



Our Future Duwamish

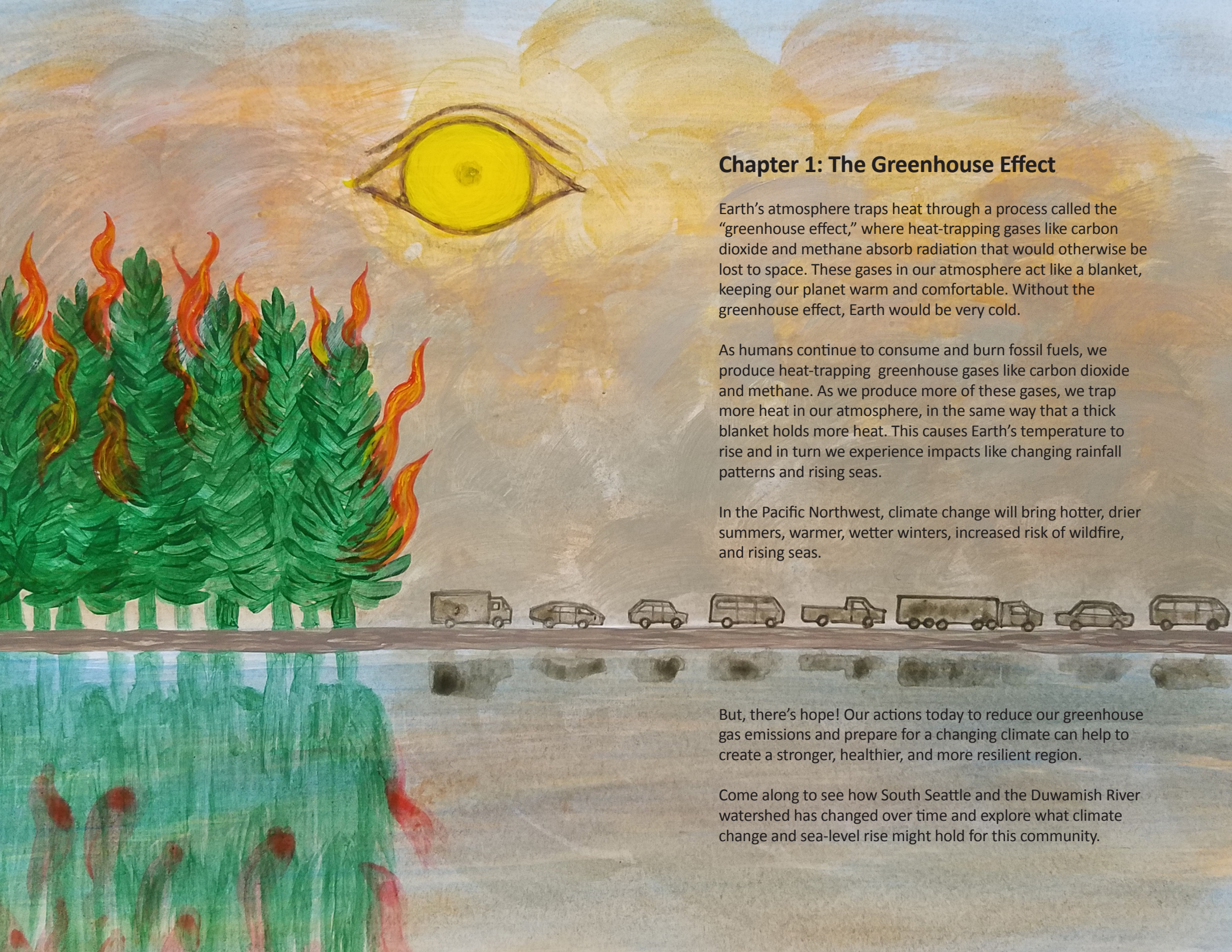
Welcome! During this experience, you will be transported back in time and catapulted into the future to explore how our actions today will shape the future of our community, city, and region.



We have created this booklet as part of the Future Duwamish VR Experience at The Seattle Public Library, with Seattle Public Utilities, the University of Washington and the University of Minnesota.

For more information on how to access the VR experience, please visit: spl.org/vr or scan the QR code at left.

VR project funding provided by Seattle Public Utilities, UW EarthLab, and the Seattle Public Library Foundation.



Chapter 1: The Greenhouse Effect

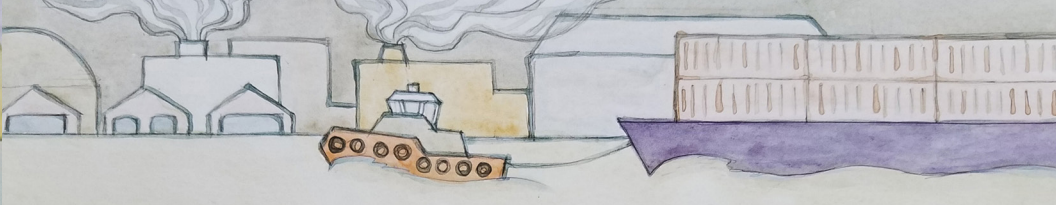
Earth's atmosphere traps heat through a process called the "greenhouse effect," where heat-trapping gases like carbon dioxide and methane absorb radiation that would otherwise be lost to space. These gases in our atmosphere act like a blanket, keeping our planet warm and comfortable. Without the greenhouse effect, Earth would be very cold.

As humans continue to consume and burn fossil fuels, we produce heat-trapping greenhouse gases like carbon dioxide and methane. As we produce more of these gases, we trap more heat in our atmosphere, in the same way that a thick blanket holds more heat. This causes Earth's temperature to rise and in turn we experience impacts like changing rainfall patterns and rising seas.

In the Pacific Northwest, climate change will bring hotter, drier summers, warmer, wetter winters, increased risk of wildfire, and rising seas.

But, there's hope! Our actions today to reduce our greenhouse gas emissions and prepare for a changing climate can help to create a stronger, healthier, and more resilient region.

Come along to see how South Seattle and the Duwamish River watershed has changed over time and explore what climate change and sea-level rise might hold for this community.



Chapter 2: Past Duwamish River

Before the Industrial Revolution began in the mid-to late- 1700's, the Duwamish River Valley, like much of the Pacific Northwest, was lush and teeming with wildlife. The climate of the region was almost 2°F cooler than today² and the concentration of heat-trapping gas like carbon dioxide was around 280 parts per million. That is around 67% less than the current concentration of carbon dioxide in our atmosphere!³

Back then, the landscape was covered by dense evergreen forests, rich floodplain marshes, and teeming tide flats--all of which provided shelter and food to humans and wildlife. The Duwamish people have lived in the Duwamish Valley since time immemorial. Artifacts found along the Duwamish River have been dated to at least the 6th century A.D.⁴ The landscape during this time was so lush and vegetated that it was difficult to navigate on foot so people often traveled by canoe. As they traveled downriver towards the ocean they could fish, hunt, and gather food.

²OWSC, 2020; (<https://climate.washington.edu/climate-data/trendanalysisapp/>)

³NOAA, 2021; (<https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>)

⁴DuwamishTribe.org



Chapter 3: The Duwamish River Today

Today, the Duwamish River and surrounding area feel like a completely different place. The river has been straightened, deepened, and shortened to accommodate industry and transportation. The meandering nine-mile long river is now a five-mile long engineered waterway, and much of the vegetation and natural environment is gone. The former mudflats and tide plains are mostly industrial lands. The riverfront neighborhoods along the river, South Park and Georgetown, have changed as well: They have been disproportionately burdened by industrial pollution, but still stand out for their vibrancy and dedication to place and culture.

Due to industrial contamination, the lower five miles of the Duwamish River was declared a Superfund site by the US Environmental Protection Agency. Together with industry, the Washington State Department of Ecology, community-based groups like the Duwamish River Cleanup Coalition, the Duwamish, Muckleshoot, and Suquamish Tribes, Yakama Nation, and other stakeholders, have developed an outline for cleanup of the waterway and upland areas. Early action cleanups have happened in some of the most contaminated areas, and the overall river cleanup will begin in 2023-2025.

Despite the industrialization of the river, it still provides critical spawning habitat for thousands of salmon and trout. Four Native American tribes use the river for fishing and ceremonies, and low-income, immigrant, refugee, and unsheltered families harvest seafood from the river for sustenance and to maintain cultural and community traditions.

What does the future hold for this river and this land?



Chapter 4: The Future Duwamish River - Our Rising Seas

To better understand the future of this coastal land, we can look to Earth's long history. In Antarctica, snowflakes that fell in the past trapped small pockets of air. By drilling ice cores and measuring the trapped gases, climate scientists have built an accurate record of the composition of greenhouse gases in the Earth's atmosphere from 800,000 years ago through to today and gained a strong understanding of how greenhouse gases affect global temperatures.

As the concentration of greenhouse gases in the atmosphere increases, more solar radiation is trapped. This warms the Earth, causing a range of impacts. One impact is the melting of mountain glaciers and the polar ice sheets in Antarctica and Greenland. As this ice melts, it will raise sea levels around the world.

Based on the current rate of human-produced greenhouse gas emissions, it is estimated that in just 500 years, increasing global temperatures could melt enough ice from Antarctica alone to raise sea level by 13.6 meters across the entire planet, or nearly 45 feet higher than today⁵. That's like eight average adults standing on each other's shoulders.

⁵ Deconto and Pollard, 2016; (<https://www.nature.com/articles/nature17145>)



Chapter 5: The Future Duwamish River Valley - How much water will there be?

Around the world, coastal communities are already experiencing the impacts of changing sea levels. In fact, where you are “standing” there has already been 9 inches of sea-level rise since 1900⁶. As sea level continues to rise, King Tides and storm events will make coastal flooding worse with water reaching further inland.



Chapter 6: Projections of Sea Level Rise

In South Park, many homes and businesses sit at low elevations. It is estimated that today's extreme high tide will become the monthly high tide by the 2050^{7,8}. Within one hundred years, in an extreme ice-melt scenario, if you were standing at the water's highest point today, during the annual extreme high tide, you would be underwater⁷.

⁶ Mauger et al., 2015 via; NOAA; (<https://cig.uw.edu/resources/special-reports/ps-sok/>)

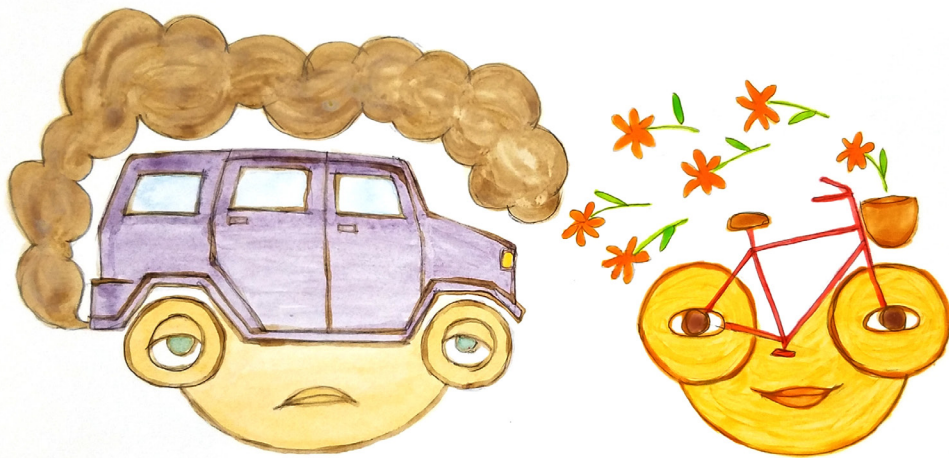
⁷ Miller et al., 2018; (https://cig.uw.edu/wp-content/uploads/sites/2/2019/07/SLR-Report-Miller-et-al-2018-updated-07_2019.pdf)

⁸ Lavin et al., 2019; (<https://cig.uw.edu/our-work/applied-research/wcrp/sea-level-rise-data-visualization/>)

Chapter 7: Local Sources of Emissions

As we look around, we can see that not only is the waterway polluted but so is the air we breathe. Greenhouse gases like carbon dioxide and methane are now more concentrated than any time going back hundreds of thousands of years. Greenhouse gases trap heat, warming the planet. Today, our industries, economy and daily life are heavily reliant on fossil fuels like gasoline and diesel. When we burn these fuels, they produce heat-trapping greenhouse gases. In Washington state, vehicle emissions are the largest source of carbon emissions, followed by residential, commercial, and industrial heating.

Greenhouse gas emissions and other human activities since the Industrial Revolution have led to the observed global warming through the 20th century to today, and this warming is projected to continue unless we reduce emissions of greenhouse gases. Icy reservoirs of frozen water, Greenland, Antarctica, and mountain glaciers, are already changing in response to warmer temperatures, so our actions today to prevent further warming will control how much ice melts and sea levels rises in the future.

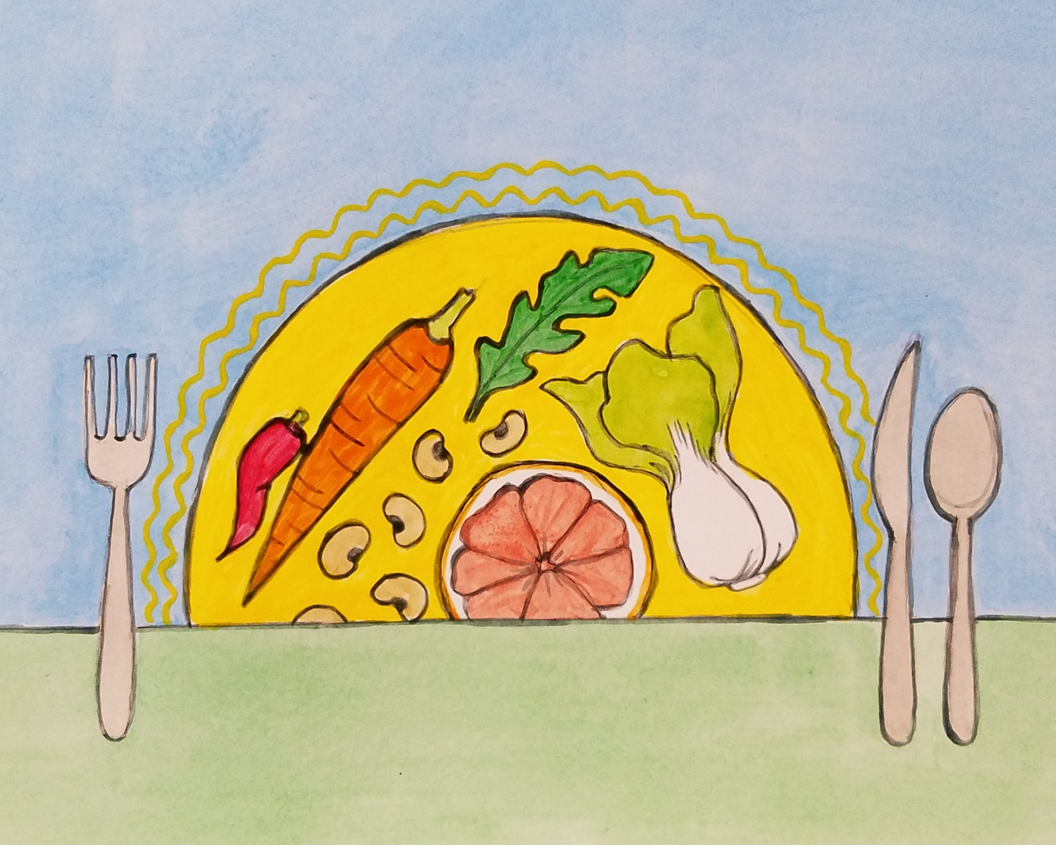


Chapter 8: Car vs. Bike

Systems changes and individual choices can influence emissions and therefore future warming. The choices we make—whether to drive a car, take public transportation, or ride a bike when possible, for example—can help reduce greenhouse gas emissions. Today, most vehicles run on fossil fuel (gasoline and diesel), whenever one is in use, it will emit greenhouse gases. By contrast, it has been estimated that, although manufacturing a bicycle initially results in the emission of 530 pounds of carbon dioxide⁹, the bicycle's lifetime transportation use will result in no additional carbon dioxide production. For comparison, the average car emits 10,100 pounds of carbon dioxide per year¹⁰.

⁹Dave, S. (2010). Life cycle assessment of transportation options for commuters. PhD thesis, Master thesis. Massachusetts Institute of Technology (MIT), United States.

¹⁰EPA, 2018; (<https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>)



Chapter 9: Food Selection

Similarly, the food and material goods we consume contribute to greenhouse gas emissions.

For example, small dietary changes can have a big impact. If all people adopted a diet limited in dairy and meat, the resulting greenhouse gas emissions reductions would be equal to the elimination of 1,165 coal-fired power plants^{11,12}. To achieve these reductions, you don't have to forfeit all meat and animal products but start by reducing one meal a week or cutting back meat consumption by about 25%.

¹¹IPCC, 2018; (<https://www.ipcc.ch/srccl/>)

¹²EPA, 2021a; (<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>)

Chapter 10: Limiting Consumption & Waste

The creation of new products from raw materials often results in greenhouse gas emissions through the processes of extracting, transporting, and refining those materials into goods and products we use. The EPA estimates about 42% of U.S. greenhouse gas emissions are caused by making, transporting, and disposing of materials¹³. Limiting our consumption, buying used goods, and recycling are all ways to help reduce emissions from consumer goods and reduce the generation of waste.

Composting food and other organic waste is another way we can reduce emissions. When organic matter decays with little or no oxygen, such as when buried in a landfill, methane forms. Methane is a greenhouse gas 25-36 times more potent at trapping heat than carbon dioxide over 100 years¹⁴. Reducing waste and composting organic materials rather than burying them in landfills offers a meaningful way to reduce the production of this potent greenhouse gas.

¹³EPA, 2009 "Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices, 2009"

¹⁴EPA, 2021b





Chapter 11: Community Climate Action - Prepare for Climate Change

To prepare for climate impacts, we need collective action and climate-smart investments in systems we rely on every day like transportation, energy production and water resources. Beyond infrastructure, community resilience is also about strengthening our communities. This means addressing systemic vulnerabilities and inequities. The COVID-19 pandemic, and the resulting economic crisis, underscored the need to develop more equitably to better position communities like South Park and Georgetown for future economic, health, and climate stressors.

In our region, the City of Seattle, and King County are taking climate change seriously. They are planning long-term investments so that they can continue to deliver water and power, prevent flooding, keep neighborhoods cool during hotter summers, and adapt to rising seas. They are also partnering with community-based organizations, schools, job training centers and colleges to build community power and help current community members to thrive.

Additional Information

Did you know? The University of Washington is home to the Climate Impacts Group, which leads pioneering scientific research and convenes regional conversations and partnerships to prepare for climate impacts.

Did you know? Seattle Public Utilities is constructing two drainage projects in South Park in 2021. The utility is working with the Seattle Department of Transportation to improve roads and drainage in the industrial area and building a pump station on 7th Ave S and S Riverside Dr. Both will move stormwater out of the roads, to the Duwamish River. SPU is also planning a water quality

facility for the area, which will clean stormwater before it is pumped into the Duwamish River. While these projects are focused on flooding from rain and not from sea level rise, the improved drainage in the area will be important as the area adapts to rising sea levels.

Did you know? The Duwamish River Cleanup Coalition (DRCC) launched the Climate Justice Platform inspired by a combination of community health listening sessions, community capacity group conversations, youth intern policy workshops, past and present environmental justice work. Within the platform are a set of principles that describe strategies that protect community and environment focusing on place keeping, elevating community decision making and advocating to end drivers of climate change to eliminate community susceptibility and disproportionate exposure to environmental hazards. Additionally, in response to requests by the community, DRCC developed the Duwamish Valley Youth Corps as a youth engagement program focusing on environmental justice and job skills.

Continued on next page



Additional Information

Continued from previous page

Did you know? The City of Seattle's Duwamish Valley Action Plan called for a sea level rise adaptation strategy for the Duwamish Valley by 2023. In line with this goal, Seattle Public Utilities and the City of Seattle's Duwamish Valley Program are working with community-based organizations to develop plans for preparing the Duwamish Valley for a changing climate, taking actions that reduce risks and underlying community stresses. They're in the early phases of adaptation scenarios, but the goal is a holistic approach to sea level rise adaptation - access to living wage jobs and healthy, affordable housing today are as critical as bricks and mortar infrastructure in fostering climate resiliency tomorrow.

Did you know? King County's 2020 Strategic Climate Action Plan includes a commitment to increase coordination around planning for sea level rise in the Duwamish Valley among the City of Seattle, the Port of Seattle, and King County.

Did you know? Seattle Public Utilities' 50-year Drainage and Wastewater Plan, called Shape Our Water, will shape the utility's capital investments in the coming decades. It is drawing on sea level rise, as well as other climate impacts, as major drivers for the utility's work in the future

Resources

Explore a few community organizations and entities that have worked to support climate resilience in King County, and beyond. Get involved today!

University of Washington EarthLab: <https://earthlab.uw.edu/>

University of Washington Climate Impacts Group: <https://cig.uw.edu/>

King County Strategic Climate Action Plan:

<https://www.kingcounty.gov/services/environment/climate/actions-strategies/strategic-climate-action-plan/2020-SCAP-update.aspx>

Seattle Public Utilities: <https://www.seattle.gov/utilities>

City of Seattle - Office of Sustainability and Environment:

<https://www.seattle.gov/environment/climate-change/transportation-electrification>

City of Seattle Climate Preparedness Strategy: <https://www.seattle.gov/environment/climate-change/climate-planning/adaptation>

City of Seattle Duwamish Valley Program: <https://www.seattle.gov/environment/equity-and-environment/duwamish-valley-program>

Duwamish River Cleanup Coalition: <https://www.duwamishcleanup.org/>

Duwamish Infrastructure Restoration Training Corps:

<https://www.thedirtcorps.com/>

Duwamish Valley Youth Corps:

<https://www.duwamishcleanup.org/duwamish-valley-youth-corp-link>

Puget Soundkeeper Alliance: <https://pugetsoundkeeper.org/>

Juntos, Si Podemos Cuidar Nuestro Río Duwamish:

<https://www.facebook.com/watch/?v=781239562364926>

Puget Sound Sage: <https://www.pugetsoundsage.org/>

Got Green: <https://gotgreenseattle.org/>

Lower Duwamish Waterway Cleanup Roundtable:

<https://www.duwamishwaterwayroundtable.org/>

Seattle Public Utilities Greenhouse Gas Emissions Information

Cutting Food Waste by 50%

Food is the single largest component found in Seattle's residential (29.5%) and commercial (24.5%) waste streams. In partnership with many other public and private entities, SPU has committed to cutting food waste by 50% by 2030 by preventing, rescuing and recovering (compost or anaerobically digest) wasted food.

Residential Food Waste Prevention

A large portion of wasted food happens in our own homes. We throw away leftovers or forget about food in the back of the fridge. That wasted food has big impacts on our environment, our community, and our wallets. SPU's Love Food, Stop Waste program helps Seattle residents make a difference by making small changes at home to reduce wasted food. Key strategies include meal planning, meal preparation, fresh and frozen food storage, understanding date labels, using up food before it goes bad, and sharing food with family and friends.

Waste-Free Communities Matching Grants

SPU's Waste-Free Communities Matching Grant funds waste prevention projects initiated and led by the community and businesses. When we prevent waste, we help the environment, protect public health, build community, and save money. Grant project focus areas include 1) Innovation—testing or expanding new waste prevention

Commercial Food Waste Prevention

SPU is leveraging West Coast regional partnerships (Pacific Coast Collaborative) to cut wasted food by 50% across food retailers, manufacturers, and their supply chains. So far, Albertsons Companies West Coast divisions (e.g. Albertsons, Safeway, Vons, and Pavilions); The Kroger Company (e.g. QFC and Fred Meyer); PCC Community Markets; New Seasons Market and Sprouts Farmers Markets have signed on.

Food Rescue

SPU is working across food donating business, hunger relief organizations and unlikely partners to foster food rescue efficiencies, reduce food and packaging waste and increase positive community outcomes.

Prior to COVID-19, Seattle-King County Public Health estimated that at least 13 percent of adults in Seattle experience food insecurity. It is likely that with the pandemic, this number has grown significantly. Nutritious rescued food helps fill a critical gap for Seattle's most vulnerable residents, in addition to preventing unnecessary food waste and reducing greenhouse gas emissions.

EnviroStars

There are 36 recognized EnviroStars businesses in the Duwamish Valley that have saved 790 gallons of hazardous waste, saved 334 gallons of fuel, and 11,039 lbs of greenhouse gas emissions. EnviroStars is a one-stop shop for Washington businesses to access environmental assistance and gain recognition for being green. Through the program, businesses can receive free technical assistance, connect with rebates and resources, and follow a clear path to sustainability. Recognized businesses are listed in our Green Business Directory, communicating their environmental commitment to customers, employees and the local community. What can you do? Support local EnviroStars businesses, encourage other businesses to join EnviroStars.

Climate Change In Our Everyday Lives

There are many climate impacts we will experience in the Puget Sound and across Washington State. In addition to rising sea levels, climate change will also bring a range of changes that will impact our health, our ecosystems, and the built environment. Organizations like the University of Washington Climate Impacts Group provide critical climate change information to organizations like Seattle Public Utilities and King County to help our region better understand the risks and impacts of climate change and ways in which we can all prepare.

More heavy rain & river flooding

Hotter & drier summers

Less snowpack & melting glaciers

Less snowpack can reduce water storage for summer drinking water, power generation, and irrigation

Changes in forest health & wildfire risk

Flooding from heavy rains, melting snow and rising seas can damage neighborhoods, homes, and businesses

Hotter days and more wildfires statewide can worsen air quality, affecting people with asthma and heart conditions

Heavier rains can increase the cost of controlling urban flooding and polluted runoff

Warming oceans & rising seas

Hotter days can impact the health and safety of outdoor workers and industries

Environmental Changes

Health Impacts

Ecosystem Impacts

Built Environment Impacts


More carbon dioxide in the oceans can harm marine food webs and shellfish

Warmer streams and oceans can stress fish and lead to more harmful algal blooms

Heat, drought, and pests can damage crops. This can affect what food is sold in markets and how much it costs.

Warmer temperatures can increase the risk of heat-related illness and disease from ticks and mosquitoes

Graphic based on the figure in the King County's 2020 Strategic Climate Action Plan.



Credits:

Juan Rubio, The Seattle Public Library

Luis Gonzalez, The Seattle Public Library

Terrell Strong, LSAMP University of Washington

Heidi Roop, University of Washington and
University of Minnesota

Peter Neff, University of Washington and
University of Minnesota

Robert Rood, VR Developer

James Rufo-Hill, Seattle Public Utilities

Ann Grodnik-Nagle, Seattle Public Utilities

Michelle Kumata, Illustrator and Designer



We have created this booklet as part of the Future Duwamish VR Experience at The Seattle Public Library, with Seattle Public Utilities, the University of Washington and the University of Minnesota. For more information on how to access the VR experience, please visit: spl.org/vr or scan the QR code at left.

VR project funding provided by Seattle Public Utilities, UW EarthLab, and the Seattle Public Library Foundation