to Recreational Salmon Fishing." Cited on May 16, 2012. http://wdfw.wa.gov/fishing/salmon/constraints. html

Wheatley, B., Wheatley, M.A. 2000. Methylmercury and the health of indigenous peoples: A risk management challenge for physical and social sciences and for public health policy. Sci Total Environ. 259(1–3):23–29.

Whitaker, R.C., Phillips, S.M., Orzol, S.M. 2006. Food insecurity and the risks of depression and anxiety in mothers and behavior problems in their pre-school aged children. Pediatrics. 18(3).



Conclusions



Conclusion

Key Findings

This Health Impact Assessment revealed many health consequences, both positive and negative, of the Lower Duwamish Cleanup operation. Of the total body of recommendations made by this report, five key health-supporting themes stood out:

1. Consider the unique local conditions and populations of the Duwamish.

The Lower Duwamish Superfund Cleanup is not the first contaminated sediment cleanup operation undertaken by the US EPA. However, no two project sites are identical. In light of this, we recommend that all parties involved in the cleanup make the efforts necessary to respect, acknowledge, and protect the unique histories and cultures of the Duwamish and its people.

2. Establish avenues for direct community communication.

Open channels of communication are essential during public works projects to account for local voices, which may have gone unheard during the earlier planning stages. To this end, we recommend a direct and open avenue for residents to voice their concerns or support and to receive timely information. These channels could take many forms, such as a website, bulletin board, or hotline.

3. Involve local residents and businesses as cleanup workers and partners.

Beyond listening to local concerns over the project, it is strongly encouraged to involve local residents and business as workers, contractors, and partners in the cleanup operations. In addition to serving the economic determinants of health, this action can reinforce the legitimacy of the agencies involved, extending the perceived citizen engagement past tokenism.

4. Adhere to established Best Management Practices.

The EPA and other agencies involved in this cleanup operation are experienced in environmental remediation projects. As experts, their operating procedures are expected to fully adhere to or exceed established best management practices and guidelines.

5. Establish alternative water access sites where disruptions or closures occur.

In the long term, cleaning up the Lower Duwamish will provide benefits to those who come into contact with the river regularly. However, the cleanup is projected to last the better part of a decade. In order to preserve contact with the river among the communities along its banks, it is encouraged to provide alternative areas of access in the event that construction operations force beach closures or limit public access.

Limitations

Although successful in identifying and recommending many important health considerations, this HIA was also limited in its efforts by a number of factors. The primary obstacle faced by this graduate student research team was a short project timeline. As the University of Washington operates on a 10-week quarter system, this report reflects about two months of work from start to finish. Under this tight deadline, opportunities for public engagement, data collection, quantitative analysis, and monitoring were unfeasible.

In addition to time restraints, there were difficulties related to the overall cleanup planning timeline. At the time of this report, the EPA had not published the full details of its proposed cleanup operation. As a result, many of the particulars related to the construction phase could not be considered in specific recommendations. Instead, a number of industry documents and early-action cleanup procedures were consulted to estimate the potential impacts. Although not quantified, the qualitative recommendations made in this fashion still positively support human health.

Next Steps

The last phases of the HIA process involve evaluation and monitoring. The objective of monitoring is to track the impacts of the HIA on the decision making process and the actions taken by decision makers. The implementation of the decisions and their ultimate impact on human health are also verified. The following questions reflect the nature of monitoring:

- To what extent did this HIA raise health awareness among decision makers, media and the community?
- Were recommendations adopted, considered, or ignored?
- Did this HIA have an effect on the determinants of human health?
- Were the established goals met?

Where monitoring aims to assess the impact of the HIA itself, the evaluation phase considers the process of conducting the HIA itself. The following key questions serve as examples:

- Who was involved in the screening and scoping phases of the HIA?
- Which health issues were addressed? Which were left out?
- Did the HIA make both positive and negative judgments of health impact?
- Did the evidence collected support the recommendations?
- What did the involved stakeholders think about the HIA process used?

Unfortunately, short timescale of this HIA does not allow for this step to be included by the graduate student research team. Therefore, it is essential that the EPA, DRCC and the Lower Duwamish Waterway Group continue to assess the impact of the recommendations made within this report during the ongoing planning process, throughout the cleanup implementation, and after the project has been completed.

Acknowledgements



Acknowledgements

The University of Washington Health Impact Assessment Class:

Leann Andrews, Scott Beckstrom, Carlos Camara, Sara Colling, Jonathan Childers, Kate Cole, Andrea Gousen, Jesse Gritton, Gita Krishnaswamy, Amanda Kimura, Timothy Lehman, Amber Lenhart, Derek Low, Tolu Okitika, Richelle Perez, Yoli Grandjean, Lisa Sturdivant, Mariko Toyoji, & Lisa Vu.

We would also like to thank the following people and organizations for their encouragement, advice, leadership, and generosity over the past ten weeks:

Andrew L. Dannenberg, MD, MPH

Affiliate Professor, Dept. of Environmental and Occupational Health Sciences, School of Public Health, and Dept. of Urban Design and Planning, College of the Built Environments, University of Washington

Consultant and former Team Lead, Healthy Community Design Initiative, National Center for Environmental Health, Centers for Disease Control and Prevention

Fritz Wagner, PhD

Dean Emeritus, University of New Orleans College of Urban and Public Affairs

Research Professor, Dept. of Urban Design and Planning, UW College of the Built Environments

Managing Director, Northwest Center for Livable Communities

Barbara Wright

Formerly with Seattle-King County Public Health Department

Bill Daniell, MD, MPH

Associate Professor, Dept. of Environmental and Occupational Health Sciences, UW School of Public Health

BJ Cummings and James Rasmussen

Duwamish River Cleanup Coalition/Technical Advisory Group

Linn Gould, MS, MPH

Just Health Action

ACKNOWLEDGEMENTS