SOURCES OF NONPOINT POLLUTION

Chapter 400-12 WAC

Agricultural practices (400-12-610)

On-site sewage disposal (400-12-620)

Stormwater and erosion (400-12-630)

Forest practices (400-12-640)

Marinas and boats (400-12-650)

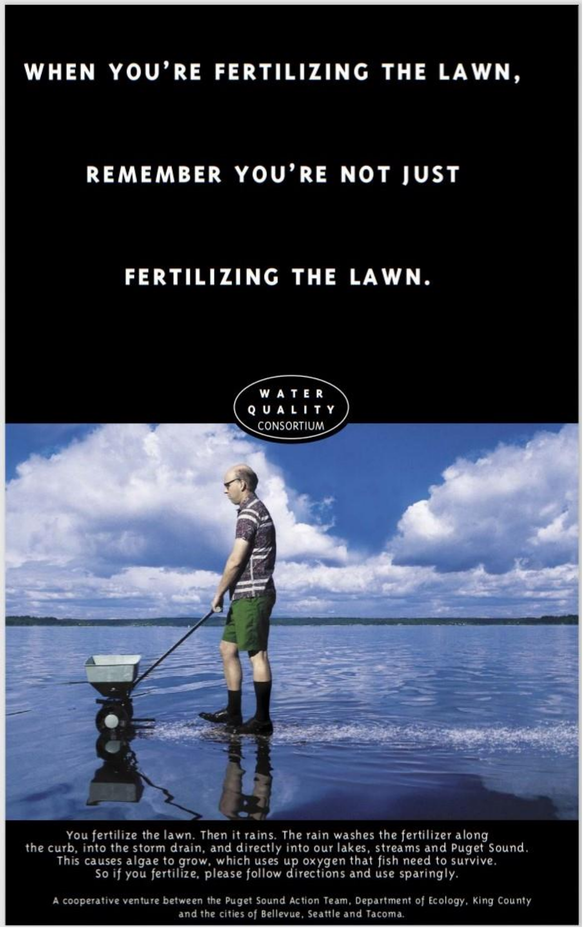
Other nonpoint sources (400-12-660)

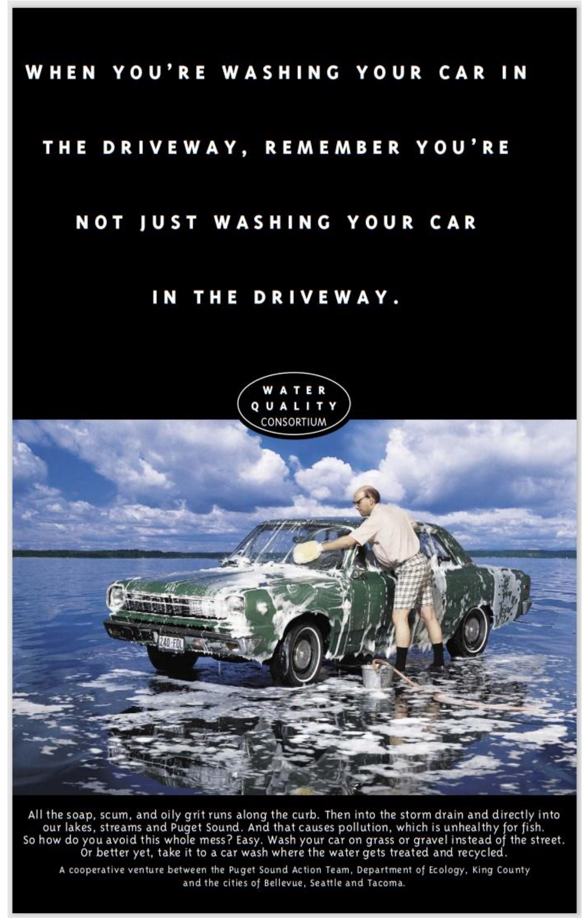
-Pesticides
-Landfills, mines, sand and gravel pits
-Septage
-Contaminated sites
-Other

Nonpoint Sources vs. Point Sources

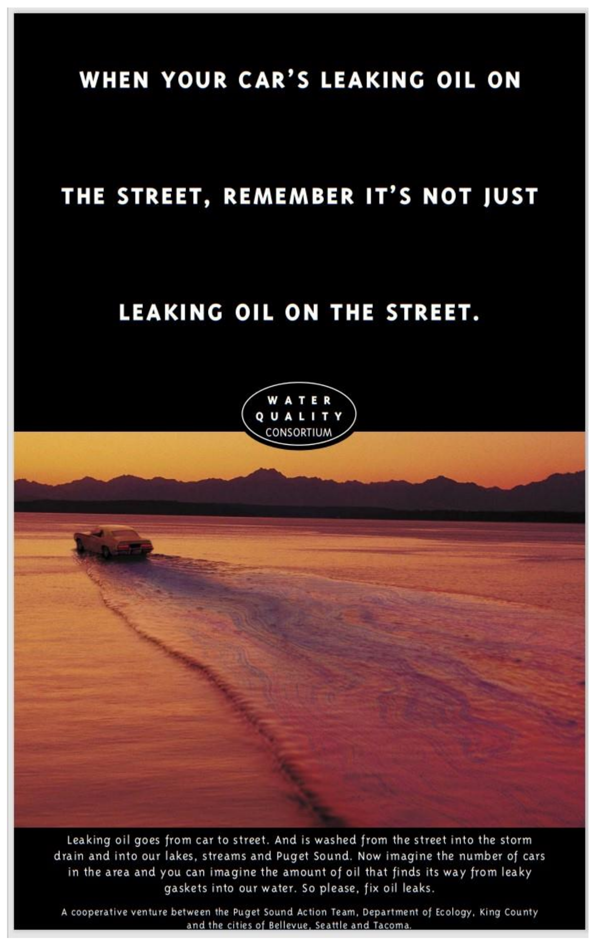
The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act:

The term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.


WHEN YOU'RE FERTILIZING THE LAWN,
REMEMBER YOU'RE NOT JUST
FERTILIZING THE LAWN.
WATER QUALITY CONSORTIUM
You fertilize the lawn. Then it rains. The rain washes the fertilizer along the curb, into the storm drain, and directly into our lakes, streams and Puget Sound. This causes algae to grow, which uses up oxygen that fish need to survive. So if you fertilize, please follow directions and use sparingly.
A cooperative venture between the Puget Sound Action Team, Department of Ecology, King County and the cities of Bellevue, Seattle and Tacoma.


WHEN YOU'RE WASHING YOUR CAR IN
THE DRIVEWAY, REMEMBER YOU'RE
NOT JUST WASHING YOUR CAR
IN THE DRIVEWAY.
WATER QUALITY CONSORTIUM
All the soap, scum, and oily grit runs along the curb. Then into the storm drain and directly into our lakes, streams and Puget Sound. And that causes pollution, which is unhealthy for fish. So how do you avoid this whole mess? Easy. Wash your car on grass or gravel instead of the street. Or better yet, take it to a car wash where the water gets treated and recycled.
A cooperative venture between the Puget Sound Action Team, Department of Ecology, King County and the cities of Bellevue, Seattle and Tacoma.


WHEN YOUR PET GOES ON THE LAWN,
REMEMBER IT DOESN'T JUST
GO ON THE LAWN.
WATER QUALITY CONSORTIUM
When our pets leave those little surprises, rain washes all that pet waste and bacteria into our storm drains. And then pollutes our waterways. So what to do? Simple. Dispose of it properly (preferably in the toilet). Then that little surprise gets treated like it should.
A cooperative venture between the Puget Sound Action Team, Department of Ecology, King County and the cities of Bellevue, Seattle and Tacoma.


WHEN YOUR CAR'S LEAKING OIL ON
THE STREET, REMEMBER IT'S NOT JUST
LEAKING OIL ON THE STREET.
WATER QUALITY CONSORTIUM
Leaking oil goes from car to street. And is washed from the street into the storm drain and into our lakes, streams and Puget Sound. Now imagine the number of cars in the area and you can imagine the amount of oil that finds its way from leaky gaskets into our water. So please, fix oil leaks.
A cooperative venture between the Puget Sound Action Team, Department of Ecology, King County and the cities of Bellevue, Seattle and Tacoma.

What You Can Do to Prevent Nonpoint Source (NPS) Pollution

Learn More about What You Can Do

- Learn how to protect water quality from urban runoff.
- Learn how low impact development can reduce urban runoff and improve water quality.
- Learn how to protect water quality from agricultural runoff.

In Urban Environments

- Keep litter, pet wastes, leaves and debris out of street gutters and storm drains—these outlets drain directly to lake, streams, rivers and wetlands.
- Apply lawn and garden chemicals sparingly and according to directions.
- Dispose of used oil, antifreeze, paints and other household chemicals properly—not in storm sewers or drains. If your community does not already have a program for collecting household hazardous wastes, ask your local government to establish one.
- Clean up spilled brake fluid, oil, grease and antifreeze. Do not hose them into the street where they can eventually reach local streams and lakes.
- Control soil erosion on your property by planting ground cover and stabilizing erosion-prone areas.
- Encourage local government officials to develop construction erosion and sediment control ordinances in your community.
- Have your septic system inspected and pumped, at a minimum every three to five years, so that it operates properly.
- Purchase household detergents and cleaners that are low in phosphorous to reduce the amount of nutrients discharged into our lakes, streams and coastal waters.

In Agricultural Environments

- Manage animal manures to minimize losses to surface water and ground water.
- Reduce soil erosion and nutrient loss by using appropriate conservation practice systems and other applicable best management practices.
- Use planned grazing systems on pasture and rangeland.
- Dispose of pesticides, containers, and tank rinsate in an approved manner.
- Work with conservation partners locally including Soil and Water Conservation Districts to understand local strategies.

WHAT IS GREEN INFRASTRUCTURE?

Green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. While single-purpose gray stormwater infrastructure—conventional piped drainage and water treatment systems—is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls on our roofs, streets, and parking lots in cities and their suburbs, the water cannot soak into the ground as it should. Stormwater drains through gutters, storm sewers, and other engineered collection systems and is discharged into nearby water bodies. The stormwater runoff carries trash, bacteria, heavy metals, and other pollutants from the urban landscape. Higher flows resulting from heavy rains also can cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

When rain falls in natural, undeveloped areas, the water is absorbed and filtered by soil and plants. Stormwater runoff is cleaner and less of a problem. Green infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the neighborhood or site scale, stormwater management systems that mimic nature soak up and store water.

Downspout Disconnection

This simple practice reroutes rooftop drainage pipes from draining rainwater into the storm sewer to draining it into rain barrels, cisterns, or permeable areas. You can use it to store stormwater and/or allow stormwater to infiltrate into the soil. Downspout disconnection could be especially beneficial to cities with combined sewer systems.

Rainwater Harvesting

Rainwater harvesting systems collect and store rainfall for later use. When designed appropriately, they slow and reduce runoff and provide a source of water. This practice could be particularly valuable in arid regions, where it could reduce demands on increasingly limited water supplies.

Rain Gardens

Rain gardens are versatile features that can be installed in almost any unpaved space. Also known as bioretention, or bioinfiltration, cells, they are shallow, vegetated basins that collect and absorb runoff from rooftops, sidewalks, and streets. This practice mimics natural hydrology by infiltrating, and evaporating and transpiring—or “evapotranspiring”—stormwater runoff.

Planter Boxes

Planter boxes are an attractive tool for filtering stormwater as well as reducing the runoff that goes into a sewer system. Planter boxes are urban rain gardens with vertical walls and either open or closed bottoms. They collect and absorb runoff from sidewalks, parking lots, and streets and are ideal for space-limited sites in dense urban areas and as a streetscaping element.

Bioswales

Bioswales are essentially rain gardens placed in long narrow spaces such as the space between the sidewalk and the curb. Bioswales are vegetated, mulched, or xeriscaped channels that provide treatment and retention as they move stormwater from one place to another. Vegetated swales slow, infiltrate, and filter stormwater flows. As linear features, they are particularly well suited to being placed along streets and parking lots.

Permeable Pavements

Permeable pavement is a good example of a practice that catches water where it falls. Permeable pavements infiltrate, treat, and/or store rainwater where it falls. They can be made of pervious concrete, porous asphalt, or permeable interlocking pavers. This practice could be particularly cost effective where land values are high and flooding or icing is a problem.

Green Streets and Alleys

Green streets combine more than one feature to capture and treat stormwater. Green streets and alleys are created by integrating green infrastructure elements into their design to store, infiltrate, and evapotranspire stormwater. Permeable pavement, bioswales, planter boxes, and trees are among the elements that can be woven into street or alley design.

Green Parking

Parking lots are a good place to install green infrastructure that can capture stormwater that would usually flow into the sewer system. Many green infrastructure elements can be seamlessly integrated into parking lot designs. Permeable pavements can be installed in sections of a lot and rain gardens and bioswales can be included in medians and along the parking lot perimeter. Benefits include mitigating the urban heat island and a more walkable built environment.

Green Roofs

A green roof system atop a building helps manage stormwater and reduce energy costs for cooling. Green roofs are covered with growing media and vegetation that enable rainfall infiltration and evapotranspiration of stored water. They are particularly cost-effective in dense urban areas where land values are high and on large industrial or office buildings where stormwater management costs are likely to be high.

Urban Tree Canopy

City trees, or tree canopy, soak up stormwater, provide cooling shade and help to slow traffic. Trees reduce and slow stormwater by intercepting precipitation in their leaves and branches. Many cities have set tree canopy goals to restore some of the benefits of trees that were lost when the areas were developed. Homeowners, businesses, and community groups can participate in planting and maintaining trees throughout the urban environment.

Land Conservation

Land conservation is another good tool for communities to use for reducing the risks of stormwater runoff and sewer overflows. The water quality and flooding impacts of urban stormwater also can be addressed by protecting open spaces and sensitive natural areas within and adjacent to a city while providing recreational opportunities for city residents. Natural areas that should be a focus of this effort include riparian areas, wetlands, and steep hillsides.

Overcoming Barriers to Green Infrastructure

Communities across the country are experiencing the benefits of green infrastructure. They have adopted performance standards or incentives promoting green infrastructure while others have built demonstration projects. Here we identify some of the barriers to adopting green infrastructure approaches and suggest strategies to overcome them.

Barriers Confronting Municipalities

Local governments are in the best position to promote sustainable stormwater management on a larger scale. They also face some of the most complex challenges. Resources are limited, responsibilities are fragmented, and the tolerance for risk is generally low. These strategies should help municipalities overcome those challenges.

Barriers Confronting Developers

Many developers are unaware of the potential for cost savings with green infrastructure. Even when developers are aware of the potential for cost savings, however, they may find it impossible to reconcile green infrastructure approaches with other codes and standards. Many of the strategies for overcoming these barriers require action by municipalities.

Design Challenges

Municipalities, developers, and engineers often express skepticism that green infrastructure is appropriate for their particular context. For example, green infrastructure is often perceived to be limited to sandy or loamy soils. Green infrastructure practices are extremely versatile, however, and strategies exist to overcome most design challenges

Green Infrastructure Design and Implementation

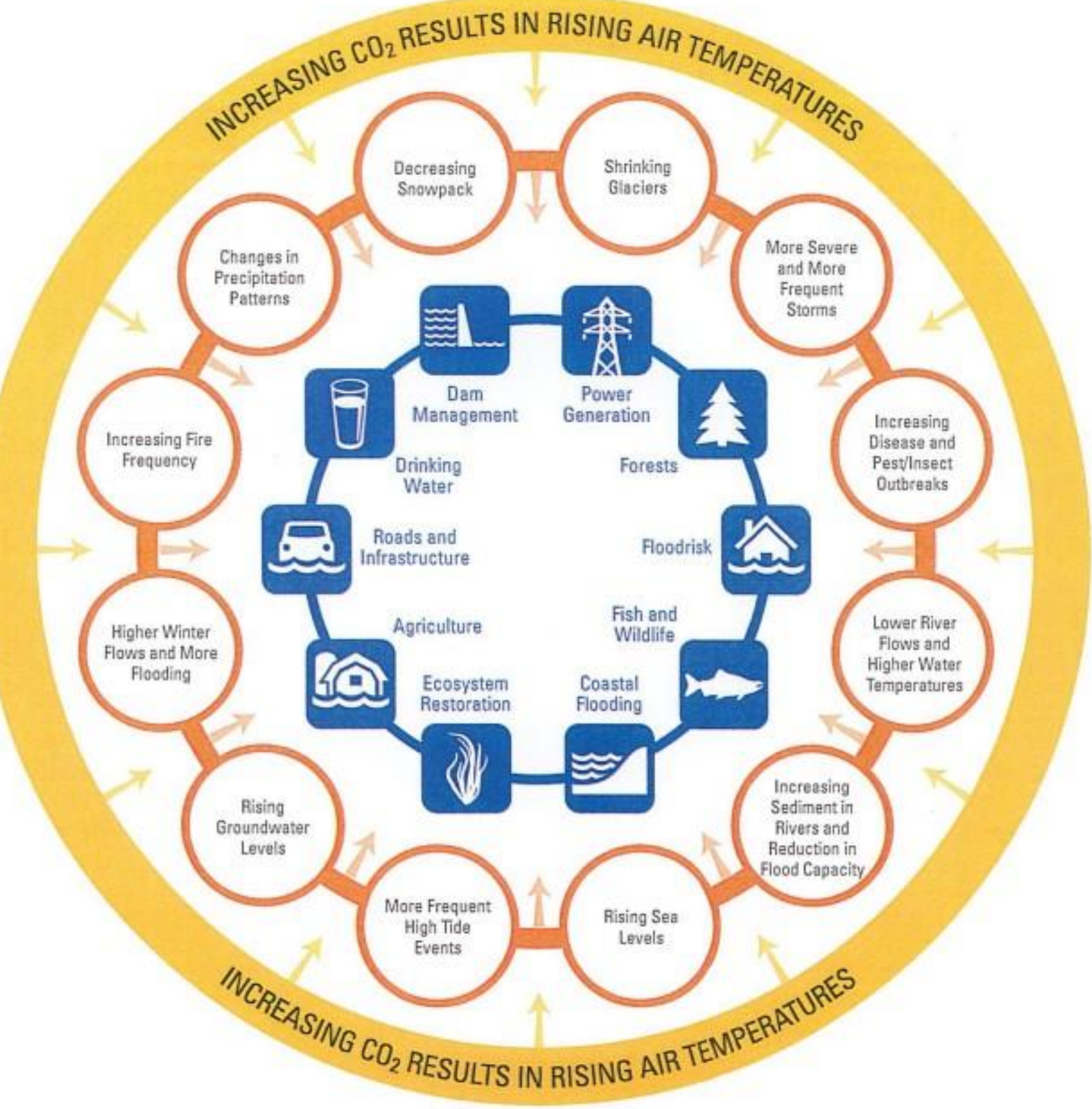
Properly designed, constructed, and maintained green infrastructure practices provide the greatest benefit to water resources and the community. Access guidance on this page about construction, operation and maintenance, and common design challenges.

For more information, go to: https://www.epa.gov/green-infrastructure/green-infrastructure-design-and-implementation

Where you will find:

- Design Manuals
- Design Tools
- Design Challenges
- Implementation
- Homeowner Resources

Climate Change Drivers → System Changes and Impacts → Human and Local Challenges



Climate Change

Introduction

North Cascades National Park Complex encompasses 681,158 acres of rugged mountains and valleys spanning the crest of the Cascade Range from the Canadian border south to Lake Chelan. The park has 3 regional climates and numerous microclimates that result in a high diversity of flora and fauna. There are 42 square miles of glaciers that provide cold fresh water to the rivers and streams supporting the region's fisheries, recreation and the hydroelectric and agricultural industries. Climate change has already affected park resources, recreational opportunities, and park management.

Observed Climate Effects

Mountain Snowpack - Mean winter minimum temperatures at high elevation stations (above 4000 ft.) have risen about 5°F since 1950s. As a result, the mean winter freezing level in this region has risen about 650 ft. since 1950 resulting in diminished mountain snowpack.

Glaciers at North Cascades have lost 53% of their area since 1900 AD. The rapid loss is driven by warmer air temperatures, which increase the rate of summer melt and decreases winter snowfall (Figure 1 and 2). Glaciers currently provide 6-18% of the runoff to the Skagit River; the largest river flowing into Puget Sound also drains 70% of the park. The net loss of glaciers has resulted in the loss of 400 billion gallons of water to the Skagit River, equivalent to 44 years of water supply for Skagit County.

Streamflow - Park streams at higher elevations and east of the Cascade crest have shown a response to warmer temperatures. Since the late 1970s, the Stehekin River's peak annual flow event has shifted from spring to fall, and three 100 year floods have occurred since 1995.

Endangered Salmonids - Rivers and streams in North Cascades provide some of the most protected, high quality habitat for bull trout, steelhead and Chinook salmon in the Puget Sound basin. Bull trout, the most sensitive of these species, need water temperatures < 55°F. Current NPS monitoring in 13 major stream systems in the park indicate that 7 of these systems already exceed the temperature criteria for bull trout.

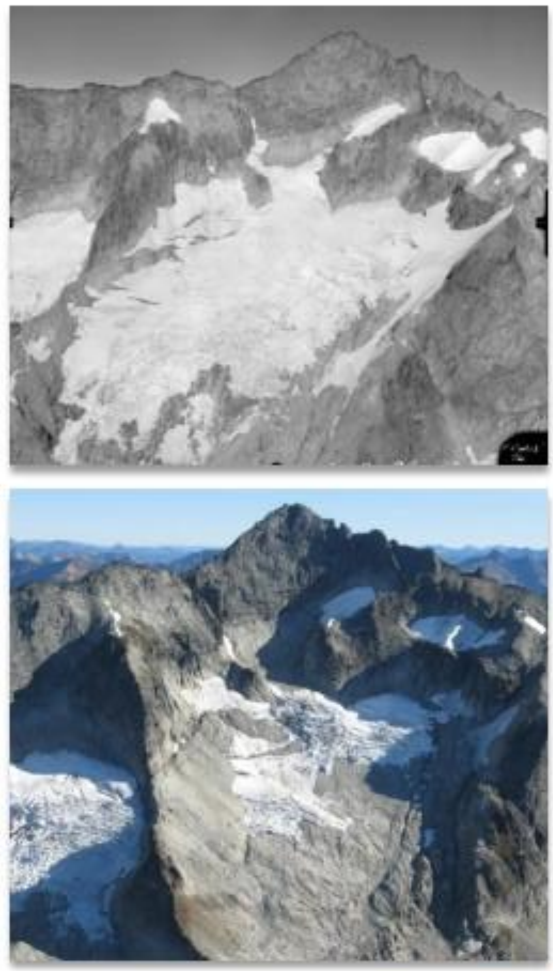


Figure 1. Comparative photos of glaciers on Forbidden Peak, at top in 1960 (Post) and at bottom in 2005 (Scurlock).

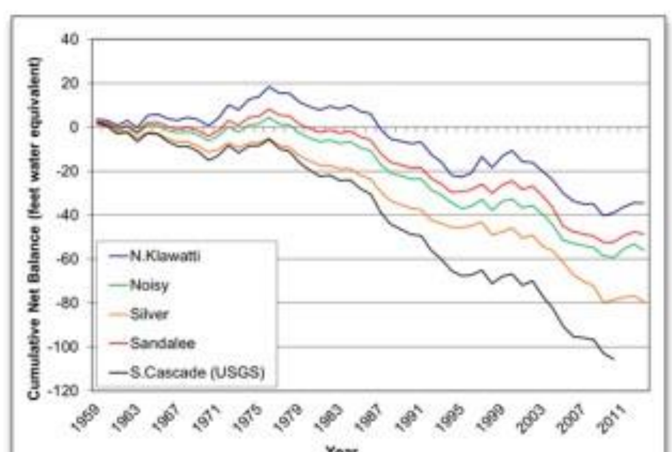


Figure 2. Reconstructed cumulative balance of 4 North Cascades glaciers monitored by the NPS (1993-2013) and South Cascade Glacier (USGS, 1959-2011).

Forest line has moved up roughly 415 feet over the last 50 years. Tree establishment in subalpine and alpine areas is expected to accelerate with warmer summer temperatures, decreased snow pack, and earlier snow melt.

Projected Climate Effects

Mean annual temperature is expected to continue to increase in the Pacific Northwest, warming on average by 2.0°F by the 2020s, 3.2°F by the 2040s, and 5.3°F by the 2080s (Mote and Salathé 2010).

Recreational access to the park will be severely impacted by changing hydrologic conditions. Currently, 78% of our roads and 97% of our trails are in snow dominated watersheds where spring peak flows are the norm. By the 2040s, the majority of roads and trails will be in transient watersheds with higher and more frequent peak flows in both spring and fall. Many culverts and bridges will be vulnerable to these increased flows resulting in decreased access (Figure 3).

Figure 3. Cascade River Road, August 2013. Heavy rain mobilized river debris clogging a culvert. The road washed out, stranding 70 visitors and their vehicles for 2 days.

Wolverines - Wolverines were extirpated from the Sierra Nevada in the mid-20th century. Today, the Cascade Range provides the southern extent of wolverine range in the PNW. Wolverines give birth in snow caves and are restricted to areas where at least 5' of snow cover persists until mid-May. In 2012, one of only two known wolverine reproductive dens was located in the park. Decreasing snowpacks will shrink wolverine habitat "islands" during the next century threatening species persistence in a key portion of their current range.

Whitebark pine survival is threatened by the introduced white pine blister rust and the native mountain pine beetle. In the park, 28% of whitebark pine trees are dead, 30% are infected with blister rust, and 1% have died from mountain pine beetles. Warming winter temperatures may facilitate mountain pine beetle survival resulting in increased whitebark pine mortality.

Citizen Science & Butterflies – Butterfly distributions are expected to shift in response to air temperature. Volunteers in the Cascade Butterfly Program monitor butterflies in North Cascades and Mount Rainier.

Montane wetlands - The loss and alteration of high elevation, shallow wetlands are projected to result from reductions in snowpack, higher evapotranspiration, and extended summer droughts. These ecologically productive areas provide core habitat for amphibians and invertebrates, and food and water for a wide range of montane birds and mammals. We are conducting research to identify vulnerable wetlands and improve our management of these unique habitats.

Pikas - North Cascades is on the northern edge of the distribution of pika in the US and the range core for the entire lineage. We are working with geneticists from UBC and U. of Colorado to understand how or if pikas can adapt in a climatically heterogeneous landscape. Our studies will inform local conservation and contribute to trans-boundary wildlife management issues.

Adaptive Management

North Cascadia Adaptation Partnership (NCAP) - The Park is working with Mount Rainier, Mount Baker-Snoqualmie NF, and Okanogan-Wenatchee NF to develop climate adaptation strategies and tactics for implementation across 6 million acres of the northern Cascade Range (www.northcascadia.org).

Management Planning - In response to several large floods, the park completed the Stehekin River Corridor Implementation Plan in 2013. The plan addresses flooding of private land and threats to access and infrastructure.

Increasing Mountain Lake Resilience - Non-native fish stocked in park lakes threaten the long-term viability of native salmon and trout and have reduced the habitat available for amphibians. Lake restoration projects have removed non-native fish, expanding amphibian breeding habitat in 8 lakes and eliminating 3 populations of highly invasive non-native Eastern brook trout.

Access Management - Maintenance and resource management staff are working to improve inventories of road and trail infrastructure. Data will be combined with projected hydrologic flows to improve park protection of aquatic ecosystems and recreational access.

More Information

North Cascades National Park Homepage:

www.nps.gov/noca/naturescience/climate-change.htm

North Coast & Cascades Network Inventory and Monitoring: http://science.nature.nps.gov/im/units/nccn/

What Can We Do About Climate Change?

From a science education perspective, one major thing that can be done about climate change is to support education efforts that help individuals and societies make informed decisions about climate change. Climate science must be integrated as practical knowledge into society so that understanding the complex physical and biological interconnections are relevant to decision-making in social, economic, political, cultural, and educational systems. While information alone is not enough to prepare society for the immediate and long-term challenges of human influences on climate, without a scientifically informed understanding of the causes and effects of climate change, it will be difficult or impossible to reduce vulnerabilities or enhance the resilience of communities and ecosystems affected by climate change.

The two most important strategies for addressing climate change are mitigation and adaptation. The two strategies are related and overlap to a degree, but the basic distinction is that mitigation means limiting the amount of climate change which occurs, primarily by reducing greenhouse gas concentrations, while adaptation means changing the way we, as a society, live in response to the changing climate.

Mitigation to reduce greenhouse gas emissions entails the reduction and conservation of oil, gas, and coal, the fossil fuels that are used in transportation, heating and cooling, agriculture, and electricity generation. Replacing carbon-intensive fuels with renewable and alternative energy sources is key to “decarbonizing” the current energy infrastructure, which will require transforming the global economy that is currently fueled primarily by carbon-based energy sources. In order for mitigation to be successful, it is necessary to understand how humans currently consume energy and how that impacts the climate, and then make appropriate decisions to minimize that impact. There are already a number of energy sources which produce electricity at costs comparable to coal and natural gas, and improving the efficiency and availability of those technologies is a major area of research. Many private homeowners and schools generate their own electricity with solar panels or wind turbines, showing students and their neighbors that these technologies are available and affordable. Simple measures to increase household energy efficiency, to drive less by biking, carpooling, and riding public transit, and to ship our food shorter distances all play important roles in averting future climate change.

Changing our own behavior can limit climate change: By switching to energy sources that don't release greenhouse gases, increasing the energy efficiency of our homes and offices, and driving less, we can reduce our effect on the climate and limit climate change.

Adapting to climate change is also crucial since, no matter how successful mitigation efforts are, the changes already occurring are predicted to increase in the years and decades to come, requiring serious planning to minimize risks, vulnerabilities, and impacts. Adaptation strategies that communities are already implementing include:

- Building sea walls and moving away from vulnerable coasts in order to avoid sea level rise and storm surges
- Diversifying crops and using drip irrigation for agriculture
- Building new public works such as sewers, bridges and aqueducts to handle changes in rainfall and flooding
- Training public health professionals for increased health impacts and emerging diseases
- Developing wildlife conservation plans and new migration corridors to protect endangered species
- Designing buildings to conserve and even generate energy, and
- Demonstrating strategies and lifestyles for increased sustainability and resilience

Because there is a lag between increased greenhouse gas emissions and increased warming, even if all greenhouse gas emissions stopped today, it would take decades before temperatures, rainfall, and other effects of human-caused climate change would begin to abate. So adaptation and mitigation will inevitably proceed in parallel.

Climate change will affect every part of society. The response to climate change — through mitigation and adaptation — has to involve individuals and families at home, students and educators in schools, leaders and workers in organizations, and local, state, national and international governmental bodies. The actions we take and decisions we make can create opportunities or limit the options for the next generation. Ideally, by reducing the effects and adapting to climate change, the present generation will improve its own condition, with benefits such as a higher quality of life and public health, while helping future generations through its foresight and planning.

Further reading:

-*Climate Change 2007: Impacts, Adaptation, and Vulnerability* and *Climate Change 2007: Mitigation*, two major reports from the Intergovernmental Panel on Climate Change, an international organization that periodically brings together scientists to evaluate the state of climate science, reviewing the evidence of how climate change in affecting society and the natural world. The Summary for Policymakers on adaptation (PDF) and the Summary for Policymakers on mitigation are especially accessible.

-*Adaptation Planning: What US States and Localities are Doing*, a 2009 report from the Pew Center for Climate and Energy Solutions, describing how states and cities in the United States are adapting to climate change

-Climate 101: Adaptation (PDF) is a brief summary of what climate adaptation is and how various parts of the US are already adapting to climate change

There are multiple citizen science projects that let individuals and groups help track climate change, such as Project Budburst, the National Phenology Network, Climateprediction.net, and OldWeather. You can learn more about citizen science and find more projects related to climate change at Scistarter and the Citizen Science Central climate change portal.

The Climate and Energy Awareness Network provides online educational resources and exercises exploring how humans can mitigate and adapt to climate change.

https://ncse.com/library-resource/what-can-we-do-climate-change

http://www.skagitclimatescience.org/about-us/