



**strategic**

# CLIMATE ACTION PLAN



November 2015



**King County**

# SECTION TWO: Preparing for Climate Change Impacts



*Flooding in the Snoqualmie Valley in January 2015.*

## KEY TAKEAWAYS

- ▶ Climate change impacts are here and now; in the last century, sea level in Seattle has risen by eight inches and average annual temperatures in the Pacific Northwest have increased 1.5 degrees Fahrenheit.
- ▶ While GHG emissions must be reduced to avoid the worst impacts of climate change, impacts are projected even if global and local GHG emissions are drastically cut.
- ▶ The County is integrating climate change preparedness into:
  - operations and maintenance of infrastructure, programs, and natural resources.
  - provision of public services.
  - partnerships with other local governments, community groups, and businesses.
- ▶ King County plays critical roles related to climate change preparedness, planning, and regional coordination, and this section of the 2015 SCAP outlines key commitments to:
  - Assess impacts of climate change on local rainfall patterns and flooding and integrate this information into a range of services.
  - Plan for climate change impacts on wastewater, stormwater, emergency management, public health, roads, flood risk reduction, and salmon recovery.
  - Improve regional coordination on climate change preparedness, including engaging partners and the public.

## INTRODUCTION

Even if global and local GHG emissions decrease dramatically, many climate impacts are now inevitable and preparation for these changes is essential. King County has had a long-standing commitment to preparing for the impacts of climate change, from joint work with the University of Washington and ICLEI-Local Governments for Sustainability to develop [Preparing for Climate Change: A Guidebook for Local, Regional and State Governments](#) for local governments in 2007, to pioneering approaches to assess the impacts of sea level rise on wastewater conveyance and treatment facilities, to integrating climate resiliency recommendations into the County's Comprehensive Plan beginning in 2008. The 2015 SCAP strengthens and expands the County's climate preparedness commitments, focusing on assessing climate impacts and tailoring recommended actions to core County services, integrating an equity and social justice lens, and expanding regional coordination.

The remainder of **Section Two: Preparing for Climate Change Impacts** presents the following information:

- **Overview: Climate Change Impacts in King County**
- **Goals and Strategies**
- **Program-specific impacts, ongoing responses, priority actions and long term direction for twelve focus areas:**
  - Built Environment
    1. Wastewater Treatment and Conveyance
    2. Roads and Bridges in Unincorporated King County
    3. King County International Airport
    4. King County-Owned Buildings and Facilities
  - Planning and Regional Services
    5. Countywide and Regional Planning
    6. Public Health
    7. Stormwater
    8. Flood Risk Reduction and Floodplain Management
    9. Salmon Recovery and Other Rural Programs
    10. Public Transportation (including King County Metro Transit and Water Taxi)
    11. Environmental Science and Monitoring
    12. Emergency Management
- **Summary of Priority Actions by 2020**

## OVERVIEW: CLIMATE CHANGE IMPACTS IN KING COUNTY

A wide range of climate change impacts are occurring or are projected to occur in King County; these are **similar to impacts across Washington State**. Because of the slow response of the climate system and the large increase in GHGs in the atmosphere since the start of the industrial revolution, these impacts are projected to occur to some degree regardless of future local and global efforts to reduce GHG emissions. Key climate impacts for King County are summarized below.



**WHAT RELATED IMPACTS ARE HAPPENING IN OUR REGION?**

CLIMATE CHANGE IS AFFECTING OUR ENVIRONMENT, ECONOMY AND HUMAN HEALTH.

<p><b>OCEANS</b></p> <p><b>OCEAN WATER</b></p> <p><b>25% MORE ACIDIC</b></p> <p>SINCE THE INDUSTRIAL REVOLUTION</p> <hr/> <p><b>PUGET SOUND</b></p> <p>HAS RISEN MORE THAN</p> <p><b>8 inches</b></p> <p>1913 2013</p>	<p><b>RIVERS</b></p> <p><b>SUMMER</b></p> <p>LOWER FLOWS</p> <p><b>FALL/WINTER</b></p> <p>HIGHER FLOWS + FLOODING</p> <hr/> <p><b>OVER 80%</b></p> <p>OF STREAMS SURVEYED IN KING COUNTY EXCEEDED A SALMON-SAFE TEMPERATURE</p> <p><b>FLOODING HAS CLOSED</b></p> <p>INTERSTATE <b>5</b></p> <p><b>4 TIMES</b> SINCE 1991</p>	<p><b>MOUNTAINS</b></p> <p><b>AVERAGE CASCADE SNOWPACK</b></p> <p><b>25%</b></p> <p>1950 2006</p> <hr/> <p><b>4</b> -FOLD INCREASE IN WILDFIRES</p> <p>YEARLY AVG. 1970-1986</p> <p>YEARLY AVG. 1987-2003</p> <p><b>6</b> TIMES THE FOREST AREA BURNED</p>
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**WHAT IS THE RISK FOR OUR REGION IN THE FUTURE?**

IF WE DON'T ACT NOW, THE COSTS AND CONSEQUENCES WILL GROW.\*

<p><b>OCEANS</b></p> <p>DISRUPTION OF MARINE ECOSYSTEM</p> <hr/> <p>MARINE-BASED ECONOMIES</p> <p>SUFFER AS</p> <p>FISH/SHELLFISH DIMINISH</p>	<p><b>RIVERS &amp; STORMS</b></p> <p><b>\$29 BILLION</b> BUILDINGS &amp; ROADS IN PUGET SOUND AT RISK OF FLOODING</p> <hr/> <p><b>INCREASE IN SEVERE STORMS</b></p> <p>2010 2050s</p>	<p><b>MOUNTAINS</b></p> <p><b>AVERAGE WASHINGTON SNOWPACK</b></p> <p><b>40%</b></p> <p>1916-60 AVG. 2040s</p> <hr/> <p><b>PNW ACRES BURNED BY WILDFIRES EVERY YEAR</b></p> <p>1916-2006 AVG. 425,000</p> <p>2020 800,000</p> <p>2040 1,000,000</p> <p>2080 2,000,000</p>
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OTHER IMPACTS ARE POSSIBLE.

<p><b>INCREASE IN CHRONIC HEALTH PROBLEMS</b></p>	<p><b>IMPACTS IN FORESTS FROM INSECTS &amp; DISEASE OUTBREAKS</b></p>	<p><b>\$1,250/yr by 2020</b></p> <p><b>INCREASE IN HOUSEHOLD COSTS</b></p>	<p><b>IMPACTS TO RECREATION AND QUALITY OF LIFE</b></p>	<p><b>IMPACTS TO SALMON AND WILDLIFE</b></p>
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\* Over the coming decades, the severity of global and local climate change impacts is largely dependent on whether greenhouse gas emissions decline or continue to rise.

### Warmer Air Temperatures

Average annual air temperatures across the Pacific Northwest are projected to increase by two degrees F to 8.5 degrees F by the 2050s, with a likely increase of 4.3 degrees F to 5.8 degrees F. This suggests that by mid-century, Washington State is likely to regularly experience average annual temperatures that exceed the warmest conditions observed in the 20th century. The range of potential temperature increases results from differences in future trends in GHG emissions and modeling uncertainties. Washington State is also expected to experience more frequent and more intense summer heat waves and less frequent and less intense winter cold spells.

These increased temperatures are projected to contribute to:

- Greater incidence of heat related mortality during more intense summer heat waves.
- More air pollution and health impacts during warm summer months.
- Higher summer energy use, especially from air conditioning.
- Warmer water temperatures in streams, rivers, lakes, and Puget Sound.
- Higher summer water demand with less accumulated snow pack, especially during more intense and longer summer droughts.
- Northward shift in vegetation patterns.
- Increased fire risk in forest lands and open space.
- More invasive species and loss of indigenous species.

### Changing Rainfall Patterns

While the total annual amount of precipitation in the Puget Sound region is not projected to change, two key changes in precipitation patterns are likely. First, winter precipitation in the Cascade Mountains is projected to fall more frequently as rain instead of snow. Second, larger and more frequent storms are projected.

These changed rainfall patterns are projected to contribute to:

- A general shift to higher winter flows and lower summer flows in major rivers.
- Larger and more frequent river flooding, especially during winter months.
- Potentially increased flows in the combined portions of wastewater conveyance systems.
- More urban flooding.
- Increased landslide risk due to greater soil saturation levels.

### Sea Level Rise and Ocean Acidification

In Seattle, the level of Puget Sound has risen about eight inches since 1900. In the Puget Sound region, additional sea level rise is expected of between six and 50 inches by 2100, depending on future global trends in GHG emissions and glacial melt rates. Ocean acidity is projected to increase by between 38 and 109 percent.

These changed conditions in Puget Sound are projected to contribute to:

- More coastal flooding on king tides and other high tides and during storm surges.
- Increased landslide risks along coastal bluffs.
- Changes to the Puget Sound food web, including potential impacts to both wild and commercially-grown shellfish.

## Population Growth

King County has grown rapidly in recent years, with a net increase of 280,000 new residents between 2000 and 2014. Current projections by the Puget Sound Regional Council estimate King County's population increasing by an additional 444,000 by 2040 for a total expected population of 2.4 million people. This population growth is driven by migration to King County from across the United States and the world. Migration patterns are caused by a variety of factors, including economic opportunities, family, friends and support systems, and climate desirability, among others. It is possible that quality of life and economic vitality of some industries in the Puget Sound region could increase relative to elsewhere in the United States due to uneven climate impacts. For example, heat waves are likely to be less severe and water supply more stable in the Puget Sound region relative to some agricultural areas in the American Southwest. Varying impacts of climate change from one region to another may result in an increase in migration from other parts of the country or other parts of the world.

It is unknown to what degree, or even if, population growth rates will increase beyond official projections due to increased climate desirability relative to other areas. If King County's population growth rate increased substantially beyond what is planned for, government services could be strained, additional infrastructure could be needed, and the availability of affordable housing could decrease.

## Economic Impacts

Projected climate impacts in King County will likely bring economic impacts. A trend of decreasing snowpack and changing precipitation patterns create additional uncertainty for water supplies (impacts vary by supplier depending on their water source) and availability of water for irrigation of agriculture. Snow dependent industries like ski areas saw one of their worst years on record in 2015. Increasing stream temperatures put stress on migrating salmon that are relied upon by Treaty Tribes and commercial fishers. Nationally, more frequent and severe storms and flood disasters are leading businesses and insurers to take steps to mitigate risks, triggering changes in insurance costs and availability.

## Disparate Impacts

Climate change is expected to have disproportionate impacts on some populations and can exacerbate pre-existing disparities in health, housing, or access to parks. For example, increased mortality from heat events is already being documented for the elderly, very young, and those with existing health conditions like diabetes and respiratory disease. Lower cost housing is in some cases concentrated in flood hazard risk areas that potentially will see more severe and frequent flooding. At the same time, lower income populations have the least resources to mitigate impacts like increased frequency of heat events and flooding, through actions like flood proofing, home insulation, air conditioning, or easily accessing a shady park or air conditioned community center. Language can also be a barrier to information on disaster preparedness. Fortunately, many of the climate solutions outlined in **Section One: Reducing Greenhouse Gas Emissions** can also serve as powerful opportunities to address broader inequities. For example, investments that better integrate transit and land use and expand commute options will increase access to work, education, and health care. Development and adoption of well-designed green building standards can make homes more comfortable during heat events, improve indoor air quality, and reduce utility and repair costs. Expanded open space protection and linking regional trails to transit expands access to healthy recreation options.

# goals & strategies

## County Services



**Goal:** King County will collaborate with local cities, residents, and other partners to prepare for the effects of climate change on the environment, human health, public safety, and the economy.

CATEGORY	STRATEGIES
<b>Public Services and Education</b> ▶▶	<b>Strategy A:</b> Integrate observed and projected climate change impacts, including severe weather, flooding, drought, fire, and landslides, into emergency management planning and programs.
	<b>Strategy B:</b> Develop funding strategies to strengthen programs for King County residents, including vulnerable sub-populations, to address public health issues associated with heat waves, large storms and flooding, vector-borne and infectious diseases, mental stress, and respiratory effects.
	<b>Strategy C:</b> Evaluate climate change impacts on King County’s natural resources, such as forests, fisheries, productive farmland, water resources, and assess and improve the efficacy of King County’s programs to protect these resources.
	<b>Strategy D:</b> Apply the Equity Impact Review process to help prioritize investments in making infrastructure, natural resources, and communities more resilient to the impacts of climate change.
<b>Coordination with Partners</b> ▶▶	<b>Strategy A:</b> Collaborate with the scientific community, state and federal agencies, and other jurisdictions to develop detailed, science-based estimates of the magnitude and timing of climate change impacts on air temperatures and heat waves, rainfall patterns and severe weather, river flooding, sea level rise, fish and wildlife, and ocean acidification in King County.
	<b>Strategy B:</b> Share information on climate change impacts and collaborate on approaches to improving resiliency of infrastructure, disaster preparedness, and public engagement with local cities and other partners to make the best use of limited resources and more effectively engage King County residents.
	<b>Strategy C:</b> Building on work by the Water and Land Resources Division to implement a high-precision pH monitoring program in Puget Sound, King County will collaborate with the Puget Sound Partnership (PSP) and other state and federal agencies to identify how King County can most effectively work to reduce the harmful effects of ocean acidification. This includes working to address potential impacts to both wild and commercially grown shellfish, as reflected in the PSP’s “Shellfish” Strategic Initiative.



**Goal:** King County will plan and prepare for the likely impacts of climate change on County-owned facilities, infrastructure, and natural resources.

CATEGORY	STRATEGIES
<b>County Infrastructure and Operations</b> ▶▶	<b>Strategy A:</b> Implement infrastructure operation and maintenance programs that consider full life-cycle costs and climate change impacts in asset management.
	<b>Strategy B:</b> Integrate estimates of the magnitude and timing of climate change impacts into capital project planning, siting, design, and construction.
	<b>Strategy C:</b> Train and educate staff to develop skills and expertise in preparing for climate change impacts.

## PROGRAM-SPECIFIC OVERVIEW: IMPACTS, ONGOING RESPONSES, AND PRIORITY ACTIONS AND LONG-TERM DIRECTION

### Introduction

Climate change will have a range of impacts on County services and facilities and must be woven into long-range planning, capital project planning and design, emergency response, and other services. Rather than establishing a stand-alone climate preparedness program, King County is integrating assessment and consideration of climate impacts throughout its operations.



The following section outlines likely climate change impacts, ongoing responses, and priority actions and long-term direction for twelve focus areas.

- ▶ Built Environment
  1. Wastewater Treatment and Conveyance
  2. Roads and Bridges in Unincorporated King County
  3. King County International Airport
  4. King County-Owned Buildings and Facilities
- ▶ Planning and Regional Services
  5. Countywide and Regional Planning
  6. Public Health
  7. Stormwater
  8. Flood Risk Reduction and Floodplain Management
  9. Salmon Recovery and Other Rural Programs
  10. Public Transportation (including King County Metro Transit and Water Taxi)
  11. Environmental Science and Monitoring
  12. Emergency Management

As noted earlier in this section, it is anticipated that climate change will have disproportionate impacts on some communities, including low income populations and those with existing health issues. King County’s Equity and Social Justice Ordinance requires the use of the Equity Impact Review process in the development of major program and project proposals. As County departments and divisions embed climate change impact considerations throughout their services and capital projects, their decision-making will be shaped by the equity frameworks outlined in the Equity Impact Review tool:



- **Process Equity:** Inclusive, open, and fair access by all stakeholders to decision processes that impact sustainable community outcomes.
- **Distributional Equity:** Fair and just distribution of benefits and burdens to all residents across the community landscape, with little imbalance based on geography, gender, race/ethnicity, or income levels of households.
- **Cross-generational Equity:** Effects of today’s actions on the fair distribution of benefits and burdens to future generations and communities.

**EQUITY IMPACT REVIEW PROCESS**



*King County’s Equity Impact Review process will help guide agencies’ decision-making on climate change.*

**Built Environment**

**1. Wastewater Treatment and Conveyance**

King County operates the regional wastewater collection and treatment system for the greater Seattle metropolitan area, serving as a wholesaler to local sewer districts, and also provides treatment for portions of Vashon Island and the City of Carnation. Wastewater districts outside of King County’s service area in southwest and south King County provide their own treatment.

**Impacts**

Climate change impacts could affect the wastewater treatment system in five primary ways:

- Sea level rise could result in greater and more frequent flooding for shoreline facilities.
- Sea level rise could increase salt water intrusion into the conveyance system in low-lying areas.
- Increased river flooding could result in greater and more frequent flooding for facilities in floodplains.
- More frequent and larger storms could increase flows in the wastewater conveyance system, especially in the combined system within the City of Seattle.
- Warmer summer temperatures and increased probabilities of droughts could increase demand for reclaimed water.

**Ongoing Response**

The Wastewater Treatment Division maintains a robust asset management program for its wastewater conveyance and treatment system. The Regional Wastewater Services Plan prioritizes

investments to maintain the integrity of the system and protect public health. The division has begun preparing for the changing climate in several ways:

- In 2008, the Wastewater Treatment Division completed an analysis of facilities along the Puget Sound shoreline and has since incorporated sea level rise into facility siting and design.
- The Wastewater Treatment Division and Seattle Public Utilities are investigating the potential increase of saltwater intrusion into the conveyance system and have begun modifying the conveyance system and outfalls to reduce or eliminate intrusions, even during high tides. Preparations for limiting saltwater intrusion may include installing flap gates, raising weirs, or other similar controls.
- The Wastewater Treatment Division has reviewed all of its facilities within the Federal Emergency Management Agency's (FEMA) 100-year floodplains and is identifying steps to ensure all facilities are protected from current flood risks. This work will be updated when information on climate change impacts on floodplains is available.
- The Wastewater Treatment Division has developed a reclaimed water program from Brightwater to the Sammamish River valley and near the South and Carnation Treatment Plants. Major infrastructure for delivering reclaimed water to the valley has been constructed and reclaimed water use has begun. Not only can reclaimed water reduce Puget Sound discharges, it can replace irrigation water withdrawals from the Sammamish River valley during low-flow summer months.

### **Priority Actions and Long-Term Direction**

In 2015, the Wastewater Treatment Division is beginning an investigation, in cooperation with the Water and Land Resources Division and the University of Washington, into the likely degree and timing of change in precipitation patterns in King County. The Wastewater Treatment Division will use this research to assess climate change impacts on the conveyance and treatment system and develop appropriate responses.

The Wastewater Treatment Division will expand its reclaimed water program in the Sammamish River valley and near the South and West Treatment Plants to reduce reliance on Puget Sound for the discharge of treated effluent. Nonpotable, reclaimed water can be used for agricultural irrigation and groundwater recharge, which in the Sammamish River valley would likely reduce the amount of locally-sourced water used for irrigation. This would help improve summer stream flows and water temperatures in the Sammamish River.

### **2. Roads and Bridges in Unincorporated King County**

The King County Road Services Division manages all roads, bridges, and related infrastructure in unincorporated King County and also provides services to some cities by contract. The division manages 1,500 miles of County roads and 180 bridges that carry more than 1 million trips per day. The 250,000 residents of unincorporated areas receive roadway, drainage, shoulder, and right of way maintenance and operations services directly from King County. These systems are aged and deteriorating. The current capital improvement program has shrunk significantly and now funds only a very small portion of needed maintenance and preservation of the road system.

The Road Services Division is focusing on immediate operational safety issues and compliance with regulatory and legal mandates.

## Impacts

Climate change is likely to have several substantial effects on roads and bridges in unincorporated King County:

- More frequent and larger rain events and more intense storms may increase urban and river flooding, which may:
  - Increase travel delays and road closures.
  - Increase risk of landslides, roadway washouts and erosion and scouring around bridge supports.
  - Overwhelm the drainage networks (culverts, pipes and open ditches) along roads, causing more local flooding issues.
  - Overtop and block roads and bridges in river floodplains.
- Sea level rise will cause more coastal flooding on king tides, high tides, and during storm surges, including along three road segments on Vashon Island. These roads are the only coastal County roads in the unincorporated area. Currently, they flood at least once per year and will likely flood more often in the future.
- More high wind events would require:
  - Increased emergency response to downed power lines and trees on roads and bridges.
  - More coordination with utility companies for downed utilities and trees in wires.
  - Additional maintenance response to protect the safety of the traveling public.
- Higher temperatures with more heat waves may increase rutting and concrete cracking in roadway pavement, requiring increased maintenance, changes to roadway construction materials and methods, and reduced durability of asphalt.

## Ongoing Response

A structural funding problem constrains the ability of the Road Services Division to maintain road infrastructure. Within budget constraints, the division aims to maintain and repair roads, bridges, and ancillary infrastructure and to respond to events in a timely manner.

**Maintaining Transportation Infrastructure.** The Road Services Division maintains roads, bridges, culverts and other related infrastructure in unincorporated King County.

## Assessing Infrastructure Condition.

The Road Services Division has started assessing the County's transportation infrastructure conditions, as part of a comprehensive asset and maintenance management program. This program utilizes Geographic Information Systems (GIS) tools and supports a data-driven asset management approach, employing new information technology to analyze asset conditions and make data-driven decisions about service and investment priorities. The asset categories include roadways, bridges, and drainage (catch basins, pipes and open ditches), as well as traffic control devices and roadside



*Dockton Road SW, located on Vashon Island in unincorporated King County, is protected by a 100-year old seawall that is vulnerable to storm surges and sea level rise.*

features, such as guardrail and sidewalks. In addition, as required by the WAC 136-20-060, the Road Services Division produces the “Annual Bridge Report,” which provides the findings of bridge inspections. Both of these assessments will help support efforts to adapt to the prospect of long-term changes in climate.

**Emergency Response to Large Storms, Windstorms, and Floods.** The Road Services Division responds to large rain events, windstorms and floods by closing roads as needed, cleaning debris after the event, and coordinating with utility companies to address downed utility lines or trees in lines. Design modifications to respond to larger storms are needed.

**Emergency Repairs Due to Flooding.** Emergency repairs are typically needed annually on three coastal road segments on Vashon Island due to coastal flooding. No funding is currently available to move these coastal roads to higher elevations. Emergency repairs are conducted on roads and bridges damaged by river flooding, except when the damage is beyond budgetary capacity. Funding for redesigning and replacing roads and bridges to avoid river floods or reduce flood risk is not currently available.

### Priority Actions and Long-Term Direction

With current funding levels, the Road Services Division will focus on immediate operational safety and emergency response needs. The Road Services Division will incorporate information about changes in future flooding, storm sizes and frequencies, and landslide risks into roads maintenance and preservation programs and projects for unincorporated King County to the extent feasible under available funding and/or as required by permitting agencies. King County will continue to evaluate and seek out options for additional funding to operate and maintain the road system. Such additional funds could help the Road Services Division be able to respond to weather impacts and storm events, to the extent that such response is consistent with strategic priorities of life safety and regulatory requirements.



### 3. King County International Airport

King County owns and operations the King County International Airport/Boeing Field (KCIA), which is located in the Duwamish River floodplain near sea level.

#### Impacts

Climate change is likely to have two key effects on the King County International Airport (KCIA):

- More frequent and larger rain events may exceed the drainage network at the KCIA, causing more standing water issues. This would require additional emergency response during rain events and additional debris clean up post-event.
- The KCIA is in the Duwamish Estuary floodplain and protected by a levee network. Sea level rise projections suggest that levees along the Lower Duwamish Waterway could be overtopped during king tides, high tides, and storm surges by the end of the century, which would inundate low-lying land along the Duwamish Waterway, including a portion of the KCIA.



*King County International Airport*

### Ongoing Response

KCIA has taken steps to mitigate drainage issues associated with large storm events and address flood related issues, including rising sea levels and large river floods. These steps include:

**Backup power supply for stormwater pumps.** Large electric pumps are installed at two of the three stormwater outlets from the KCIA to the Duwamish River. KCIA's two diesel-powered electric backup generators can power the stormwater pumps should the KCIA lose power during a storm. The backup generators were purchased as part of the response to the increased flood risk associated with the Howard Hanson Dam structural integrity issues. At the third outfall, a diesel-powered backup pump would be rented should that system's gravity system be overwhelmed. These pumps are capable of pumping more than the expected amount of stormwater runoff at the airport and can pump regardless of tidal/river flood stage.

**Stormwater outfall flap gates and backflow preventers.** KCIA has several methods for preventing high tides or river flows from causing flooding upstream of the pump stations. The two stormwater outfalls with pump stations have backflow preventers in their outlet flumes. The KCIA is considering additional backflow preventers for each location to prevent the Duwamish River from backing up all of the way to the pump stations. The third outfall has a flap gate at the Duwamish River. The flap gate and backflow preventers work in conjunction with the levee system to ensure that the KCIA is protected from flows and tides several feet higher than the current high tide and 100-year flood event.

**Enhanced drainage along runways.** Edge drains were installed along runways to ensure proper drainage during large storm events. This enhanced drainage improves airport safety by ensuring that soils along the runways are not saturated and thus are safe for airplanes, in case an airplane veers off the tarmac. Edge drains were installed using Federal Aviation Administration grant funding.

### Priority Actions and Long-Term Direction

The KCIA is completing a comprehensive inventory, digital survey, and evaluation of the airport stormwater system. It is a closed system and where repairs, improvements, and additions are identified, they will be completed as part of the Capital Improvement Program for the airfield. Long-term concerns about sea level rise and increased flood sizes will be addressed over the next several decades as the Lower Duwamish Waterway levee network is maintained.

## 4. King County-Owned Buildings and Facilities

King County owns and manages buildings and other infrastructure throughout the county to house government operations.

### Impacts

Larger and more frequent storms are likely to cause more stormwater runoff from all County-owned properties and buildings, which may overwhelm the stormwater management system. Buildings in floodplains and along the coast will have a higher risk of flooding. All buildings may also have increased cooling needs during summer heat events.

### Ongoing Response

King County's buildings all meet or exceed all required state and federal stormwater and flood protection requirements.

### Priority Actions and Long-Term Direction

Long-term concerns about managing increased stormwater runoff from rain events will be addressed in future updates of the Surface Water Design Manual. Long-term concerns about increasing flood sizes and frequencies will be reassessed following research on climate change impacts on flooding.

## Planning and Regional Services

### 5. Countywide and Regional Planning

King County complies with all requirements of the GMA, which includes adoption and periodic updates of the King County Comprehensive Plan and Countywide Planning Policies and participation in development and maintenance of Multicounty Planning Policies. The GMA contains the primary state-level mandates to identify and protect critical areas, with special consideration given to areas that support salmonids, and to identify and protect resource lands of long-term significance. King County uses Washington State Office of Financial Management and Puget Sound Regional Council (PSRC) growth projections for planning purposes.

#### Impacts

A core focus of GMA and the County's Comprehensive Plan is ensuring that designated urban growth areas and planned infrastructure improvements are adequate for anticipated population growth. According to current estimates, the population of the central Puget Sound region is projected to increase from about 3.69 million people in 2010 to nearly five million people in 2040. However, some areas of the United States are projected to face substantial drought and heat impacts from the changing climate, which could shift migration patterns towards areas less impacted by climate change, such as the Puget Sound region. Current growth projections used by PSRC do not account for increased migration due to climate disruption. Increased population growth beyond what is planned would strain services and infrastructure and could result in political pressure to expand the urban growth boundary.

#### Ongoing Response

King County conducts major updates to its Comprehensive Plan on a four-year cycle. Beginning with the major update in 2008, the County added policy and program recommendations for climate change mitigation and preparedness. King County is currently developing the 2016 update and will review and update climate change-related information and policy recommendations in the Comprehensive Plan. King County also engages continually in countywide and multicounty planning at the Growth Management Planning Council and Puget Sound Regional Council.

### Priority Actions and Long-Term Direction

King County will coordinate with Washington state agencies, PSRC, GMPC, other jurisdictions, and university researchers to evaluate potential population growth increases beyond current projections due to migration from climate disruption. King County may contribute funding to a shared research effort on this topic. Information on the likelihood, magnitude, and timing of potential increases in population growth rates will be used by the Wastewater Treatment and Transit Divisions in future updates to their respective service plans.

### 6. Public Health

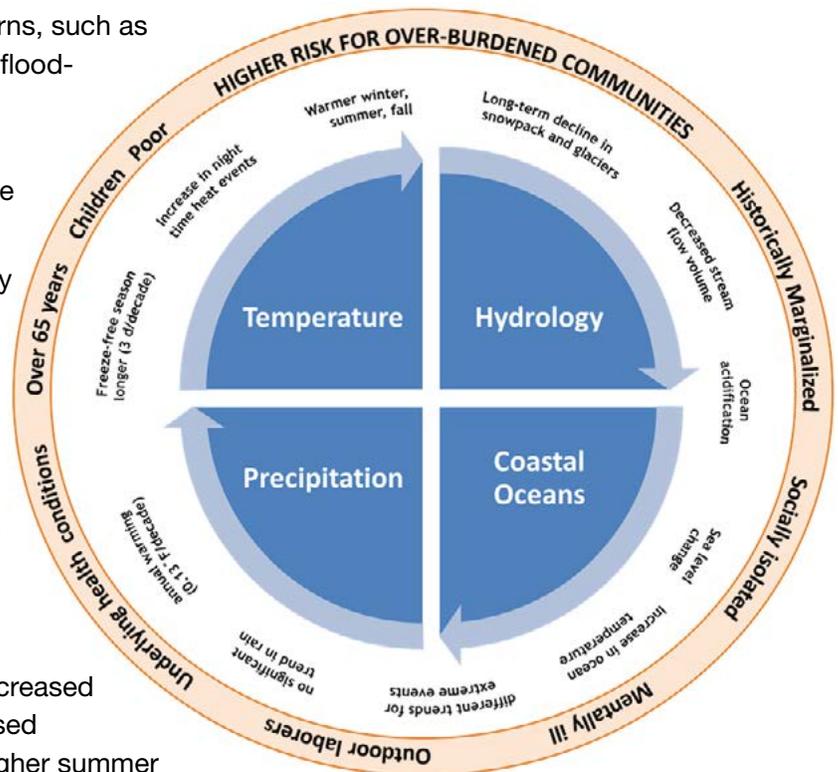
Public Health – Seattle and King County (Public Health) provides a wide range of services to protect and improve the health and well-being of all people in King County. Public Health protects the public from health threats, promotes better health, and helps ensure accessible, quality health

care for the public. Health promotion includes leading efforts to encourage healthy living and prevent chronic conditions and injuries. Health protection functions include tracking and preventing disease and other threats, preparing for and responding to emergencies that impact health, and ensuring the safety of food, water, and air.

**Impacts**

Although in general, the health impacts are under-studied and widely diverse, climate change is expected to affect both physical and mental health of people in King County. Some populations are more vulnerable to impacts on their health from a changing climate, such as children, people over age 65, economically disadvantaged individuals, socially isolated individuals, and people with existing mental or health conditions. Climate change impacts such as extreme weather events, flooding, sea-level rise, and increased temperatures may lead to significant health impacts, which can include:

- Heat-related illness, such as heat stroke and other cardiorespiratory illness.
- Flooding damage to potable water and wastewater systems and disease concerns, such as bacterial growth or mold, in flood-impacted structures.
- Wildfire impacts, such as respiratory illness and smoke inhalation or burn injuries.
- Disruption to the food supply affecting local agriculture and seafood harvests.
- An increase in the number and range of vector-borne diseases, such as Lyme disease and West Nile virus, and water-borne diseases, such as E. Coli and Vibrio parahaemolyticus.
- Respiratory impacts from increased urban air pollution or increased allergens associated with higher summer temperatures.



*Health impacts of a changing climate will be experienced differently by King County residents, influenced by factors such as income, age, health, and where they live.*

**Ongoing Response**

Public Health responds regularly to severe weather events including winter storms, drought, and high heat, leveraging departmental expertise and programs such as Environmental Health, Emergency Medical Services, Communicable Disease Epidemiology, Public Health Preparedness, and Communications. Future and ongoing response to increased severe weather events and other impacts identified above are constrained because of a structural funding problem across the department. Community partnerships are critical in response efforts, and Public Health actively partners with local emergency management, healthcare, and community and faith-based organizations. Monitoring the situation, developing and disseminating life-saving information, and conducting outreach are key focus areas during severe weather events.

Public Health responds to severe weather through the following activities:

- Activates the Health and Medical Area Command (incident command structure) to coordinate “Emergency Support Function 8” response activities.
- Monitors disease surveillance data and requests hospitals and healthcare providers report cases of carbon monoxide poisoning during times of widespread power outages.
- Monitors King County Medic One response calls for reports of illness or medical issues, such as heat-stroke and carbon monoxide poisoning.
- Coordinates messaging with governmental and healthcare partners through public information officers and joint information centers.
- Partners with the Northwest Healthcare Response Network to monitor impacts to hospitals, health systems and long-term care facilities, assuring that service capacity is maintained and systems are operational.
- In partnership with the Office of Emergency Management, activates the Winter Weather Transportation plan to provide transportation for individuals needing life-saving treatment for acute or chronic health conditions that require regular intervention (such as chemotherapy or dialysis) and have already explored all other options.
- Activates the Community Communication Network to provide outreach and education to communities at risk for carbon monoxide poisoning due to power outages and cold temperatures, heat safety messages for those vulnerable due to medications, age, and environment, as well as other life-safety messages.
- The Vulnerable Populations Action Team’s (VPAT) Community Communication Network (CCN) is a way to exchange information with community and faith-based organizations and community leaders to ensure essential emergency and emergency health-related information reaches vulnerable residents of King County.<sup>3</sup> There are currently over 400 agencies are enrolled in the CCN totaling over 700 individuals.
- Leverages community partnerships developed by VPAT to help service providers get prepared, stay prepared, and be ready to respond to their clients’ needs during times of disaster. Systems and tools developed for emergency-related events can be leveraged to help agencies be better prepared to withstand impacts caused by climate change.
- Conducts outreach to communities that may be disproportionately impacted by disasters through partnerships developed through VPAT including the Somali Health Board, Homeless Stakeholder Group, and Vietnamese Community Communication Project.

Vulnerabilities before, during, and after emergencies are rooted in structural and systemic barriers; crisis exacerbates the damaging effects of these factors. Those that need the most help, the most vulnerable, are often the ones who fall through gaps in access to information, services, and resources.

### Priority Actions and Long-Term Direction

Public Health is operating in an austere budget environment.

The current projected deficit in the Public Health fund presents a challenge in taking on new work as Public Health has substantially lower staffing levels and lower levels of service than in the past. For example, the budget for preparedness work is comprised



<sup>3</sup> The Vulnerable Populations Steering Committee defines a vulnerable population as: “Any individual, group, or community whose circumstances present barriers to obtaining or understanding information, and/or to access and use the resources offered before, during and after a disaster event. Circumstances that may present barriers include, but are not limited to age; physical, mental, emotional, or cognitive status; culture; ethnicity; religion; language; citizenship; location; or socioeconomic status.”

entirely of federal grants, which are limited in scope and have been cut in recent years. In addition, the Environmental Health section is funded primarily by fees, which are restricted for program activities that generate those fees. Without additional funds, Public Health will capitalize on existing outreach efforts to conduct stakeholder engagement to inform the climate change work going forward and will seek to identify additional funding to support implementation of the identified actions.

By 2020, Public Health will:

- Develop and implement a stakeholder engagement strategy to gauge perceptions of climate impacts on human health and to inform policy changes to prepare for climate change. First, Public Health will partner with the Office of Emergency Management to implement a survey of local emergency managers. Other potential stakeholders include Public Health employees and community partner organizations.
- Use engagement and survey results to develop strategy and potential policy changes to address and prepare for climate change.
- Develop a funding strategy for a comprehensive public health and climate change program to include:
  - Implementing a data surveillance system to monitor and report human effects of climate change, particularly for vulnerable populations.
  - Conducting community and stakeholder engagement, education, and outreach, with an emphasis on historically marginalized and overburdened communities.
  - Establishing systems to detect and respond to current and emerging health threats.
  - Preventing and adapting to current and anticipated human health impacts.
- Secure the assistance of an intern or practicum student to help identify key components, develop a program framework, and pursue a strategy to secure funding required for implementation.

## 7. Stormwater

King County and the local cities have stormwater management programs with several functions, including ensuring new stormwater facilities have adequate flow control and water quality treatment, operating and maintaining stormwater facilities, and responding to emergencies to maintain stormwater facilities and limit urban flooding.

### Impacts

Stormwater conveyance and treatment systems in unincorporated King County have been designed to accommodate runoff generated by historical rainfall patterns. As climate change is projected to shift rainfall patterns to more frequent and larger storms, it is possible that some of the stormwater systems may be undersized for future conditions, which would result in more urban flooding and increased emergency response and maintenance needs before and after storms.

### Ongoing Response

The Water and Land Resources Division is in the process of developing a comprehensive asset management plan for its stormwater conveyance and treatment assets. King County maintains a stormwater design manual and meets all requirements of its municipal stormwater permit issued by the Washington State Department of Ecology under the National Pollutant Discharge Elimination System for stormwater management in unincorporated King County. The manual is also used by

multiple cities within King County. The Water and Land Resources Division reviews development plans and designs to ensure stormwater infrastructure built in unincorporated King County meets flow control and water quality treatment requirements. The Water and Land Resources Division is also designing and constructing additional facilities in the Evans Creek basin and the May Creek basin to address stormwater management issues and has submitted a grant proposal to the Washington State Department of Ecology to assess climate change impacts on stormwater facility design.

Proper design, asset management, construction and maintenance of stormwater infrastructure preserves water quality and limits harmful stormflows; this provides the resiliency of the system as storm patterns change.

### Priority Actions and Long-Term Direction

The Water and Land Resources Division has been selected to receive grant funding from the Washington State Department of Ecology to assess the impacts of climate change on precipitation patterns and stormwater infrastructure sizing requirements. This project is being co-funded by the Wastewater Treatment Division and will be conducted by researchers at the University of Washington. Pending the final funding availability in Washington State's next biennial budget, the project will develop recommendations for updating King County's Surface Water Design Manual to account for climate change impacts on precipitation patterns. The findings will be incorporated into the design manual's 2019 update, which would then be used by developers and County agencies when building new stormwater infrastructure and for maintaining, replacing or upgrading existing stormwater infrastructure. Following this effort, future evaluations may focus on assessing the impacts of changing precipitation patterns on operations and maintenance costs and on emergency response costs.



### 8. Flood Risk Reduction and Floodplain Management

The Water and Land Resources Division implements flood risk reduction activities under contract from the King County Flood Control District, which was established by the King County Council in 2007 to protect public health and safety, regional economic centers, public and private properties, and transportation corridors.

The Flood Control District, under direction from the King County Flood District Board of Supervisors, is addressing the backlog of maintenance and repairs to levees and revetments, acquiring repetitive loss properties and other at-risk floodplain properties, and improving countywide flood warning and flood prediction capacity.



*The creation of the Flood Control District has resulted in a substantial increase in local funding for flood risk reduction activities, with 2015 tax revenues of \$52.8 million. Pictured here is the Reddington Levee setback project along the Green River in the City of Auburn.*

## Impacts

Researchers at the University of Washington and elsewhere have completed multiple studies that project increased size and frequency of river flooding throughout the Pacific Northwest due to climate change, although river-specific estimates have not yet been determined for King County watersheds. In addition, climate change-driven sea level rise is likely to cause more frequent and larger coastal flooding during king tides and storm surges. Flood risk reduction is also likely to be affected by the increased landslide risk on steep slopes along river valleys. Finally, as flood size and frequency increases, emergency response activities would increase accordingly.

## Ongoing Response

The Flood Control District is addressing a backlog of maintenance and repairs to levees and revetments, acquiring frequently-flooded properties in river floodplains and other at-risk river floodplain properties, assisting with risk reduction activities on properties at risk of river flooding, and improving countywide flood warning and flood prediction capacity. Overarching countywide strategies and objectives include:

- Improving levee protection through major commercial, industrial and residential areas.
- Improving flood water conveyance and capacity.
- Reducing risk by removing or elevating flood- and erosion- prone residential structures, elevating farm structures, and assisting with the construction of farm pads.
- Coordinating, communicating, and implementing responses to flood emergencies with other agencies, jurisdictions, and the public.
- Providing safe access to homes and businesses by protecting key transportation routes.
- Minimizing creation of new risks to public safety from development pressure.

## Priority Actions and Long-Term Direction

In addition to ongoing work to reduce flood risk in King County, three key new work items will be completed to address the potential impacts of climate change.



First, the Water and Land Resources Division will use research results on changing local rainfall patterns to assess risk of increased flood sizes and frequencies in King County rivers. The study on changing precipitation patterns is co-funded by the Water and Land Resources and Wastewater Treatment Divisions and a grant from the Washington State Department of Ecology and will be conducted by the University of Washington. The Water and Land Resources Division will seek funding in 2016 and 2017 to expand this study to assess impacts on flooding size and frequency. If funding is secured, projections of impacts on flood sizes and frequencies in King County will be incorporated into future updates to King County's **Flood Hazard Management Plan**. Until this assessment is complete, the Water and Land Resources Division will complete the development of corridor plans for each river system. If warranted, the corridor plans will incorporate a higher level of protection to flood risk reduction projects to account for existing uncertainties and community risk reduction interests, including uncertainty of climate change impacts on flood size, frequency, damages, and disruption.

Second, shoreline homes and businesses are at increasing risk of coastal flooding and erosion during king tides and/or storm surges due to sea level rise. During the process to update FEMA's 100-year floodplain maps for the coast, King County previously mapped changes in coastal flooding due to a two-foot sea level rise. Beyond requiring a three foot elevation above the 100-year flood level for new construction and major remodels in unincorporated King County, which also

applies to coastal floodplains, King County does not currently have a comprehensive strategy for reducing future flood risks to Puget Sound shoreline homes and businesses under its jurisdiction in the unincorporated area of Vashon-Maury Island. The cities of Shoreline, Seattle, Burien, Normandy Park, Des Moines, and Federal Way also face potential impacts from sea-level rise.

The first step for developing an approach to address coastal flooding risks would be to conduct an analysis of the magnitude and economic impacts of the current risks, and the timing and magnitude of the increase over time. This analysis would build on a previous effort to map changes in coastal flooding due to sea level rise. Potential approaches for addressing risks might include improved sea-walls, structure elevation, structure purchase and demolition, incentive programs, new permitting requirements, and enhanced insurance requirements. King County will seek funding to develop a comprehensive approach to reduce risks to Puget Sound shoreline homes and businesses at increasing risk of flooding and coastal erosion due to sea level rise.

Third, the Water and Land Resources Division, with funding from the Flood Control District, and Department of Permitting and Environmental Review are updating landslide hazard analyses and mapping along major river corridors and on Vashon Island. Larger and more frequent storm events, which are projected to occur under climate change conditions, increase the risks of landslides due to increased soil saturation. The landslide hazard mapping along river corridors and on Vashon Island is scheduled to be completed in 2016. The Water and Land Resources Division will seek funding to update the landslide hazard analysis and mapping for the rest of King County by 2020.

Following completion of the three new actions, several long-term climate change preparation activities are recommended related to flood risk reduction:

- Depending on the magnitude of the projected timing and changes of flood size and frequency, further assessment of climate change impacts on the depth and extent of flood inundation, or on the increased economic impacts, could be warranted. It is possible that future development of FEMA 100-year floodplain maps may allow for incorporation of climate change impacts on flood size and frequency.
- Funding will be sought to implement the comprehensive strategy for reducing future coastal flood risks to shoreline residents and businesses.
- Following the updates to the landslide risk mapping along river corridors, policies related to reducing landslide risks may be reviewed and updated.

## 9. Salmon Recovery

Puget Sound Chinook salmon and bull trout were listed as threatened under the Endangered Species Act in 1999, and steelhead were listed as threatened in 2007. The Water and Land Resources Division maintains interlocal agreements with 39 cities to provide watershed planning and habitat protection and restoration services in support of the salmon recovery plans. The interlocal agreements are scheduled to be renewed for the 2016-2025 time period.

Lake Sammamish native kokanee salmon population is declining precipitously. The kokanee spend their entire lifecycle in freshwater, migrating to Lake Sammamish as inch-long fry and spending three to four years in Lake Sammamish before spawning in their natal streams. Since 2007, King County has worked with other local jurisdictions, state and federal agencies, tribes, community groups, and kokanee advocates in the watershed as part of the Lake Sammamish Kokanee Work Group to reverse the decline.

## Impacts

Salmon populations and salmon habitat are likely to be impacted by climate change in several ways:

- Increased water temperatures will stress salmon populations, affecting stream-rearing juveniles, adult salmon returning to spawn in the fall, and kokanee salmon in Lake Sammamish.
- Changes in peak flows from spring to winter may result in shifts in migration patterns or food availability for young fish.
- Increased flood frequency and severity may result in increased scouring of river bottoms, which can destroy salmon redds (nests).
- Decreased spring and summer flows in major rivers may limit habitat available for spawning and rearing.

## Ongoing Response

King County is implementing salmon recovery plans in the King County portion of Water Resources Inventory Areas (WRIAs) 7, 8, 9, and 10. These 50-year plans and the associated interlocal agreement for coordination and funding are scheduled for updating in 2015. The goal of the salmon recovery plans is to improve salmon habitat for long-term population resiliency. To achieve these goals, the plans focus on habitat restoration projects to restore watershed processes and habitat that support Chinook salmon and other salmonids in each WRIA. This goal applies under climate change conditions.



*An analysis by the University of Washington and the National Oceanic and Atmospheric Administration of climate change impacts on salmon recovery efforts indicated that the Salmon Recovery Plan would need to increase its level of effort to outpace the impacts of climate change and achieve positive net gains in habitat.*

## Priority Actions and Long-Term Direction

Two new actions to adapt the salmon recovery programs to climate change impacts will be completed within the next five years.



First, King County will expand its efforts to maintain minimum flows in rivers during summer months. This will include working with water purveyors and the U.S. Army Corps of Engineers to ensure dam operations allow for minimum flow targets to be met or exceeded in low-snowpack years. The County will also work with water purveyors and farmers to expand water conservation efforts and minimize withdrawals from already overtaxed watersheds. These activities might include tightening plumbing and landscape code conservation requirements, enhancing programs to reduce urban outdoor water use, and expanding the use of reclaimed water.

Second, King County will seek grant funding to assess climate change impacts on salmon recovery plans and to update the plans for climate resiliency. The salmon recovery plans currently focus on projects to protect habitat and restore habitat-forming processes, increase populations, and enhance long-term resiliency. However, these plans have not yet been analyzed in detail for future performance under climate change conditions. High priority salmon recovery actions, such as reconnecting floodplains, protecting forest cover, and restoring riparian areas, will also help offset projected climate change impacts. Nevertheless, further review of the plans to ensure resiliency

under climate change conditions is critical to long-term survival of Chinook salmon and other salmon in King County.

### 10. Public Transportation (including King County Metro Transit and Water Taxi)

The King County Water Taxi provides safe, reliable, efficient, environmentally sound, customer-friendly, and fiscally responsible passenger-only ferry services to the public and establishes waterborne transportation as a viable alternative mode of transportation in support of regional mobility and a high quality of life in King County. The Water Taxi operates passenger ferries between downtown Seattle and West Seattle and downtown Seattle and Vashon Island.

#### Impacts

Sea level rise could cause higher tides or storm surges that exceed the designed capabilities of the floating docks and/or gangways.

#### Ongoing Response

The floating dock and gangway in West Seattle that is utilized by the Water Taxi was replaced in 2010 with a new floating dock and gangway, which are able to accommodate several feet of sea level rise. The dock used by the Water Taxi in downtown Seattle is owned and maintained by the Washington State Department of Transportation. Replacement of this dock is currently scheduled for 2017, and will include accommodation of several feet of sea level rise. The Vashon Island dock is also owned and maintained by the Washington State Department of Transportation and is scheduled for seismic upgrades in the second half of 2015. King County coordinates with Washington State Department of Transportation to ensure that sea level rise is accounted for in their projects.



*Floating docks used by the Water Taxi are attached to pilings, with floating gangways attached to neighboring fixed docks.*

#### Priority Actions and Long-Term Direction

Long-term concerns about sea level rise will be addressed over the next several decades as ferry terminals are reconstructed by Washington State Department of Transportation.

### 11. Environmental Science and Monitoring

The Water and Land Division conducts ongoing monitoring of environmental conditions in King County to track long-term trends and identify if conditions are improving or declining over time. The monitoring team also conducts permit-required monitoring for multiple agencies, provides scientific and environmental support to capital projects, and provides scientific input and review to various King County policies and regulations.

### Impacts

The importance of monitoring changes in environmental conditions is likely to increase with a changing climate, as conditions once believed to be essentially static, such as average temperatures and average rainfalls, are now changing over time.

### Ongoing Response

The Water and Land Resources Division will maintain its water quality monitoring program as one method for tracking climate change impacts. Among other parameters, this program provides data on multiple topics directly related to climate change, including rainfall patterns, river and stream flows, groundwater levels, water temperatures, ocean acidification, and large lake and Puget Sound food webs. These data, and collaborative modeling efforts with the University of Washington, allow for King County to ensure that impacts are understood and accounted for in plans and policies. In addition, the Water and Land Resources Division recently began monitoring ocean acidity of the Puget Sound's central basin in cooperation with the University of Washington and the National Oceanic and Atmospheric Administration.



*The importance of monitoring changes in environmental conditions is likely to increase with a changing climate, as conditions once believed to be essentially static, such as average temperatures and average rainfalls, are now changing over time. Pictured here, King County staff measures in-stream flows in Taylor Creek.*

### Priority Actions and Long-Term Direction

The Water and Land Resources Division will continue to track changes in hydrology, water quality, habitat, and biota and pursue funding to better understand impacts of change patterns of precipitation on stormwater runoff and major river flooding.

As noted earlier in this chapter, the County has taken the approach of embedding climate change considerations throughout its diverse programs and services. Climate science is continuously progressing, with new and refined projections on timing and magnitudes of changes getting published each year. County agencies have varying levels of technical expertise and resources to monitor and apply new findings to their operations and capital programs. The County should establish a dedicated climate change preparedness staff position to support the work of departments, act as a central point of contact for developing research and funding proposals, and develop partnerships with other local governments, universities, and non-profit organizations.



### 12. Emergency Management

The Office of Emergency Management provides leadership and support throughout King County. The Office of Emergency Management works in partnership with cities, counties, state and federal agencies, tribes, special purpose districts, non-profit organizations, community groups, and businesses to develop a regional approach to emergency planning, response, and recovery. These collaborative partnerships are essential for effective coordination of information, resources, and services throughout the region.

King County supports a number of programs aimed at preparing for, responding to, and recovering from regional disasters and local emergencies. The five phases of emergency management - Mitigation, Prevention, Preparedness, Response, and Recovery - drive the Office of Emergency Management's work to:

- Coordinate regional emergency planning, response, and recovery activities through partner agency engagement.
- Manage resources and information sharing before, during, and after a disaster.
- Facilitate trainings and exercises to test regional emergency capabilities and interagency communications.
- Recommend policies, strategies, and standards.
- Fund and maintain regional technology tools that provide situation awareness, alert, warning, and notifications for emergencies.

### Impacts

Climate change is projected to increase the frequency and severity of certain types of emergencies that will require a coordinated response. Severe weather, flood events, heat waves, fires, and landslides are all likely to increase in severity and frequency in the future. This increase will require additional and expanded emergency response.

### Ongoing Response

As the impact of climate change on hazards becomes more evident, emergency management capabilities must become more robust. The Office of Emergency Management has four major focal points in addressing climate change impacts:

**Regional Hazard Mitigation Plan (RHMP):** Hazard mitigation is the use of long-term and short-term policies, programs, projects, and other activities to alleviate the death, injury, and property damage that can result from a disaster. King County and a partnership of local governments within the county have developed and maintained a regional hazard mitigation plan to reduce risks from natural disasters. In particular, the [RHMP](#) helps to identify and mitigate the impacts of disasters and creates a community more resilient to natural, technological and societal hazards, including the impacts of a changing climate. The 2014 RHMP includes 28 mitigation actions addressing all hazards, including climate change. These actions include infrastructure improvements to critical facilities and ongoing planning initiatives.

**Response Planning:** Emergency plans are developed in collaboration with jurisdictions, businesses, and other emergency response partners to be consistent with Federal and State laws, as well as local ordinances. The plans describe roles and responsibilities before, during, or after an emergency. They also address likely hazards, develop a context for when a plan might be used, and describe responsibilities, actions, and related timelines. Response plans include:

- **Comprehensive Emergency Management Plan (CEMP)** is used by elected and appointed King County officials to mitigate, prepare for, respond to, and recover from disasters. The CEMP is the basis for how the Emergency Coordination Center will operate in the event of an incident or disaster.
- **King County Continuity of Operations Plan (COOP)** addresses the continuation of essential services (delivered by government during normal business conditions) when emergencies occur.

- **Regional Coordination Framework (Disaster Plan)** is a unique “mutual aid agreement” that establishes the framework to allow public, private and nonprofit organizations an avenue to efficiently assist one another during a disaster.
- **Disaster Debris Management Plan** is a jurisdiction-specific process for how disaster debris may be collected and managed, including personal belongings.
- **King County UASI Evacuation Template** aids jurisdictions in preparing an evacuation annex to their Comprehensive Emergency Management Plan (CEMP) or to serve as a stand-alone plan for a specific hazard. The template presents evacuation planning concepts that are applicable across all scales and scopes of evacuations.
- **Business Emergency Operations Center (BEOC)** – used as a model to increase business preparedness and collaboration between public and private partners. The BEOC will be staffed as a branch under the Operations Section of the Regional Communications and Emergency Coordination Center and will foster face-to-face interactions between private sector, King County Government, and emergency response agencies. The BEOC will be asked to problem solve and collaborate regarding response operations, resources, and capabilities. The BEOC also serves as a mechanism to provide first-hand situational awareness to the private sector in order to facilitate the continuity of operations.

**Resilient King County Initiative/Recovery Planning:** To be completed by the end of 2015, King County’s recovery framework will describe how the six Recovery Support Functions identified within the National Disaster Recovery Framework will operate within King County. The framework will establish a process for both short and long-term recovery, including how to manage the transition from the Regional Communications and Emergency Coordination Center to a Long-term Recovery Task Force. Key elements of King County’s recovery strategy include:



- Establish “one voice” King County – ensure communication with public is clear, consistent, and uses multiple methods to communicate.
- Determine regional recovery strategy, task forces, and the path(s) forward for collaborative decision making and coordination.
- Convene key stakeholders (all levels of government, private sector, community groups) to participate as leads and subject matter experts in recovery organizational structure.



*Climate change is projected to increase the frequency and severity of certain types of emergencies that will require a coordinated response. Severe weather, flood events, heat waves, fires, and landslides are all likely to increase in severity and frequency in the future. This increase will require additional and expanded emergency response. Pictured here, King County Executive Dow Constantine and regional leaders and emergency managers gather as part of the Resilient King County initiative.*

- Act as a broker of additional resources from state and federal partners.
- Assist with cross-jurisdictional issues and identify gaps that need attention.

The Resilient King County initiative seeks to establish a recovery framework to assist individuals, families, businesses, and government to recover from an emergency in a manner that sustains the physical, emotional, social, and economic well-being of the community.

**Public Education:** The Office of Emergency Management’s community outreach program is intended to manage all efforts to get the community personally prepared and informed about all hazards in the community, including climate change. Public education is provided through the following mechanisms:

- Paid and earned media events focused on preparedness, leveraged through the Make it Through and Take Winter by Storm campaigns.
- Education of community groups, employers, schools, and other organizations.
- Community events, including safety fairs, farmers markets, town halls, etc.
- Development of resources for limited-English proficiency populations.

### Priority Actions and Long-Term Direction

The Office of Emergency Management has identified three new actions to be completed over the next five years. First, The Office of Emergency Management will be responsible for producing an annual report based on the status of mitigation actions and strategies identified in the RHMP. Each planning partner will be required to assess whether the mitigation actions and strategies identified for their jurisdictions should be modified based on current and changing conditions, including climate change risks and impacts. This assessment will help better inform emergency planning and response.

Secondly, based on the most recent assessments of climate change impacts, information on climate change will be integrated into the Office of Emergency Management’s ongoing public education presentations and campaigns.

Finally, as the Office of Emergency Management continues to complete periodic activations, drills, and exercises, it will test a heat wave scenario for emergency response coordination in the next five years.



The following information compiles and summarizes the near-term priority actions presented in the programmatic overview above. As outlined in the Environmental Science and Monitoring programmatic overview, the County should establish a dedicated climate change preparedness staff position to support the work of departments, act as a central point of contact for developing research and funding proposals, and develop partnerships with other local governments, universities, and non-profit organizations.



### Science and Research

- **Assess climate impacts on rainfall patterns.** The Water and Land Resources Division, in cooperation with the Wastewater Treatment Division, and partially supported by a grant from the Washington State Department of Ecology, will implement a study in collaboration with the University of Washington to assess climate change impacts on local rainfall patterns. Building on results from this research, King County will:

  - **Update stormwater design requirements.** The Water and Land Resources Division will apply the research findings to stormwater facility design and sizing requirements. Results of this research will be incorporated into future updates of the King County Surface Water Design Manual.
  - **Assess impacts on wastewater conveyance and treatment.** The Wastewater Treatment Division will use the results of the research to assess potential impacts on wastewater conveyance and treatment. Results will be incorporated into future updates of the Regional Wastewater Services Plan and the King County Combined Sewer Overflow Control Plan.
- **Assess climate impacts on flood sizes and frequencies.** The Water and Land Resources Division will build on local rainfall research to model river flows under climate change conditions. This effort will quantify likely impacts of climate change on flood sizes and frequencies in King County rivers. Results from this study will be incorporated into future updates of the King County Flood Hazard Mitigation Plan.
- **Assess climate impacts on population growth rates.** The Department of Natural Resources and Parks and the Executive's Office will coordinate with Washington State, the Puget Sound Regional Council, local researchers, and other local jurisdictions to evaluate potential increases in population growth beyond current projections due to increased migration resulting from climate change and potential implications for regional infrastructure and services.
- **Survey and engage stakeholders on health and climate change.** Public Health will develop and implement a stakeholder engagement strategy to gauge perceptions of climate impacts on public health.
- **Assess Food-Water-Energy Dynamic:** In collaboration with universities and local governments, the County will research, assess, and characterize the United Nation's food-water-energy dynamic and the regional climate impacts and risks at Pacific Northwest regional scale.



## Planning and Implementation

- **Expand use of reclaimed water.** The Wastewater Treatment Division will further develop and expand its reclaimed water program in the Sammamish River valley and near the South Treatment Plant to reduce reliance on Puget Sound for the discharge of treated effluent and provide a water source for agricultural irrigation and groundwater recharge.
- **Water Supply:** Review research by the Water Supply Forum, Seattle Public Utilities, and other water suppliers, and universities on how regional climate change impacts will impact local water supply. King County will use this information to report to the Council by June 2017 on how new information on local water supply will impact how King County implements its responsibilities under the Growth Management Act, such as its review of Water Comprehensive Plans. The report to Council will address how recycled water can be used to address water supply concerns.
- **Preserve road safety and maintenance.** The Road Services Division will focus on immediate operational safety and emergency response needs. To the extent feasible under available funding and/or as required by permitting agencies, it will incorporate information about changes in future flooding, storm sizes and frequencies, and landslide risks into roads maintenance and preservation programs and projects for unincorporated King County. 
- **Conduct hazard mapping.** The Water and Land Resources Division and the Department of Permitting and Environmental Review will complete the update to King County's landslide hazard analyses and mapping along major river corridors and on Vashon Island. When funding is available, they will also conduct an update to King County's landslide hazard analyses and mapping elsewhere in King County. 
- **Plan for sea level rise impacts on coastal zones.** The Water and Land Resources Division will prepare a comprehensive strategy to reduce risks to Puget Sound shoreline homes and businesses at increasing risk of flooding and coastal erosion due to sea level rise.
- **Plan for salmon recovery.** The Water and Land Resources Division will seek grant funding to assess climate change impacts on salmon recovery plans and to ensure the plans are resilient in the face of climate change. 
- **Expand and fund public health preparedness and responses.** Public Health will seek new funding to implement a comprehensive public health and climate change program. 
- **Further integrate climate change impacts into emergency management and planning.** Building on recent integration of climate change into King County's 2014 Regional Hazard Mitigation Plan, the Office of Emergency Management will:
  - **Evaluate emergency preparedness mitigation strategies.** The Office of Emergency Management will require that each planning partner assess whether the emergency preparedness mitigation actions and strategies identified for their jurisdictions should be modified or updated due to projected climate change impacts.
  - **Provide emergency preparedness climate education.** The Office of Emergency Management will integrate information about climate change in ongoing campaigns that provide public education about emergency preparedness.
  - **Conduct a heat wave emergency response drill.** The Office of Emergency



Management will conduct an emergency response drill to evaluate preparedness for a major heat wave.

### Partnerships

- **Plan for low stream flows.** The Water and Land Resources and Wastewater Treatment Divisions will work with water purveyors and the U.S. Army Corp of Engineers to help ensure minimum river flows for fish and agriculture during low flow seasons and work with water purveyors and farmers to expand water conservation efforts and use of reclaimed water.
- **Work Regionally to Prepare for Climate Impacts.** Counties and cities across Central Puget Sound are at various stages of assessing climate impacts on their communities, identifying vulnerabilities, and mapping out climate preparedness actions. Employment opportunities, transportation networks, and disaster recovery planning efforts span jurisdictions boundaries. With upcoming updates to local comprehensive plans, regional transportation plans, and emergency plans, there is an opportunity to pool expertise and resources and coordinate regionally. Regional coordination will allow for more efficient and strategic use of resources for research on local climate impacts, support more effective and consistent communication with the public, and support better integration across planning disciplines. King County, PSRC, neighboring counties and cities in Central Puget Sound, non-profit organizations, and businesses have had preliminary discussions about establishing a Central Puget Sound Climate Preparedness Partnership, and King County will actively partner to scope and establish this partnership.

## ACCOUNTABLE AGENCIES

Strategies for addressing climate change impacts on natural resources are primarily the responsibility of the [Department of Natural Resources and Parks](#), including the [Water and Land Resources](#) and the [Parks and Recreation Divisions](#). Strategies related to flooding are the responsibility of the [King County Flood Control District](#), which is a special purpose government created to provide funding and policy oversight for flood protection projects and programs in King County. The Flood Control District's Board is composed of the members of the [King County Council](#). The Water and Land Resources Division of the King County Department of Natural Resources and Parks carries out the approved flood protection projects and programs under an interlocal agreement.

Strategies related to transportation are the responsibility of the [Department of Transportation](#), including the [Metro Transit Division](#), [Road Services Division](#), [King County International Airport](#), and the [Water Taxi](#).

Strategies for emergency management are the responsibility of the [Office of Emergency Management](#). Strategies related to planning for and addressing the impacts of climate change on public health are the responsibility of [Public Health – Seattle and King County](#).

Strategies for preparing for impacts to infrastructure and operations are the responsibility of all King County agencies listed above, as well as DNRP's [Solid Waste Division](#) and [Wastewater Treatment Division](#) and the [Department of Executive Services' Facilities Management Division](#).

The Department of Natural Resources and Parks' Climate Team plays a coordinating and oversight role and is accountable for strategies related to staff training and education. The Climate Leadership Team, which includes Department Directors from four County departments and staff from the Executive's Office, provides a forum for coordinating climate preparedness actions and resources.