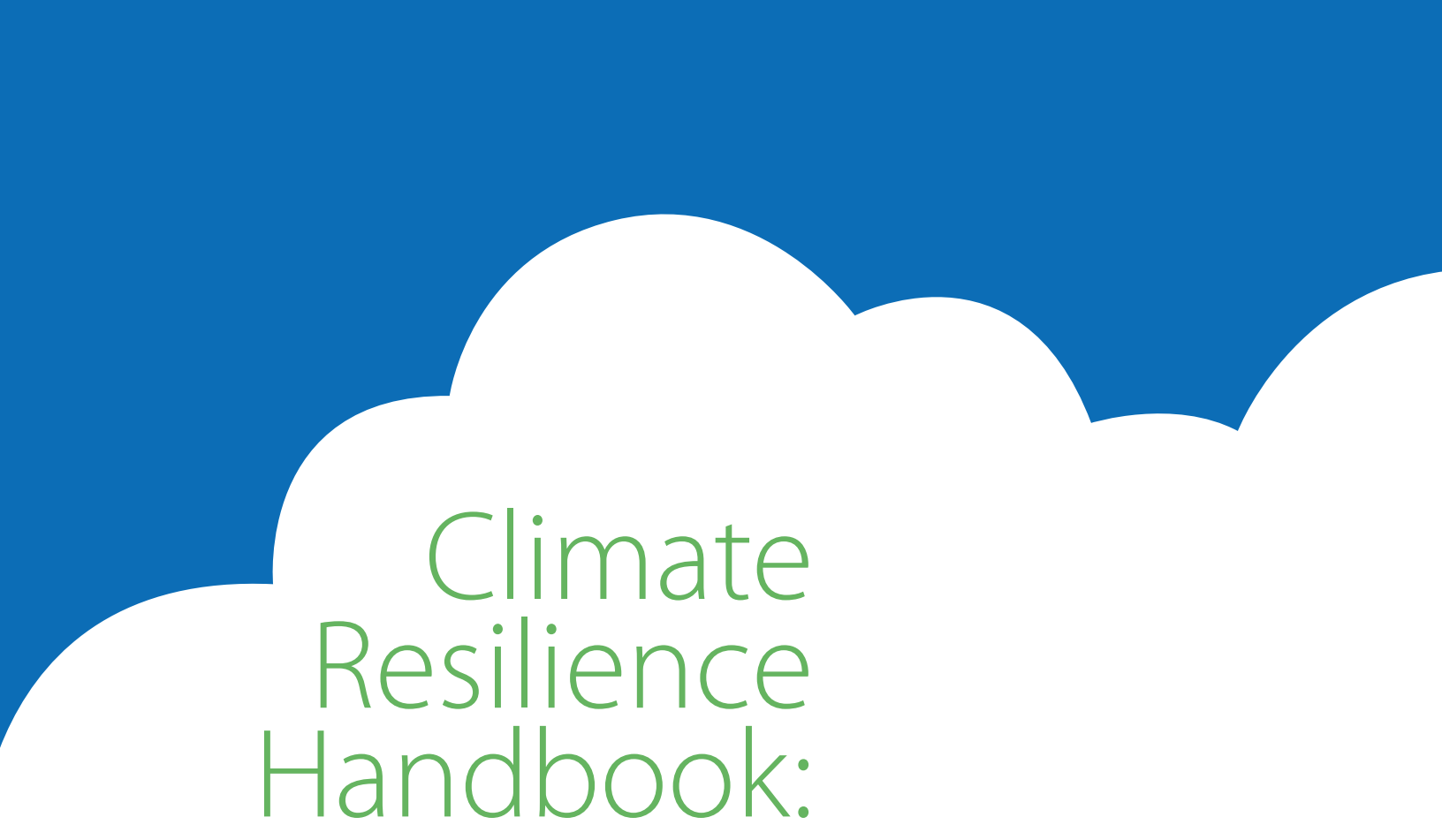


# Climate Resilience Handbook:

**Preparing for a changing environment**





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## Preparing for a changing environment

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# Climate Resilience Handbook: Preparing for a changing environment

## Preface

The Climate Resilience Handbook provides basic information, resources, references, and examples regarding climate change and climate action planning, as well as hazard mitigation planning due to climate change.

The primary audience is the membership of the Association of Washington Cities—elected and appointed officials of the 281 cities and towns in Washington state. However, this information may be of interest and value to other people and organizations involved in similar efforts. All are welcome to make use of the information in this Handbook.

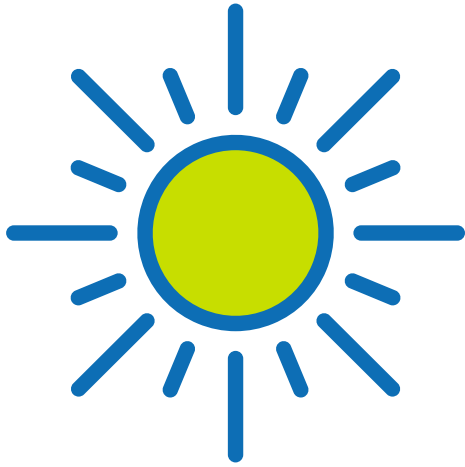
Cities are understandably preoccupied with budgets and finances in the face of the COVID-19 pandemic and resulting economic downturn. Respecting that, **the emphasis of the first edition of the Climate Resilience Handbook is on risk management, cost impacts, and adaptation strategies.** There is also a section on mitigation strategies to reduce greenhouse gas (GHG) emissions for those cities wanting to take additional steps.

This approach will provide an immediate focus on risks and costs, along with an appropriate bridge to the broader issues associated with climate change that will emerge in this decade and beyond.

Climate change is having a profound effect on the environment and its interrelationships with people, including cities of all sizes across Washington state.



# 1. Introduction: What's changing?



*Identifying and preparing for risks and costs is at the heart of resiliency and sustainability efforts for cities.*

Climate influenced events are increasing in frequency, intensity, and severity. These include: wildfires, storm events, floods, landslides, droughts, extreme heat, sea level rise, ocean acidification, and impacts on forests and agriculture.

Cities large and small are experiencing impacts related to climate change. Impacts vary depending upon location and geography, as well as the frequency, intensity, and severity of individual events.

What is more, these events can add significant risks and costs, impacting city operations, finances, and budgets as well as local economies. Examples include:

- preparing for significant infrastructure changes resulting from flooding and surface water management
- upgrading infrastructure
- preparation for fighting wildfires inside city limits
- responding to sea level rise in coastal communities.

Most climate influenced events and associated risks can be anticipated, and plans made to prepare for them. Many communities are preparing climate action plans generally consisting of three elements:

- **Adaptation:** preparing for events such as wildfires, floods, landslides, sea level rise and emergency management preparedness;
- **Mitigation:** reducing greenhouse gas (GHG) emissions; and
- **Economic impacts:** identifying economic vulnerabilities and green economic development opportunities.

The Climate Resilience Handbook will identify the most likely impacts and risks to Washington cities and offer resources and examples of best practices to plan for and respond to a changing climate.

**Note:** Throughout this Handbook the phrase “climate influenced events” is used to describe those events and impacts directly or indirectly related to climate change (increasing in frequency, intensity, or severity). These include: wildfires, heat events, smoke, heavy rainfall events, floods, landslides, droughts, sea level rise, species migration, health impacts, and more.

## Summary of a changing environment

Climate influenced events such as heat, rainfall, coastal flooding, and wildfires will become more commonplace under a warmer climate.

The Pacific Northwest is projected to continue to warm during all seasons under all future scenarios, although the amount of longer-term warming depends in part on how much and how fast future GHG emissions increase or decrease.

Warmer temperatures are expected in all parts of the region. Most areas will likely experience increases in the frequency and intensity of rainfall events. The warming trend is projected to be accentuated in certain mountain areas in late winter and spring, further exacerbating snowpack loss and increasing the risk for insect infestations and wildfires. (NCA-24, p. 2)

### What is the NCA-24?

The *National Climate Assessment* is a publication of the United States Global Change Research Program, comprised of 13 federal agencies including NOAA, NASA, EPA, DOT, DOD, Commerce, Interior, and others. In the *Fourth National Climate Assessment*, "Chapter 24: Northwest" focuses specifically on Washington, Oregon, and Idaho. This chapter is hereafter referred to as the **NCA-24**. See Appendix for a link to this document.

Cities are where most people live, and increased frequency and intensity of climate influenced events can have significant impacts on municipal responsibilities and services, both operationally and financially. These impacts will vary for each city based on factors such as location and service profiles and vulnerable population groups. Assessment of these impacts is at the heart of developing adaptation plans and strategies to measure and manage risk.

The NCA-24 identifies impacts that will emerge in cities. Natural patterns of climate variability such as El Niño/La Niña and the Pacific Decadal Oscillation (PDO) have had a strong influence on Washington's

climate, causing some years (or decades) to be cooler/wetter than average and other years (and decades) to be warmer/drier than average.

These influences are expected to continue in the future, at times worsening and at times alleviating the influences of climate change. Cities in Washington will need to plan for both.

According to the NCA-24:

- Average winter precipitation is expected to increase over the long term, but year-to-year variability in precipitation is also projected to increase.
- Years of abnormally low precipitation and extended drought conditions are expected to occur throughout the century, and extreme events, like heavy rainfall associated with atmospheric rivers, are anticipated to occur more often.
- Along the coast, severe winter storms are expected to occur more often, such as occurred in 2015 during one of the strongest El Niño events on record. El Niño winter storms contributed to storm surge, large waves, coastal erosion, and flooding in low-lying coastal areas.
- Changes in the ocean environment, such as warmer waters, altered chemistry, sea level rise, and shifts in the marine ecosystems are also expected.
- These projected changes affect the Northwest's natural resource economy, cultural heritage, built infrastructure, recreation, and the health and welfare of Northwest residents. (NCA-24, p. 3)

The University of Washington Climate Impacts Group (CIG) has studied climate variability and offers that natural variability has generally favored cooler and wetter conditions in the Pacific Northwest over. As an example, between 1998 and 2013, there have been eight La Niña winters vs. four El Niño winters, and 111 out of 176 months have been cool-phase PDO. (*Pacific Northwest Climate: A Tale of Two Signals*. See Appendix for link.)

The CIG goes on to note that trends at any single location can differ from regional averages. Therefore, climate variability can result in warmer or cooler temperatures and variations in conditions that run counter to regional and global warming trends.

Climate change and climate influenced events:

- pose a threat to life, health, and property
- increase physical hazards
- increase financial and legal risks
- increase costs associated with response and recovery
- carry economic risks and potential loss of tax revenues
- create challenges to provision of essential services (water, sewer, drainage, health, power, and transportation).

Isolated communities and those with systems that lack redundancy are the most vulnerable. Adaptation strategies that address more than one sector, or are coupled with social and environmental co-benefits, can help increase resilience.

## Changing risk profile

Cities experience risk in terms of direct or indirect financial costs, and legal liability or legal exposure. Climate change is a risk multiplier for both. Climate influenced events present a new paradigm, where historic data are no longer reliable predictors of future events. With this shift comes a new standard for defining how risks are defined, measured, and managed, and what new duties and obligations are conferred upon municipal corporations in light of new information.

Climate influenced events (such as the wildfires in California, Oregon, and Washington in 2020) are generating a growing private and public sector interest and response to risk analysis and management. Banking, insurance, financial, and legal institutions are now assessing or reassessing their role in managing environmental and financial risks associated with climate change.

In September of 2020, Moody's Corporation announced the formation of an Environment, Social, and Governance (ESG) solutions group. As part of this effort, they have invested in Vigeo Eiris, a firm specializing in ESG assessments, and Four Twenty Seven, a leading firm in climate risk assessments.

Moody's has noted that higher maintenance costs and lost tax revenue are particular credit risks for state and local governments over the next several decades. State and local governments' ability to manage debt levels while investing in adaptation efforts will become increasingly crucial to credit quality. In 2020, the bond rating agency at Standard and Poor's (S&P) also put some local governments in Oregon on credit watch due to climate change risk.

Rhodium Group is another firm analyzing market impacts of energy and climate policy and the economic risks of global climate change. Their interdisciplinary team includes policy experts, economic analysts, energy modelers, data engineers, and climate scientists. Research by the Rhodium Group was recently used in a report assessing climate risk in the United States by county.

Other studies by both Moody's and Rhodium assessing climate risk have been published in *The Economist*, *The New York Times*, and *ProPublica*. See Appendix (Liability) for links.

## 2. Climate Action Plans (CAPs)



A growing number of organizations are calling for cities to mobilize in response to climate change and climate influenced events. These include the U.S. Conference of Mayors, National League of Cities, Intergovernmental Panel on Climate Change, Washington State Insurance Commissioner, Washington State Department of Commerce, and Association of Washington Cities. Private sector organizations are also calling for local government actions, including the Federal Reserve Bank of San Francisco, Moody's, and other banking, insurance, and financial institutions.

The most common response by cities is to prepare a climate action plan (CAP). However, the elements of a CAP can be incorporated in other city plans, policies, and codes, such as comprehensive plans or emergency management plans.

CAPs generally consist of these elements:

- **Adaptation:** Preparing for events such as fires, floods, landslides, sea level rise and developing overall emergency management preparedness;
- **Mitigation:** Reducing greenhouse gas (GHG) emissions;
- **Community involvement and engagement:** Citizen participation and stakeholder involvement;
- **Other issues and considerations:** Environmental justice, economics, finance, education, health, and others.

A CAP may include elements such as energy, sustainability, or other elements consistent with a community's vision and unique circumstances. The CAP will likely reflect the forecast for growth and future GHG emissions, and it should link transportation and land use. Preparing CAPs is an emerging field of planning in Washington and across the nation. Chapter 3 of this Handbook provides examples and links from jurisdictions that have prepared CAPs.



## 2.1 Adaptation planning: Preparing for climate influenced events and managing risk

Adaptation strategies generally focus on risks associated with climate influenced events and a changing environment. These events can have dramatic impacts on public health and safety and pose a threat to human life, infrastructure, and property. Such events can significantly impact city budgets for operations, capital, and infrastructure.

Fortunately, most of these events can be anticipated and planned for. Data and information identifying risks are readily available and frequently updated. These data should serve as an essential platform for adaptation planning and emergency preparedness.

Assessing risks involves first identifying risks for a city and then analyzing potential impacts over time using best available science.

The University of Washington Climate Impacts Group (CIG) suggests three key components needed to accomplish this:

- **Educate:** Raise awareness and understanding of climate risks by educating key decision-makers.
- **Analyze:** Use science and local information to assess risks and likely climate impacts that matter to your city.
- **Act and adjust:** Take multisectoral, adaptive, responsive, and flexible actions to manage and address those risks, then learn and adjust as needed.

For example, a city assessing risks from sea level rise would likely follow these steps:

**1. Identify the risk:** Based on best available science, projected sea level rise is expressed in terms of probabilities (e.g., the percent chance of experiencing a specific amount of sea level rise at a particular time). Scenarios range from approximately 8 inches to approximately 2 feet by 2050, and they vary for different locations in the state. The low and high estimates are low percentage probabilities on either end of a bell curve. However, the middle range

at the top of the curve—1 foot of sea level rise by 2050—has a 50% probability.

**2. Identify risk variables:** Based on best available science, what factors might modify sea level projections for your city? Factors to consider include: soil uplift or subsidence, flooding, or estimations of tidal influences or other factors that may impact severity of risk and local variability.

**3. Identify what is at risk and develop response scenarios:** What is at risk from sea level rise in your city (for example, population centers, parks, beaches, water or wastewater treatment facilities)? What does the science reveal regarding worst-case scenarios such as king tides during flooding and storm events and the estimated timing of such events? What are the scenarios, options and timing for responding, and the estimated costs and timing of these scenarios?

**4. Formulate and implement a response:** What operational, regulatory and/or capital measures will be considered and taken, and how will they be paid for? What emergency planning is required? How will decision-makers and the public be educated and informed? What will public outreach look like in your community?

**5. Monitor and evaluate the efficacy of the response and evolving climate risks.** Update response as necessary, incorporating the best available data and information.

These five steps are generally applicable for assessing and responding to all of the risk factors associated with climate change. Please note that risk factors are dynamic; it is essential to integrate best available science into this work and to monitor and update these efforts.

## Significant risks of climate influenced events

What follows is a description of the most common types of risks and challenges associated with a changing climate and climate influenced events. Each identified element is accompanied by a listing of reliable resources for accurate data and adaptation planning, found in the Appendix.

## Water supply

Water for drinking, irrigation, industrial use, and natural resources is impacted by weather and climate. Water supply is dependent on precipitation and water storage capacity such as snowpack. Climate change is altering historic precipitation patterns and, over time, will likely reduce natural fresh water supply in many areas of the state in some seasons.

The NCA-24 predicts existing water infrastructure will face challenges from flooding, drought, and extreme events—potentially compromising reliability of water supply. These changes will impact water availability, storage, management, water rights, irrigation, and natural resources.

*“Isolated communities and those with systems that lack redundancy are the most vulnerable.”  
(NCA p.145)*

## Wastewater

As fresh water becomes scarcer, treated wastewater becomes more valuable as a potential resource to meet growing needs. This trend will likely continue and will impact how future water infrastructure is designed and constructed.

Treating water as a holistic system is emerging as an effective strategy. The development of integrated water systems that treat wastewater as a potential resource may be an effective response to declining water resources.

Each year, millions of dollars are spent on water infrastructure that has evolved in silos (e.g., water, wastewater, and surface water as separate systems). The emerging industry-wide movement known as “One Water” is breaking down traditional silos and optimizing water use, efficiency, and environmental and community benefits.

The Washington State Department of Commerce recently published its Green Economy Work Group recommendations, which include examining a comprehensive new framework for managing water systems using the One Water approach. This work was informed by the Center for Sustainable Infrastructure and the *Growing the Green Economy in Washington State* report by the AWC Center for Quality Communities—both referenced here. (See Appendix for links.)

## Surface water management

Increasing frequency and intensity of heavy rainfall events will require additional surface water management capacity. Such events are projected to increase under all climate scenarios, particularly for areas west of the Cascade Mountain range.

*“Average winter precipitation is expected to increase...and extreme events, like heavy rainfall associated with atmospheric rivers, are also anticipated to occur more often.” (NCA-24 p. 3)*

In response to surface water challenges, cities are incorporating nature in the form of “green infrastructure” or “green and gray” infrastructure. Such approaches incorporate nature-based solutions with more traditional engineering approaches.

Green infrastructure strategies can complement legacy systems, taking some of the burden off of pipes, pumps, and treatment facilities. These systems can also provide additional water resources and can be designed to meet different scales.

Examples include: bioswales, rain gardens, permeable pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting systems.

At larger scales, the preservation and restoration of natural landscapes such as forests, floodplains, and wetlands are also critical components of green infrastructure.

## Flooding and landslides

As climate changes, snowpack decreases, and heavy rainfall events become more frequent, local flooding and associated landslides will occur more frequently and will factor into future preparedness for cities. Areas with streams, drainage, slopes, and soil profiles indicating potential instability and greater risk should be monitored, particularly during periods of intense rain events.

The geology of the Pacific Northwest is complex, shaped by plate tectonics, volcanos, and glacial recession. Different geological areas or zones are more prone to landslides resulting from slope failure, mudflows, debris flows, and rockfalls. Much of the state, and in particular Western Washington, is characterized by layers of sediment including sandy soils, clay, and gravel.

When soils become saturated due to rain and storm events, the moisture serves as a lubricant. The layers of soil become less stable and more susceptible to slope failure, leading to landslides.

Rainfall events are projected to increase in frequency and intensity, bringing periods of heavy precipitation. These events will result in increased flooding and saturated soils, contributing to more frequent landslides. The risk of landslides can increase even further after fire events where vegetation and root systems have been damaged, reducing soil and slope stability.

Landslide risks can have major impacts on development and infrastructure such as roads and railways.

## Sea level rise

Under all climate change scenarios, sea level rise will continue—though the rate and speed may accelerate under warmer climate scenarios.

Coastal communities are preparing for sea level rise and impacts to transportation, water systems, urban flooding, and port facilities. In some cases, coastal cities or towns are even making plans for relocation.

The NCA-24 notes: “Along the coast, sea level rise is projected to increase flood risks in low-lying areas and will likely magnify the potential for coastal erosion and

infrastructure damage during extreme events with high storm surge and wave hazards...”(NCA-24 p. 18)  
In terms of actual projections for Northwest shoreline areas, it should be noted that estimates made even several years ago are now changing in an upward direction. The UW CIG and Washington Sea Grant programs are continuing to model these changes in our area. It is clear that this will have a significant impact on infrastructure investments throughout the Northwest, particularly in the low-lying urban areas of the Puget Sound and Portland.

Planning for sea level rise will likely assess several factors including:

- projected sea level rise
- vertical land change (uplift or soil subsidence)
- storm surge
- wave action
- local flooding

Risk assessments will project these factors in conjunction with:

- extreme high tides (king tides)
- infrastructure and assets at risk, such as water systems, port facilities, and parks
- time frames such as near-term (2020-2050), mid-term (2050-2070), and long-term (2070-2100)

Financial risk assessments associated with sea level rise will need to inform finance and insurance strategies to fund improvements or replacement.

Ports and cities with assets inside shoreline areas are incorporating sea level rise in the design, construction, and financing of new facilities or improvements.

## Wildfires

Wildfires pose a threat to cities and are expected to continue and increase under all climate scenarios. Wildfires differ from other climate influenced events as they are unpredictable compared to storms, flooding, or sea level rise—all of which have varying degrees of advance warning.

Recent experiences in the Western states region, as well as British Columbia and Alberta, have highlighted the increased risks and liabilities associated with wildfires. These include:

- injury and loss of life
- direct fire damage to structures and infrastructure (e.g., roads, railways)

- reduced water quality and impacts to reservoirs
- impacts to energy transmission and communication networks
- toxic waste cleanup
- health risks associated with smoke and fine particulate air pollution

In recent years, the total area under threat of wildfires has greatly expanded. Longer fire seasons have also increased risks, including within city limits.

Cities are adapting and responding, developing fire suppression and hazard reduction tactics to address wildfires in urban settings and densely populated areas, as well as wildfires that encroach upon the outskirts of cities.

## Infrastructure

Energy, transportation, and water infrastructure planning and construction are undergoing significant changes in response to climate change.

The demand for clean energy, coupled with climate-related impacts to roads and water systems, are changing how states, cities, counties, public and private utilities, and special purpose districts plan and deliver infrastructure and services.

Historic weather patterns are no longer reliable predictors of future weather events, and these new climate influenced events will need to inform future planning. The NCA-24 predicts increases in extreme events such as storms, heavy rains, floods, landslides, sea level rise, and wildfires.

What is more, the nation built much of today's infrastructure between the 1930s and 1970s. Therefore, much of the infrastructure we rely on today (roads, water, irrigation, dams, etc.) was built more than 40 years ago and is nearing the end of its designed life cycle. This infrastructure was not designed to meet the needs of today's economy, let alone tomorrow's climate.

These factors raise serious and immediate concerns regarding managing assets, upgrading existing systems, and building new infrastructure to meet tomorrow's needs.

A city's relationship to infrastructure will vary considerably based on population, geography, and

other factors. The assessment of risks associated with infrastructure and climate change will vary accordingly.

## Liability

The basics of climate science, related to GHG emissions and warming impacts, have been well understood since the 1970s. Since then, countless studies have documented impacts associated with climate change, including those referenced in this Handbook.

Climate influenced events are changing historical patterns such as temperature, weather, storms, wildfires, and sea levels, and altering local characteristics and circumstances.

Historic weather and climate patterns, and the statistical frameworks we have used to measure them, are no longer reliable predictors of future events. These events are increasing in number, intensity (based on metrics used to measure such events), and severity (damage to life and property).

However, liability associated with climate change is an emerging field of law. Litigation has focused primarily on attempts to hold fossil fuel companies and utilities accountable for impacts resulting from GHG emissions or for damages (loss of life or property) associated with climate influenced events.

An example of liability resulting from damages is the litigation against the Pacific Gas & Electric Company (PG&E) from the 2018 wildfires in California. PG&E's power lines were found to be the cause of the fires that killed 85 people and destroyed thousands of homes. PG&E filed for bankruptcy as a result, and litigation is still underway regarding settlement for damages. For cities, risk and liability issues will likely focus on two areas: expenses resulting from climate influenced events; and liability associated with climate influenced events (e.g., fires, flooding, sea level rise, and droughts).

These risks should be identified in a city's CAP under adaptation and/or emergency management planning—they are largely predictable or can be evaluated as a change in risk. Failure to identify, anticipate, condition, or regulate risks associated with climate change may increase liability risks for cities.

The liability risks to cities associated with climate change will vary depending on circumstances, facts, and law. Cities are advised to exercise appropriate and reasonable care to identify and examine potential risks associated with a changing climate and take appropriate actions to limit and/or manage such risks.

## Emergency management

Emergency preparedness—identifying risks associated with climate influenced events—is at the heart of adaptation planning for climate change and risk management. Climate change will test preparedness efforts as climate influenced events present new challenges including increased storms, floods, and wildfires.

Emergency preparedness and emergency management are primary responsibilities of states, cities, and local governments as well as the federal government (e.g., FEMA assistance). Cities will need to update risk assessments and develop plans to respond to these changes. Effective planning will rely on coordination and partnerships with other governments, health care providers, the private sector, and nongovernmental organizations.

Emergency management risk assessments are uniquely tailored to local circumstances and conditions. Steps can be taken prospectively to identify and plan for risks. In previous sections of this Handbook, sources are identified providing reliable data and projections for climate influenced events based on the best available climate science.

## 2.2 Mitigation

Mitigation is the reduction of greenhouse gas (GHG) emissions. This section addresses what cities can do to reduce emissions.

The Intergovernmental Panel on Climate Change (IPCC) issued a report in October 2018 titled *Global Warming of 1.5° Celsius*. This report focuses on actions necessary to meet the Paris targets limiting warming to 1.5 to 2 degrees Celsius. Sections 4 and 5 of the report specifically focus on strengthening global response, sustainable development, and a low-carbon climate resilient pathway. “Pathways limiting global warming to 1.5° C...require rapid and far-reaching transitions in energy, land, urban infrastructure (including transport and buildings)

and industrial systems.” (IPCC *Global Warming of 1.5° C Summary for Policy Makers*, p.15).

The IPCC followed with a report in 2019 titled *Climate Change and Land*, examining land use interactions with climate change, desertification, food security, and the relationship with GHGs. These two reports recommend actions cities can take to address climate change.

The IPCC recommendations are to act with urgency to reduce GHG emissions. Carbon dioxide (CO<sub>2</sub>) is by far the largest contributor to GHG emissions, and in Washington state the largest sources of CO<sub>2</sub> emissions are from transportation and buildings. Since Washington’s electricity is generated primarily by hydropower, the GHG emissions profile for electricity is low compared to other regions of the U.S. Other sources of GHGs include methane, nitrous oxide, and fluorinated gases.

What follows are actions cities might consider when evaluating their GHG emissions profiles and how GHGs may be reduced. It is advisable to begin with a basic inventory of emission sources and use that inventory as a benchmark when evaluating the efficacy of mitigation strategies and measures.

## Transportation

Transportation is the largest source of GHG emissions in Washington state. Within this category, burning fossil fuel in internal combustion engines in cars and trucks is the primary contributor. Other sources include consumption of fossil fuels for: aviation, rail, maritime shipping, marine, agriculture, construction equipment, generators, and other uses.

Cities can consider two approaches as they work to address GHG emissions from transportation:

- First, actions under city control related to municipal corporations, including vehicle fleets, operations, and utilities.
- Second, policy action to incentivize or influence GHG reductions through the exercise of regulatory police powers or incentives—such as transportation, land use, building codes, taxes, and fees.

For both strategies, cities should consider prioritizing and incentivizing actions, avoiding fossil fuel consumption, reducing fuel use, replacing fossil

fuel use with renewables, and purchasing carbon offsets.

**Examples include:**

- **Reduce vehicle miles traveled (VMT)** through telecommuting, virtual meetings, and eliminating nonessential travel. The COVID-19 response has provided new incentives, opportunities, and tools to reduce VMT. Furthermore, VMT reduction generally translates to lower operating costs.
- **Transition fleets to electric vehicles (EVs).** Zero emission vehicles—both fleet cars and buses—will reduce overall emissions. This will require investing in EVs, charging infrastructure, and likely partnerships with energy utilities.
- **Build or provide incentives for EV charging infrastructure.** Accelerating the transition to electrification will require significant investments in charging infrastructure as well as policy changes to building codes and partnerships with energy utilities.
- **Provide for nonmotorized transportation** such as pedestrian and bicycle access and bicycle infrastructure—bike lanes, bike and walking trails, safety and security measures, sidewalks, and pedestrian amenities. This will likely include street design considerations, providing for safe travel and weather protections.
- **Incentivize transit use** with transit passes, parking pricing and incentives, congestion pricing, and other policies that discourage auto use in favor of transit and nonmotorized alternatives. Promote carpooling, vanpooling, and incentives for employers.
- **Invest in regional transportation and public transit services** to provide transportation alternatives to driving single- or low-occupancy vehicles powered by fossil fuels. This approach also requires changes in land use, higher density development, transit-oriented development (TOD), and partnerships with regional transportation providers, other local governments, and the private sector.

## Buildings and land use

Buildings are the second largest source of GHG emissions after transportation. Energy use in buildings, electricity, HVAC systems, and building construction materials contribute to GHG emissions. Other factors that can impact GHG emissions include: planning, building codes, energy codes,

transportation and land use, TOD, and street design.

Cities have a range of tools to consider related to planning, land use, and buildings.

**Examples include:**

- **Craft planning and land use regulations to incentivize higher density, infill, mixed-use development, and TOD.** Tools include: accessory dwelling units, design standards, fee waivers, density bonuses, investment prioritization, development impact fees, and tax incentives. Linking higher density land use and transportation is one of the most effective tools available for cities to reduce their GHG footprint and is clearly recognized as a central strategy in IPCC reports.
- **Adopt building and energy codes requiring all new construction to meet the most efficient energy use standards and providing incentives to retrofit existing buildings.** There are multiple models for green building standards and best practices, and they are being updated frequently. Cities can use these models to develop and adopt codes resulting in better buildings and reduced GHG emissions. The Washington State Department of Commerce Energy Office has information regarding codes and energy efficiency programs available to cities and local governments. See Appendix (Transportation) for link.
- **Partner with energy utilities to incentivize EV charging infrastructure and all-electric buildings, maximize efficient energy use, and transition away from fossil fuel use.** Cities can develop plans for energy efficiency that will reduce GHG emissions and reduce costs. Additionally, there are private sector companies that specialize in efficient buildings and energy use (e.g., McKinstry).
- **Identify and incentivize green building materials and technologies.** Consider codes and standards for green buildings and sustainable infrastructure. There are many examples and models for these strategies that include building materials, green roofs, walls, pavements, water usage, water recycling, landscaping, and more.
- **Adopt standards for stormwater, low impact development, and best management practices** consistent with the Washington State Department of Ecology and federal clean water standards and permit conditions. Climate data

indicate storm events will increase in frequency, intensity, and severity. This will result in more rainfall in portions of Washington state. Surface water and stormwater management will present significant challenges as climate influenced storm events increase.

## Other mitigation actions to reduce GHGs

- **Purchasing policies** can have an impact on GHG emissions. Cities can examine their purchasing policies to reduce GHG impacts.
- **Urban forest canopy** can have a cooling impact on urban areas, remove CO<sub>2</sub> from the atmosphere, and contribute oxygen. Preserving and planting trees is an important strategy for cities and an effective way to engage and educate neighborhoods regarding climate issues.
- **Involve the public** in actions and education. A growing number of people are involved and engaged in climate issues. This is particularly true with frontline communities and young people who are keenly aware of climate issues in their future. This public and human resource can play an important role in grassroots education and involvement in local initiatives to reduce GHG emissions. Programs such as community gardens, tree planting and preservation, and pedestrian, bicycle and nonmotorized activities can serve to bring communities together responding to climate change and GHG reduction.
- **Develop waste management systems** that reuse and recycle more solid waste. Clean energy and clean materials recovery are important tools for resiliency strategies. The Center for Sustainable Infrastructure recently published a report, *From Waste Management to Clean Materials*, that provides a roadmap for this work. See Appendix (General information) for link.

## 2.3 Community engagement

Responding to climate change benefits from an informed and engaged public. Development of CAPs, like all community planning, reflects a local community's vision and context. Some examples of CAPs have originated primarily from citizen

involvement ("bottom up," such as Resilient Methow and Olympia), while other examples are primarily directed by local officials ("top down," such as King County and Everett). All of these examples included community engagement. Whether CAP planning is "bottom up" or "top down" it benefits from local citizen engagement and stake holder input.

The tools to accomplish this are already part of Washington's regulatory DNA:

- Washington state law requires open government and transparency (e.g., Open Public Meetings Act and Public Records Act).
- Community and comprehensive planning efforts require public involvement (e.g., Growth Management Act, Shoreline Management Act, local planning laws).
- Project reviews also require public notice and involvement (e.g., State Environmental Policy Act).

Local communities' development of climate action plans for mitigation, adaptation, and green economic development will pay dividends in three important ways.

First, it will help educate and inform residents of the risks facing their communities resulting from climate change. This will assist in developing emergency management and community engagement strategies. It will also create a public involvement framework to engage and inform the public.

Second, it will provide avenues for the two-way communications and community involvement necessary for adaption and mitigation responses and including vulnerable communities.

Finally, new clean energy and utility development will engage the community as energy producers as well as consumers. Smart grid and smart systems will enable new relationships between customers and utility suppliers. Other green economic initiatives will also depend on community acceptance and support.

Note that impacts associated with climate change will be more severe in some communities (see *Environmental justice* section below). These are generally poorer communities with fewer resources to develop resilience and adaptation strategies.

The Fourth National Climate Assessment notes: “Communities on the front lines of climate change will experience the first, and often the worst, effects. Frontline communities in the Northwest include Tribes and Indigenous peoples, those most dependent on natural resources for their livelihoods, and the economically disadvantaged” (FNCA p. 145).

These communities will need additional support and resources in order to respond to climate change. Issues of environmental justice need to be taken into account in assisting those communities most impacted by climate change.

## 2.4 Other issues and considerations

In addition to the significant risk categories already identified, there are other factors to consider in preparing for climate change, mitigation, adaptation, and economic development planning. Some of these are detailed here.

### Environmental justice

Climate influenced events impact some communities and population groups more severely than others. Communities that often experience more severe consequences associated with climate impacts include:

- communities on the frontline of impacts (e.g., those highly dependent on natural resources)
- poor communities
- communities of color
- indigenous populations

These communities may be less resilient due to fewer job and economic resources, inadequate health care, food insecurity, fewer housing options, and lack of access to transportation. The nature and extent of impacts to vulnerable communities will vary depending on local circumstances, climate risks, population demographics, and local economic conditions.

Some of the issues in assessing environmental justice and vulnerable communities include:

- community identity and leadership for vulnerable communities
- economic characteristics such as job base and income

- green job development and emerging opportunities
- emergency preparedness
- access to health care
- access to affordable housing
- access to transportation
- food availability, access, and security

Responding to climate impacts and climate influenced events raises significant environmental justice issues for all government organizations, including cities.

### Economics

Climate change will result in new economic opportunities as well as economic impacts:

- Strategies to reduce GHG emissions, transition to clean energy, and adapt to climate change will drive new green economic development.
- Energy, water, transportation, agriculture, building materials, health care, technology, and other economic sectors are likely to experience new green economic activity in response to climate change.
- Markets for new green economic development, technologies, goods, and services are global.

Cities evolved as centers for commerce, economic development, and education. The Association of Washington Cities Center for Quality Communities (AWC-CQC) has been working with the Washington State Department of Commerce and others to identify and promote opportunities for green economic development.

In 2019, AWC-CQC published *Growing the Green Economy in Washington State* which examines four sectors where climate change may advance green economic development. Subsequently, the Legislature appropriated funds for the Washington State Department of Commerce to convene a working group to further advance these efforts. This effort was completed in July 2020 and a report was submitted to the Legislature in September 2020.

Since that time, AWC has continued work with the Department of Commerce on these issues. However, due to the many crises and competing priorities of 2020, no further action related to this report has been completed yet. It is hoped that the information in this report will help lay the foundation for legislative action in the near future.



## Finance

Climate change will increase demand for capital. Infrastructure impacts associated with climate influenced events (e.g., water, roads, and energy) will require changes in risk management, operations, and capital finance. Infrastructure will need to be designed or re-designed to account for these events.

*Bond rating agencies have sent strong signals that bond ratings will be affected by both the amount of climate risk a municipality is facing and the degree to which it is preparing for that risk.*

Upgrading and replacing infrastructure will bring new financial challenges in the era of climate change. The COVID-19 pandemic will add to these, at least in the near term, as local and state resources are severely stretched and tax revenues—particularly sales tax—are in decline.

Infrastructure providers, public and private utilities, and local and state government entities are facing a number of challenges:

- aging infrastructure built decades ago
- increasing costs to modernize infrastructure that exceed the capacity of local government revenues (tax or rate base)
- climate influenced events

For example, the National Infrastructure Advisory Council estimates a \$400 billion to \$1 trillion gap between existing funding and the amount needed to restore water infrastructure nationally in order to maintain current service levels ranges. Local debt capacity alone will not meet these needs.

Value planning is a technique that can ensure utility and public funds are spent efficiently and effectively. Value planning requires a broader look at infrastructure, incorporating natural systems and triple bottom line economics. The Center for Sustainable Infrastructure has identified this “whole systems” approach to meet the changing circumstances driven by climate change.

## Education

Education at all levels will be essential to address a changing climate. This includes research and development (R&D) responding to emerging needs in key sectors such as clean energy, water, transportation, agriculture, health care, building materials, and more. Workforce training will also be necessary to meet the needs of a changing world responding to climate change.

Cities are where most educational institutions are located and have a vested interest in fostering this development. The AWC-CQC study and the Washington State Department of Commerce report focus on education—R&D and workforce training—as essential in developing the green economy.

The Appendix to this Handbook offers links to educational institutions and programs for further information.

## Health impacts

Climate change presents unique health impacts associated with extreme heat, air pollution, severe weather, infectious diseases, and disruption to water and food supplies. Health impacts include respiratory and cardiovascular disease, asthma, heat-related illness, and mental health impacts. Cities, health care providers, and public health professionals will need to plan and coordinate work to address these emerging health issues.

Recently the COVID-19 pandemic and wildfire smoke provided insights into health impacts and the value of coordination and preparedness related to climate change. In September of 2020, smoke from wildfires created hazardous air quality conditions throughout much of the West Coast and Pacific Northwest regions. Vulnerable populations such as homeless individuals and families were not able to find relief or shelter from smoke and hazardous air pollution. Emergency shelter capacity was also limited due to COVID-19 distancing restrictions. These circumstances presented real-time challenges for cities and public health officials.

# 3. Examples of local responses



Preparing for climate change through adaptation, mitigation, and clean energy economic development are relatively new roles for cities, counties, and Tribes in Washington state and across the nation. They are responding by reducing GHG emissions, adapting to changing circumstances, and providing incentives for an economy based on clean renewable energy.

These efforts are evolving as new and better information and technologies become available. This Handbook offers five steps for managing risk using best available science and embedding science in an ongoing process to measure, manage, and revise policies (see *2.1 Adaptation planning*). These processes are dynamic, evolving, and improving over time in response to a changing climate, a changing knowledge base, and better tools.

Two key elements are driving local governments' response to climate change. First, changing circumstances make it clear that climate change is an immediate concern. Best available science can provide critical information regarding climate influenced events and trends related to wildfires, floods, sea level rise, and weather patterns. This work informs event response and development of best practices and policies, often saving lives and reducing property damage.

Second, financial risks are becoming more evident as better science-based information becomes available. Financial, insurance, and investment services institutions such as Moody's and S&P are including climate science and research into their calculations of risk. With better science and risk management data, the legal community is better able to define risk and associated liabilities. Together, these are powerful incentives to change policies in favor of sustainability and reducing risk.

The remainder of Chapter 3 is a list of Washington cities, counties, and Tribes that have done significant work in responding to climate change, using science-based information, and crafting policies. This is not an exhaustive list.

## Cities, counties, and Tribes in Washington state

### City of Bainbridge Island

The City of Bainbridge Island adopted a [Climate Action Plan](#) (CAP) in November of 2020. The CAP includes mitigation and adaptation elements and addresses energy, transportation, buildings, natural environment, and other elements.

### City of Bellingham

In 2007 the [City of Bellingham](#) adopted a [Climate Protection Action Plan](#) with emission reduction targets for 2020. The city has completed the initial milestones and updated the [Climate Protection Action Plan](#) in 2018 with new emission reduction targets for 2030.

### Chelan County

Chelan County released a draft [Chelan County Climate Resiliency Strategy](#) in October 2020. The draft examines climate impacts including wildfires, droughts, flooding, water supply, and declining snowpack. It includes the cities of Leavenworth, Wenatchee, Cashmere, Entiat, and Chelan and is being prepared in partnership with the Washington State Department of Natural Resources, UW Climate Impacts Group, Chelan County PUD, U.S. Environmental Protection Agency, Federal Reserve Bank of San Francisco, and FEMA.

### City of Everett

The City of Everett has taken a series of steps addressing climate change. In 2015 the city adopted a [Climate Change element](#) in its comprehensive plan. In 2019 the city adopted a [Climate Action Plan](#) with specific strategies to reduce GHG emissions.

### King County

King County published its [2020 Strategic Climate Action Plan](#) in August, an extensive plan including strategies to reduce GHG emissions, support environmental justice, frontline communities, green jobs, housing, and preparing for climate change adaptation. The King County-Cities Climate Collaboration (K4C) participated in the development of the plan. The K4C cities in King County represent 80% of the county's population.

### City of Kirkland

Kirkland adopted a [Climate Protection Plan](#) in 2010 and joined the King County-Cities Climate Collaboration (K4C), a group of cities and the county coordinating efforts responding to climate change. Kirkland's work includes GHG inventory, strategies to reduce GHG emissions (including a 2018 emissions update), and other measures.

### City of Olympia

The City of Olympia has long recognized that a small amount of sea level rise greatly increases the probability of flooding in the downtown core, potentially affecting public infrastructure. In 2020 Olympia updated its planning for sea level rise, publishing [Olympia Sea Level Rise Response Plan](#).

### City of Seattle

Seattle maintains an [Office of Sustainability & Environment](#) and works in a number of areas related to climate change, building and energy, equity and environment, and food policy programs. In 2018 Seattle updated its [climate strategy](#) addressing pollution from transportation and buildings.

### City of Shoreline

The [Shoreline Climate Action Plan](#), adopted 2013, establishes GHG emission reduction targets and educates the community on what they can do to address climate change. The plan specifically addresses energy and water; materials and waste; transportation, land use, and mobility; and urban trees, parks, and open space.

### City of Spokane

Spokane has codified climate actions in its municipal code (Title 15 Environmental Stewardship) and the adopted Sustainability Action Plan, updated in 2017. The action plan, originally adopted in 2009, addresses climate mitigation, adaptation, and energy security. The city council also recently released a [Draft Sustainability Action Plan](#), open for public comment until August 2021.

## City of Tacoma

Tacoma adopted an [Environmental Action Plan](#) (EAP) and in 2016 adopted a resolution directing investments to meet target goals. The EAP is reviewed annually, and annual progress reports are included on the website. The measures include GHG emission reductions as well as other elements such as health, local environment, equity, transportation, energy, and affordability.

## Resilient Methow

[Resilient Methow](#) is a collaborative effort led by local organizations, local, state, and federal agencies, and community leaders to build local resiliency in the face of climate change. It differs from other CAP efforts in that it originated from community efforts to address adaptation and mitigation issues present in the Methow watershed (from Mazama to Pateros, including the cities of Twisp, Winthrop, and other communities). Resilient Methow is developing a CAP for the watershed expected to be completed in the spring of 2021.

## Quileute Indian Nation

The [Quileute Indian Nation](#) is examining risks associated with climate change and actions they can take to protect people and natural resources. They are involved in ongoing work with federal, state, and tribal organizations, including other Tribes (Quinault and Hoh), to assess vulnerability.

## Quinault Indian Nation

The Quinault Indian Nation is located on the Washington coast, and the village of Taholah is at the confluence of the Quinault River and the Pacific Ocean. Taholah is particularly vulnerable to sea level rise, storm surge, and river flooding as well as tsunamis. The village is undertaking a [vulnerability assessment](#) and considering relocating residents of the village.

## Yakama Nation

The Yakama Nation published a [Climate Adaptation Plan](#) in 2016 addressing important resources (natural and cultural) that are vulnerable to climate change and making specific recommendations for further work. The focus is on protecting natural resources such as salmon, the Columbia River watershed, and agriculture.

## Examples from other states

### Ashland, Oregon

Ashland, Oregon, is recognized as a leader in planning for climate change mitigation and adaptation. The city's work includes [specific strategies and actions](#) to reduce GHG emissions by 8% annually and achieve carbon neutrality by 2050.

### Eugene, Oregon

The City of Eugene, Oregon, recently updated the CAP adopted in 2010, to the [2020 City of Eugene Climate Action Plan 2.0](#). The focus of CAP 2.0 is on reaching carbon neutrality, reducing fossil fuel use, and adapting to climate change. Eugene is recognized for its work in [nonmotorized transportation](#)—pedestrian and bicycle transportation.

### Kansas City region

The Kansas City region has been recognized for its leadership on climate action planning. It adopted the [KC Regional Climate Action Plan](#) with a set of strategies that can be used by governments and organizations in the region. They also serve as examples for others engaged in climate planning. The update in 2021 focuses on reducing GHG emissions, transportation, energy, and other elements.

### Georgia Climate Project

The [Georgia Climate Project](#) is an organization comprised primarily of higher education institutions preparing for climate change and impacts with science-based solutions. The project recognizes the potential risks associated with climate change and potential rewards and opportunities in responding. Its focus is on science-based strategies, building constructive dialog, and building networks. This work may be of particular interest to communities where climate change is considered a controversial issue.

## **Resilient Virginia**

[Resilient Virginia](#) was created by the Virginia Sustainable Building Network, an organization dedicated to sustainable building practices. Strategies have been developed to help communities prepare for and respond to disruptive challenges such as extreme weather events and economic disruptions. The Resilient Community efforts focus on four main components: ecosystem services, economic activities, infrastructure and building, and community action. It takes a broader view of resiliency including, but not limited to, climate change.

## Appendix: Sources and resources

This appendix identifies sources for further information and data corresponding to topics in the Handbook.

### General information and data

- AWC Center for Quality Communities
  - [Growing the Green Economy in Washington State](#) (Executive Summary with link to full report)
  - [Growing the Green Economy: Exploring an Eco-Nomic Center](#)
- [Center for Sustainable Infrastructure](#) (CSI) is dedicated to collaborative approaches to sustainable infrastructure. CSI's reports include water, energy, and the most recent report on waste management.
  - [From Waste Management to Clean Materials](#) (referenced on p. 12 of Handbook)
- [Fourth National Climate Assessment, "Chapter 24: Northwest" \(NCA-24\)](#) The National Climate Assessment is a publication of the United States Global Change Research Program comprised of 13 federal agencies including NOAA, NASA, EPA, DOT, DOD, Commerce, Interior, and others. "Chapter 24: Northwest" specifically focuses on Washington, Oregon, and Idaho.
- The [Georgetown Climate Center](#) is associated with Georgetown University Law Center and works to inform state and national policies related to climate change, reducing carbon pollution, and supporting clean transportation options. Its work includes research on transportation and energy across the U.S.
- Geos Institute, based in Ashland, Oregon, helps communities build resilient climate change strategies based on local environmental and ecosystem characteristics. In 2020, it launched the [Climate Ready Communities](#) project providing guidance on how to build climate resilience.

- [Intergovernmental Panel on Climate Change \(IPCC\)](#)
  - In October of 2018, the United Nations IPCC issued the report [Global Warming of 1.5 Celsius](#). This report focuses on actions necessary to meet the Paris targets limiting global warming to 1.5 to 2 degrees Celsius. Sections 4 and 5 of the report specifically focus on strengthening the global response, sustainable development, and a low-carbon climate resilient pathway.
    - Summary of the IPCC report by the University of Washington Climate Impacts Group: [No Time to Waste](#)
  - In 2019 the IPCC followed with a report titled [Climate Change and Land](#) examining land use and interactions with climate change, desertification, food security, and the relationship with GHGs.
- [State of Washington Water Research Center](#)
- University of Washington [Center for Urban Waters](#) focuses on environmental engineering, applied research, and water technologies.
- University of Washington's [Climate Impacts Group](#) offers actionable science and research to help identify and manage regional climate risks and build climate resilience.
  - Referenced on page 3 of Handbook: [Pacific Northwest Climate: A Tale of Two Signals](#)
- Washington State Department of Commerce – Green Economy Work Group report: [Washington's Green Economy](#)
- [Washington State Department of Ecology](#)
- Washington State University's [Metropolitan Center for Applied Research and Extension](#)
- Washington State University's [Center for Environmental Research Education and Outreach](#) (CEREO) provides a wide range of environmental research and projects.

## Economics

- AWC Center for Quality Communities
  - [Growing the Green Economy in Washington State](#) (Executive Summary with link to full report)
  - [Growing the Green Economy: Exploring an Eco-Nomic Center](#)
- Washington State Department of Commerce Green Economy Work Group report: [Washington's Green Economy](#)

## Emergency management

- Local agencies and emergency management organizations
- [Emergency Management Division, Washington Military Department](#)
- [FEMA](#)
- [Washington State Emergency Management Association – Climate Change](#)

## Environmental justice

- Local leadership for vulnerable communities including: NGOs, city and county planning and health departments, advocacy organizations, population and employment data from state and/or local sources, and local electric utility providers
- [Front and Centered](#) (formerly Communities of Color for Climate Justice)
- University of Washington Climate Impacts Group report: [An Unfair Share: Exploring the Disproportionate Risks from Climate Change Facing Washington State Communities](#)

## Finance

- Local utilities and public works organizations
- [Center for Sustainable Infrastructure](#)
- [National Infrastructure Advisory Council](#)

## Flooding and landslides

- Your local public works or planning department, or surface water utility
- [FEMA](#)
- Washington State Department of Ecology – [Coastal Atlas Flood Hazard Maps](#)
- Washington State Department of Natural Resources
  - [Geologic Hazards and Environment](#)
  - [Landslides](#)

## Health impacts

- Local health departments and health care providers
- [Washington State Department of Ecology – Air Quality](#)
- [Washington State Department of Health](#)

## Infrastructure

- Local city and county public works departments and utility providers, including public and private electric utilities
- [American Public Works Association \(APWA\)](#)
- [American Water Works Association \(AWWA\)](#)
- [Infrastructure Assistance Coordinating Council \(IACC\)](#)
- [National Infrastructure Advisory Council](#)
- [Washington State Department of Commerce – Public Works Board](#)
- Washington State Department of Transportation
  - [Climate Change](#)
  - [Climate Impacts Vulnerability Assessment 2011](#)

## Liability

- Your local city attorney or legal counsel
- [Climate Docket](#)
- [Milliman: Climate Risk Briefing Note](#)
- Moody's:
  - [Environmental, Social, and Governance Solutions](#)
  - [Environmental, Social, and Governance Affiliates](#)
  - [Partnership with Vigeo Eiris research and service](#)
- National Association of Insurance Commissioners Report: [The Potential Impact of Climate Change on Insurance Regulation](#)
- [Rhodium Group public and private sector global risk analysis](#)
  - [ProPublica article including Rhodium Group study](#)
- Sabin Center for Climate Change Law – [Climate change litigation database](#)
- [Washington State Association of Municipal Attorneys](#)
- [Washington State Office of the Insurance Commissioner](#)

## Sea level rise

- [NOAA Sea Level Rise Viewer](#)
- [Puget Sound Climate Preparedness Collaborative](#)
- University of Washington Climate Impacts Group: [Interactive sea level rise visualizations](#)
- University of Washington Climate Impacts Group and Washington Sea Grant – [How to choose: A primer for selecting sea level rise projections for Washington state](#)



- [Washington Coastal Hazards Resilience Network](#)
- [Washington Sea Grant – Hazards, resilience, and climate change](#)
- Washington State Department of Commerce – [Short Course on Local Planning](#)
- Washington State Department of Ecology – [Sea level rise](#)

## Surface water management

- Your local public works department or surface water utility
- The Nature Conservancy of Washington’s [What is Green Stormwater Infrastructure?](#)

## Transportation

- Washington State Department of Commerce – [Energy programs](#)
- [Washington State Department of Transportation](#)

## Wastewater

- Your local utility, wastewater treatment system, or water district

## Water supply

- Your local source for water, local utility, water district, or water provider
- Washington State Department of Health – [Water supply and climate](#)
- Washington State University’s Metropolitan Center for Applied Research and Extension – [Food, Energy, and Water \(FEW\) research](#)
- [Water Utility Climate Alliance](#) provides leadership and resources to water utilities on issues related to climate change and water resources.

- Resources include these [engineering case studies](#) that showcase how the water sector is applying climate adaptation in practice.

## Wildfires

- Your local fire department or fire district
- [Local air quality agencies](#)
- [Community Planning Assistance for Wildfire](#)
- [United States Forest Service – Fire information](#)
- [United State Geological Survey – Wildfire tools](#)
- Washington State Department of Ecology
  - [Air Quality](#)
  - [Wildfire Information](#)
- Washington State Department of National Resources
  - [Wildfire Information](#)
  - [Wildfire Preparedness \(Firewise\)](#)
  - [Wildfire Resources](#)

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