



***“A Healthy and Safe Future for the People of Crook County”***



## **CLIMATE AND HEALTH ADAPTATION PLAN**

**Crook County Health Department**

**Prineville, Oregon**

**August 2013**

## CONTRIBUTORS

This project was funded by the Centers for Disease Control and Prevention; Climate-Ready States and Cities Initiative which was assigned to assist 16 states and 2 cities develop ways to anticipate health effects by applying climate science, predicting health impacts, and preparing flexible programs. The grant was administered by the Oregon Health Authority and the project ran from August 2011 through August 2013.

### CROOK COUNTY ASSESSMENT AND PLANNING TEAM

Assessment, Literature Review, Analysis, Report Writing

- Karen Yeargain, LPN, Preparedness Coordinator
- Max Hamblin, REHS, Environmental Health
- Muriel DeLaVergne-Brown, RN, MPH , Public Health Director

**Crook County Health Department**  
**375 NW Beaver St., Ste.100**  
**Prineville, Oregon 97754-1802**  
**Phone: 541-447-5165**  
**Fax 541-447-3093**

**E-mails:**

[\*\*kyeargain@h.co.crook.or.us\*\*](mailto:kyeargain@h.co.crook.or.us)

[\*\*max.hamblin@co.crook.or.us\*\*](mailto:max.hamblin@co.crook.or.us)

[\*\*mdelavergnebrown@h.co.crook.or.us\*\*](mailto:mdelavergnebrown@h.co.crook.or.us)



The **Crook County Health Department** offers a variety of public health services to protect and promote health to our residents (Appendix 1) The CCHD staff are licensed or certified in their professions, assuring the utmost in quality care. All services are provided without regard to religion, race, color, national origin, creed, disability, gender, or ability to pay. We are dedicated to improving the health of the communities we serve.

[\(http://www.co.crook.or.us/Departments/Health\)](http://www.co.crook.or.us/Departments/Health)

## ACKNOWLEDGEMENT TO COMMUNITY PARTNERS

Crook County Health Department Staff  
Jim Hensley, Crook County Sheriff  
Dave Dethman, Emergency Manager  
Dave Freitag, SAR, ARES, RACES  
Steve Dougill, Crook County IT Manager  
Eric Bush, Prineville PD  
Scott Willard, Lutheran Community Services  
Kevin Benton, Oregon Department of Forestry  
Phil Stenbeck, Assistant Planning Director Crook County  
John Jackson, Singletree Enterprises, LLC  
Ken Fahlgren, Crook County Commissioner  
Penny Keller, Crook County Road Department  
Joie Wright RN, BSN, St. Charles Health System  
Matt Smith, Chief, Crook County Fire and Rescue  
Dennis Merrill, American Red Cross  
Mike Kasberger, Manager, Ochoco Irrigation District  
Tim DeBoodt, OSU Extension

*Mariel DeLaVergne-Brown, RN, MPH*

8-27-13

**SIGNATURE**

**DATE**

*“Climate Change is such a huge issue that it requires strong, concerted, consistent and enduring action by government.”*

Peter Garrett

*“The science is compelling. And the longer we wait, the harder the problem will be to solve.”*

Senator John Kerry

*“The earth is warming at an alarming rate, we are running out of fossil fuels, and it is long past time for us to take action to correct these problems.”*

Bill Clinton

*“The significant problems we face cannot be solved at the same level of thinking we were at when we created them.”*

Albert Einstein

## TABLE OF CONTENTS

Executive Summary	5
Process Summary and Methodology	8
Crook County Description	10
Background for Climate Health Action Plan	11
Climate Change – What is it?	14
What is Climate Adaptation?	15
How Can Communities Take Action on Climate Adaptation	15
<b>BRACE STEPS - Framework for Approaching the Health Impacts of Climate Change</b>	
Brace Step 1: Assessing Local Climate Impacts, Health Outcomes, and Vulnerable Populations (Oregon, regional, local)	16
Brace Step 2: Health Risk Assessment and Qualifying the Data	20
Brace Step 3: Key Interventions to Local Health Impacts of Climate Change	22
Brace Step 4: Actions Steps for Implementing CCHD Climate and Health: How Can Crook County Take Action on Climate Change	25
Conclusion	26
References	28
<b>List of Appendices:</b>	
# 1 Organizational Chart	31
# 2 Global Surface Mean Temperature Anomalies	32
# 3 US Drought Monitor	33
# 4 Projected Impact of Climate Change on Agricultural Yields	34
# 5 Potential Health Effects of Climate Change	35
# 6 Ten Essential Services – Links to Climate Change	36
# 7 Health Recommendations for Wildfire Smoke Events	37
# 8 Health Risk Assessment Model – Climate Change Consequences	38
# 9 Hazard Risk Assessment Model – OEM Threat Analysis	39
# 10 Hazard Risk Assessment Model – Public Health Consequences	40

## EXECUTIVE SUMMARY

The Crook County Health Department Climate and Health Action Plan was funded by the Centers for Disease Control and Prevention; Climate-Ready States and Cities Initiative which was assigned to assist 16 states and 2 cities develop ways to anticipate health effects by applying climate science, predicting health impacts, and preparing flexible programs. The grant was administered by the Oregon Health Authority and the project ran from August 2011 through August 2013.

Historically, Crook County worked with partners prior to the grant opportunity discussing climate change mitigation, adaptation, and the implications of climate change on Crook County as part of the Emergency Management Hazard Vulnerability Plan. In addition, the GeosInstitute led a group of Central Oregon stakeholders through a process in 2010 exploring how the communities and natural resources of Crook, Deschutes, and Jefferson Counties may be affected by projected changes in climate conditions. Recommended actions identified by local leaders and experts in that process included the following:

- **Increase water storage, decrease flood risk, increase groundwater recharge, and improve surface water quality for restoring wetlands, complex stream channels, and floodplains.**
- **Conserve water** through improved irrigation water delivery and reduce water-intensive landscaping.
- **Decrease water demand.**
- **Reduce forest fuels** through thinning and controlled burns.
- **Protect intact habitats** with relatively small populations of invasive species.
- **Limit urban wild land and floodplain development and initiate conservation minded land use planning.**

Changing climate conditions stimulate conversation and action; and two primary approaches to climate change are adaptation which increases the resilience of communities and resources to near-term climate change impacts, and mitigation which reduces the long-term severity of climate change by lowering the concentration of greenhouse gases in the atmosphere.

This grant opportunity was meant to enhance the ability of public health to engage in this important work. The Crook County Climate Health Action Plan developed by Public Health will:

- Develop strategies for public health staff to be a source of leadership, expertise, and guidance concerning sustainable development in Crook County;
- Raise awareness in Crook County as to the important responsibilities of, and actions regarding sustainable development and climate change; and
- Help shape local policy promoting sustainable development, with strategies to mitigate climate change for Crook County.

Climate change and health are inextricably linked; changes in the types and incidence of disease, as well as events such as floods and heat-waves can negatively impact health. Crook County has a long history of risk analysis and emergency planning related to the incidence and impacts of disease and climate change is no exception.

**Key Local Climate Variables Identified:**

- Drought
- Air Quality
- Vector-borne and Communicable Diseases

**Health Results in Crook County:**

- Decreased water quality and quantity which could contribute to Crook County’s decrease in crop production, lower lake/stream levels, less animal production (birthing, milk, meat), and an increase in human related diseases
- Decrease in air quality leading to an increase in aggravation of cardiovascular and respiratory diseases, asthma, and decreased lung function growth in children
- Shorter lengths of sub-freezing conditions, coupled with longer, wetter spring and fall, can increase the numbers of mosquitoes and rodents which are vectors of West Nile Virus, Hanta Virus, and Plague

**Recommended Actions:**

**1. Collaboration and Coordination:**

Incorporate the work of the plan into the Emergency Management Groups work-plan and add partners as needed. The work-group consists of the following members and meets monthly.

- Emergency Management
- St. Charles Health System
- Crook County Health Department
- City of Prineville
- Crook County Commissioner
- Ochoco Water District
- BLM
- Oregon Department of Forestry
- Environmental Health
- State, County, and City Law Enforcement Agencies
- Crook County Road Department as requested
- DEQ as requested

**2. Drought, Water Issues:**

- Develop strategies to recognize health effects of drought on the population of Crook County.

- Continue to build relationships with regional partners.
- Assure information targeting at-risk populations for identified health effects related to drought are culturally appropriate and accessible.
- Continue to gather local information through community assessment and incorporate into the regional health improvement plan.
- Coordinate efforts through the Emergency Management work-group.

### **3. Air Quality Issues:**

- Monitor Crook County's air quality results; compare them to past results in order to monitor trends.
- Strengthen partnerships with the area DEQ to provide information to and protect the public during acute smoke events using the DEQ Visibility Scale, air quality index monitoring, and protocol (Appendix 7).
- Monitor asthma trends related to smoke events through the Coordinated Care Organization claims system.
- Implement a Healthy Homes Initiative to assist in the education of families in Crook County.

### **4. Communicable Disease Issues:**

- Monitor health trends in Crook County in regard to diseases that are vector-borne.
- Receive reports and investigate reports of disease cases or clusters per Communicable Disease protocols, with local climate change risks incorporated into the assessment of contributing factors.
- Foster and maintain lines of communication with local laboratories, hospitals, medical clinics, and schools in regard to notifying CCHD about unusual disease and/or trends, in addition to reportable diseases.

### **5. Include information on the Crook County Health Department website** on the Climate and Health Plan, and include the air quality information on the regional Healthy Communities Website.

- Promote community education on effects of climate change on the community.
- Post the climate health action plan on the website, with recommended actions.
- Develop and strengthen relationships with community groups to educate community members.

## PROCESS SUMMARY AND METHODOLOGY

The Crook County Health Department staff began work in August of 2011, as part of a CDC project, to enhance the capability of state and local health agencies to prepare for issues associated with the projected climate change in our region and county. CCHD worked with the Oregon Health Authority (OHA) and four other local health departments on the CDC's Climate-Ready States and Cities Initiative ([www.cdc.gov](http://www.cdc.gov)).

Crook County Health Department's lead role in the process was grounded in the mission of protecting the health of our residents. The 10 Essential Public Health Services guide the work of the department.

1. Monitor health status to identify and solve community health problems.
2. Diagnose and investigate health problems and health hazards in the community.
3. Inform, educate, and empower people about health issues.
4. Mobilize community partnerships and action to identify and solve health problems.
5. Develop policies and plans that support individual and community health efforts.
6. Enforce laws and regulations that protect health and ensure safety.
7. Link people to needed personal health services and assure the provision of health care when otherwise unavailable.
8. Assure competent public and personal health care workforce.
9. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.
10. Research for new insights and innovative solutions to health problems.

The Crook County Health Department utilized the CDC's framework for climate change planning, the BRACE framework. The model consists of five sequential steps in addressing climate health issues.

### BRACE METHODOLOGY:

- 1. Forecast local climate impacts and assess health vulnerabilities** – Determine with stakeholders, existing conditions and the potential future impacts of a changing climate on all members of the community with particular focus on understanding the needs of vulnerable populations.
  - What will the local climate future potentially look like?
  - Which factors may result in increased illness, injury, or death?
  - Which populations may be vulnerable?
- 2. Health risk assessment** – quantifying disease burden involves prioritizing and focusing on the scope of issues identified in step 1 and determining what is feasible to assess and in what way.
  - Identify potential data sources about health impacts from Step 1.
  - Quantify the additional burden of illness, injury or death (if possible)
  - Qualitatively describe the potential health impacts.
- 3. Identify key and potential interventions** to respond to health impacts of climate change – evaluate the magnitude/burden of health impacts, stakeholder input, and the

resources available to recommend interventions

**4. Develop and begin implementation of climate and health action (adaptation) plan** utilizing stakeholder feedback to ensure the most effective and practical interventions and communication plan.

- Develop a written adaptation plan for proposed changes to address health impacts of climate change.
- Disseminate to stakeholders and the public.
- Evaluate planning process and product.
- Evaluate and expand stakeholders

**5. Evaluation (at each step)**

The Crook County process was divided into two parts:

- Karen Yeargain implemented the 1<sup>st</sup> year process and was joined by D. Max Hamblin, REHS in year two.

CCHD staff's first step was to understand the BRACE model, and incorporate knowledge of the region into the process. Initial information was gained through a GEOSInstitute Report which had been completed the previous year. The report documented climate change issues in the Central Oregon region. Community partners and stakeholders attended the meeting and provided local input.

The staff attended monthly meetings of the Crook County Emergency Preparedness Committee and incorporated community partner input into the process. Members of the Emergency Preparedness Committee include the following partners: In addition, staff researched the history of Crook County's climate through website searches, the Crook County Historical Museum Archives, local city and county archives, and county health records.

Additional input on air quality included working with community business partners (stove shop) and the former Environmental Health Specialist who monitors the air station for DEQ in the county. The staff learned how to read the information for future monitoring. The DEQ information related to smoke monitoring and response provided valuable data for the plan.

The Communicable Disease data was gathered through a focus group with health department staff and the gathering of data from the local hospital on asthma/COPD. The staff also attended monthly meetings with emergency room staff and was able to ask their input for this process. Data gathering on the hospital side is challenging and future work with the Coordinated Care Organization will improve this process for the implementation of the Regional Health Improvement Plan. The School Based Health Center staff was able to provide some information on the number of students with asthma who had visited the center.

During this timeframe, the CCHD VISTA volunteer, Tobacco Coordinator, and Public Health Director were working with the City of Prineville on the 20 year transportation plan incorporating strategies to decrease greenhouses gases, increase bike and walking paths, and incorporate a new strategy for the East Cascades Transit fixed route bus system in the

community.

The staff with community input completed the Worksheets of Public Health Climate Change Consequences and rated the scores. The staff attended required meetings in Portland, coordinated efforts with other county partners working on the project and with the data gathered chose the three top public health risks. Since the staff had assisted the county on their HVA, it was reassuring to find similar issues with the climate change assessment.

This report is the result of all the input, training, and support provided to begin the process for a Climate Health Action Plan. This plan is the first step for Crook County; staff will continue to implement climate change adaptation as a health policy approach, provide training for staff, and continue work with community stakeholders.

## **CROOK COUNTY DESCRIPTION**

Crook County, Oregon, was established on October 24th, 1882. The early settlers ventured from the west after word arrived that conditions were abundantly available for growing crops. There has been steady growth over time to a current population of 20,978. During the years 1990-2000, there was an increase of 35.94% and the population is projected to double in the next two decades. Crook County, located in the geographic center of Oregon, encompasses 2,982 square miles. Although considered rural, the county and region have experienced growth over the past ten years (Oregon Blue Book, 2013).

From 2000 to 2010, Crook County has grown, yet with the loss of jobs, and other issues, the 2010 census population recorded 20,978 (US Census, 2010) individuals living in the county. The county's main population center is Prineville, home to approximately 10,000 individuals, while the remaining individuals live throughout the county in small communities such as Paulina, Post, Alfalfa, and Powell Butte. Although Prineville is the county's only incorporated city, the growth in the county has outpaced the growth within the city. This growth has affected the Powell Butte area to the west, and the Juniper Canyon area on the south side of town. While both areas have experienced growth, Powell Butte continues to be an area with higher than average household incomes and land values. The Juniper Canyon area on the other hand, is a mixed development with mid ranged housing in one canyon, and lower income, some substandard housing in the next canyon. These pocket areas have contributed to Juniper Canyon's continued identification as one of Crook County's areas of poverty, as in the rural Paulina area.

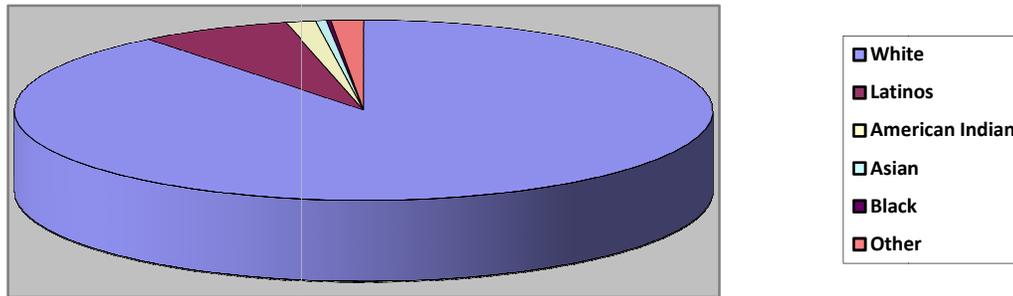
The county is bordered by Deschutes County to the west and south, Jefferson and Wheeler counties to the north, and Grant and Harney counties to the East. Crook County's economy once depended on wood mills, but since their closures, the county job growth is in the service and trade sectors. Equally, Crook County has a large agricultural (hay, grain, and mint) and beef production sector. Economically, Crook County's growth has leveled out this past year and forest products, agriculture, livestock, construction, and recreation/tourism services (two reservoirs) represent Crook County's overall economy. Recently, the county was fortunate to

gain two data centers, including Facebook and future business may include wind and solar farms. The unemployment rate in Crook County continues to be one of the highest in the state and there are transportation barriers due to the lack of a fixed route bus system from Prineville to Redmond and Bend.

**FIGURE 2: Crook County Population by Age: (US Census – 2010)**

2010 Population	<5 years	6 - 18 years	19-64 years	>65 years
<b>20,978</b>	1,364	4,783	11,999	2,832
<b>Total %</b>	6.5%	22.8%	57.2%	13.5%

**FIGURE 4: Population by Race/Ethnicity: (US Census – 2010)**



The county is predominately white with the following demographics (2010 – US Census):

- 89.4% White
- 0.2% Black or African American
- 7.0% Hispanic or Latino origin
- 1.4% American Indian and Alaska Native
- 0.5% Asian
- 0% Native Hawaiian and Other Pacific Islanders
- 1.5% Other

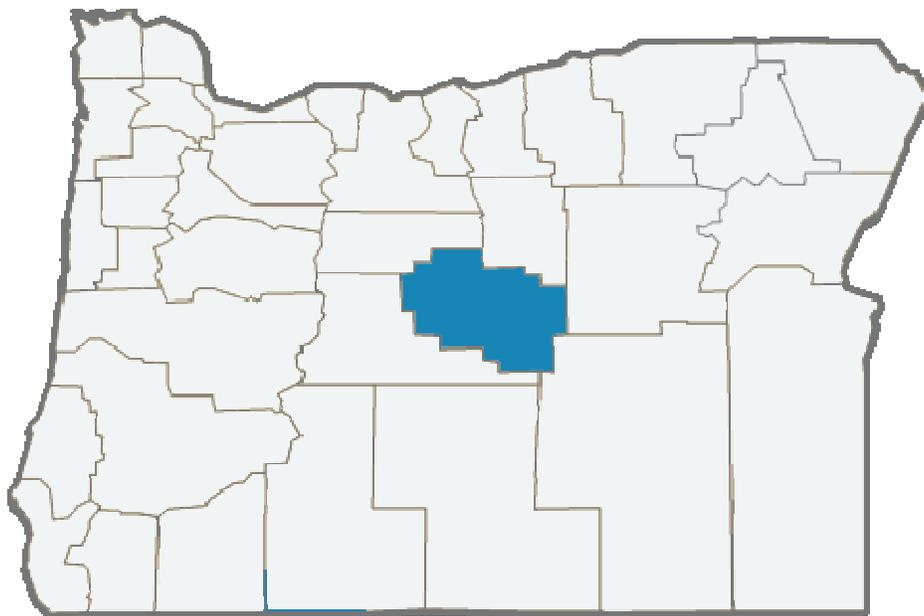
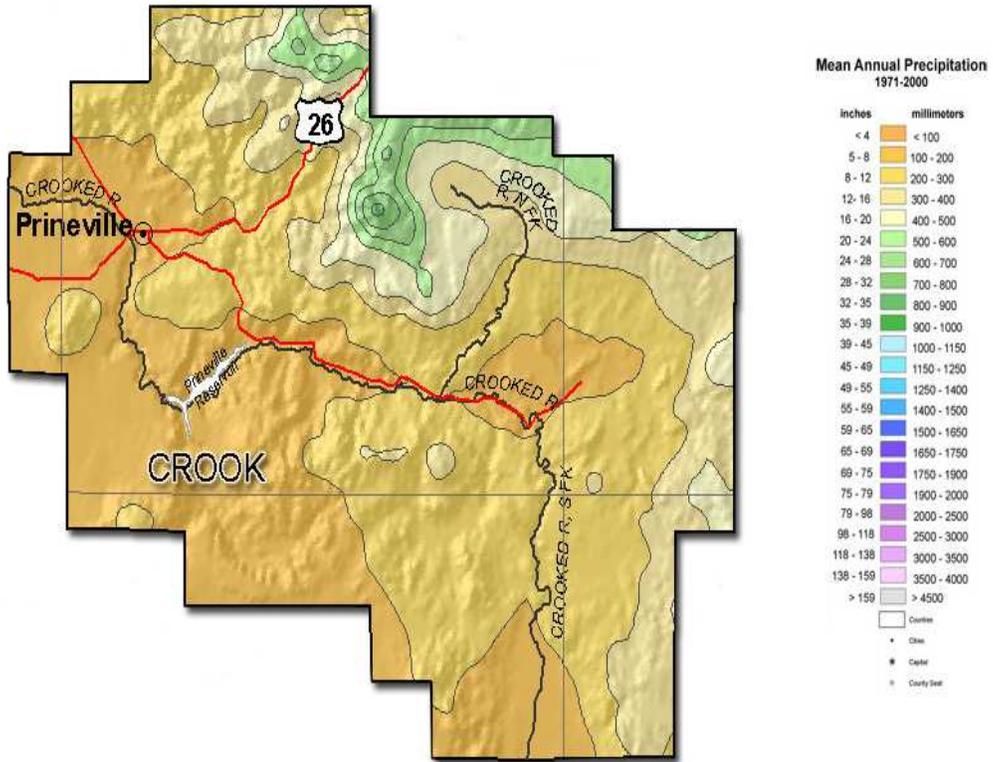
## **BACKGROUND FOR CLIMATE HEALTH ACTION PLAN**

Crook County is considered cool and dry. Precipitation varies from 14 inches to less than 10 inches per year. The standard explanation for the climate is that Central Oregon lies in the rain shadow of the Cascades Mountains. Typically warm, moist, marine air from the Pacific rises over the Cascades and cools while ascending. It then loses its moisture holding capacity and thus rains or snows, predominately (although not exclusively) on the west slopes. Due to the cold, semi-arid climate, and predominately shallow, rocky soils; Central Oregon has a limited inventory of indigenous plants. On the Cascade slopes and in the Ochoco Mountains in Crook County ponderosa pine forests prevail, ranging down to about 3,500 feet. Below 3,500 feet, the juniper forest takes over through much of Crook County. Where the juniper cannot grow, sage, bitterbrush, and grasses predominate (Pohl, et.al. 2002). The annual rain fall measures

about 10.5 inches compared to the Pacific Northwest's 37 to 50 inches per year. The summer precipitation is very low. Summertime annual temperatures range from 86—100 degrees with an all-time Oregon high of 114 degrees during one summer.

Climate change is predicted for Central Oregon, including drought. This is a natural and consistent characteristic of these ecosystems; and consequently climate changes may result in more frequent and/or extensive periods of drought in the region. Plant and animal species' geographic ranges and distribution are directly determined by climate conditions such as temperature and rainfall along with ecosystem factors (topography, slope, aspect, elevation, soils, geology, surface water and wet environments). All of these factors shape habitat and species distribution as well as competition, predation and other species interactions in the region (Barr & Leonard, 2010). The plan focuses on Crook County, yet Central Oregon is a geographic region which relies on the involvement and work of Deschutes County and Jefferson County. (See maps on following page)

## CROOK COUNTY MAPS



## CLIMATE CHANGE – WHAT IS IT?

The climate is changing, and it will affect the way we live and where we live, now and in the future. Overwhelming scientific evidence of anthropogenic climate change exists (Solomon et al., 2007). The United Nations Intergovernmental Panel on Climate Change (IPCC) concludes that “warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising of global average sea level.”

Climate change has serious and far-reaching health implications for present and future generations. For example, climate change is already changing the distribution of some infectious disease vectors and threatens to “increase the number of people suffering from death, disease and injury from heat-waves, floods, storms, fires and droughts.” Climate change will disproportionately burden the very young and the elderly, the physically and mentally disabled, the poor and economically disadvantaged and other marginalized communities (Ebi, et al., 2008).

United States temperatures have increased by 1.5°F since 1895 with more than 80% of this increase since 1980 (NCADAC, 2013). The planet has already warmed by almost 1°C since 1900. The consensus amongst the world’s climate scientists is that without action to cut greenhouse gas emissions, emission levels in the atmosphere could reach 550-600 parts per million (ppm) before 2050. This could warm the planet to 3-4°C above pre-Industrial global temperatures (NOAA, 2011).

Warming is expected to be the strongest in the Arctic and would be associated with the continuing retreat of glaciers, permafrost, and sea ice. Other effects may be more extreme weather events and species extinctions due to shifting temperature changes. Effects significant to humans include threat to food security from decreasing crop yields and loss of habitat (Battisti, 2009).

The current projection is to limit global temperature rises to around 2°C above pre-industrial levels, and stabilize atmospheric CO<sup>2</sup> levels to 450ppm before 2050. This should prevent further global warming and avoid the worse impacts of a changing climate. This assumes achieving cuts in global carbon emissions to 85%-95% of current levels by 2040 (UNFCCC, 2011).



## WHAT IS CLIMATE ADAPTATION?

There are two primary approaches to climate change – adaptation and mitigation.

- **Adaptation** increases the resilience of communities and resources to near-term climate change impacts.
- **Mitigation** reduces the long-term severity of climate change by lowering the concentration of greenhouse gases in the atmosphere.
- **Adaptation** measures can be effective in the near term but will ultimately fail without effective mitigation.

Climate Adaptation is about adjusting the way we live, build our homes, expand our cities and towns in Crook County, in order to cope with increasingly unpredictable and changing local climate conditions. Humans have always adapted to local climate conditions. However, until now, our global climate has been stable for most of the last 10,000 years. This knowledge is some of the foundation of climate adaptation solutions emerging today. However; because we are now facing an increasingly uncertain and volatile climate, we will also have to find new solutions.

## HOW CAN COMMUNITIES TAKE ACTION ON CLIMATE ADAPTATION?

One of the largest challenges to climate adaptation strategy development is the diversity in the potential impacts, which include effects on public health, economic vitality, ecosystem health, water supply, and natural hazards. Fortunately, many existing local and regional plans already address some of these impacts, meaning that communities are likely to have good ideas of the types of strategies likely to be most effective. The ultimate goal should be for climate adaptation to be included as one consideration in all local and regional policy-making processes.

1. Administrative policy, procedures, and initiatives: Strategies that do not require governing board action can be implemented by a coordinated approach within an agency.
2. General Plan: The community general plan, especially the safety element, is an appropriate document for goals, objectives, and policies related to climate change adaptation.
3. Local Hazard Mitigation Plan: Adaptation strategies related to wildfire, flooding, drought, heat and cold emergencies.
4. Climate Action Plan and Land Use Planning.

## **BRACE STEP 1: ASSESSING LOCAL CLIMATE IMPACTS, HEALTH OUTCOMES AND VULNERABLE POPULATIONS**

### **REGIONAL IMPACTS**

#### **CLIMATE CHANGES IN OREGON**

The Pacific Northwest is one area that will see drastic climate changes over the next 100 years. Oregon, with its division of the Cascade Mountain range, will see greater variances in temperature, precipitation, and increase forest risks. Oregon can see increases in temperatures, thus leading to changes that would trickle down to the surrounding counties. Over the last half a century, low to mid-elevation snowpack has been declining in the Cascades (Mote et al. 2005; Chang et al. 2010) By 2050, snowpack in the Cascades is projected to decline by about half (Leung et al. 2004; Chang et al. 2010) The loss of snowpack negatively affects Central Oregon in terms of water supply, crop productivity, forest fire danger, human health conditions, and the natural ecosystem changes to native species.

#### **CLIMATE PROJECTIONS – LOCAL IMPACT**

The November 2011 document, Integrated Strategies for a Vibrant and Sustainable Central Oregon developed by the USDA Forest Service, along with GEOS Institute and Headwaters Economics presented the following information to community members from Central Oregon in Crook County prior to the climate change grant opportunity. This report provides an excellent resource for Crook County along with Deschutes, and Jefferson County.

##### **Future Climate of Crook, Deschutes, and Jefferson Counties (Barr, GeosInstitute Institute, 2011)**

Three global climate models (CSIRO, MIROC, and HADCM) and a vegetation model (MC1) were used to project future temperature, precipitation, vegetation, runoff, and wildfire in Central Oregon. All three climate models projected an increase in annual average temperatures compared to 1961 to 1990 temperatures (2.1 to 4.0° F increase by mid-century and 5.4 to 8.7° F [2.5 to 4.6° C] by late century). All seasons showed warming, though summer projections show the greatest degree of warming.

Projections for annual average precipitation ranged from an overall reduction of 7% to an increase of 22% by late century. All three models agreed that future winters are likely to be somewhat wetter than past winters (an increase of 4% to 24%). All other seasons had variable projections for precipitation trends. Increasing temperatures, despite projected increases in winter precipitation, suggest that snow pack levels will continue to decline in the region.

Vegetation model results indicated a shift in growing conditions. Ponderosa pine dominated mixed conifer forests are expected to expand at the expense of Douglas fir dominated mixed

conifer and subalpine forests. The extent of wildfire is projected to increase by 11 to 16% by late century.

Crook County's climate projections fall into three categories:

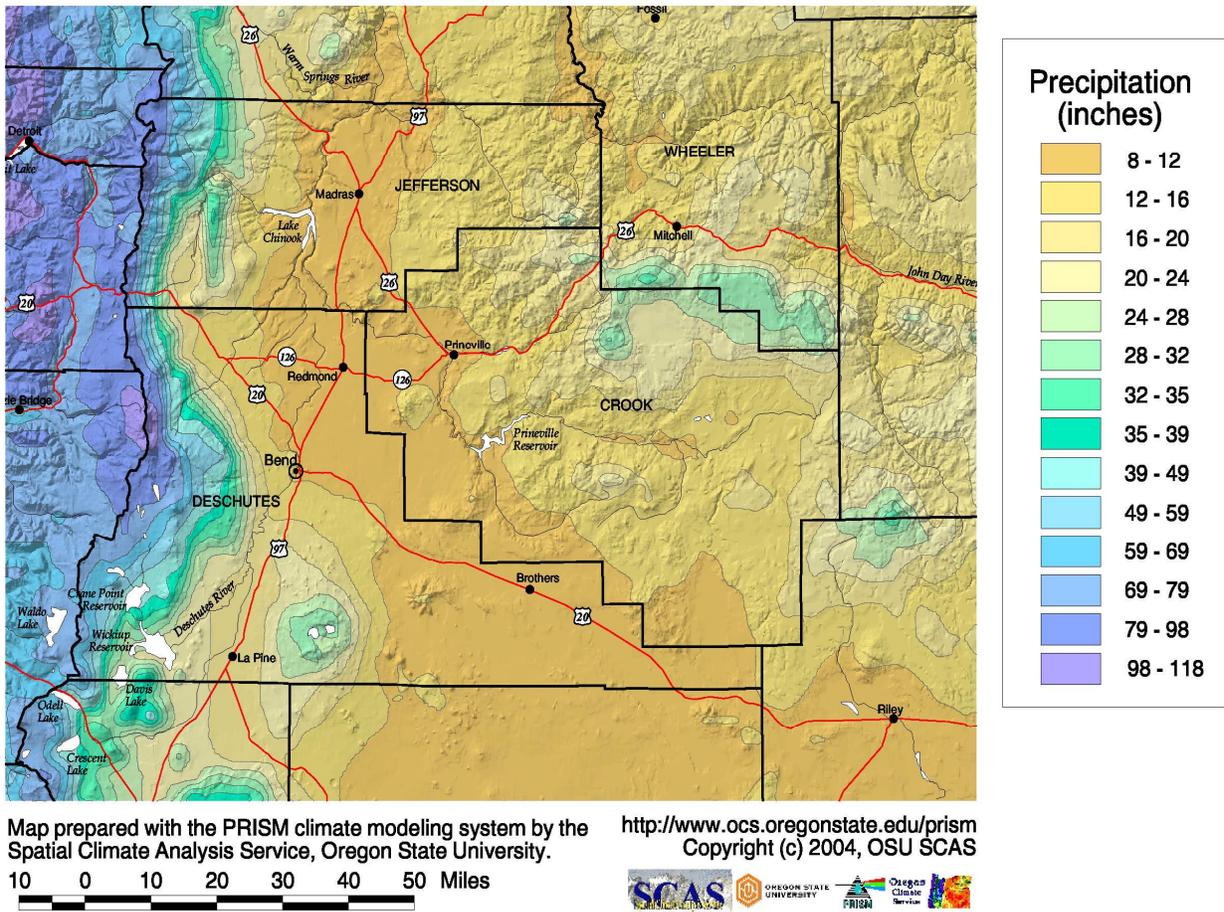
- Drought
- Air Quality
- Vector and Communicable Diseases

These three areas would impact different vulnerable populations in diverse ways. Crook County's vulnerable population mainly includes the elderly, the uninsured, and people with chronic health conditions, rural residents, and low-income residents. The vulnerability would mainly be enhanced by their age, income, and lack of health care. In the three categories below, each population is affected differently.

### **DROUGHT IN CROOK COUNTY**

The effect of drought due to increase climate changes is going to be dramatic in 30 years. From 1900, the average minimum temperature has stayed steady with an average of 70.6 degrees. But due to the earth's increase of CO<sup>2</sup> and other gases in the recent years (caused by burning fossil fuels, forest clearing, and man-made productions), a blanket has formed around the earth, thus increasing the earth's rate of temperature. In Crook County, with its high desert terrain and low average rainfall, this would increase daily temperature more drastically over the next 10, 20, and 30 years (See graph-pg. 18).

Crook County's drought trends are strongly affected by the Cascade Mountain Range. While annual average precipitation in Prineville is about 10.5 inches, Ochoco Ranger Station in the western foothills of the Ochoco Mountains receives about 17 inches per year (DEQ, 2012). The relatively low precipitation, particularly at lower elevations adjacent to areas of community development, strong solar radiation and gusty wind patterns combine to generate a fairly dry environment.



With more frequent drought conditions occurring, this would contribute to Crook County’s decrease in crop production, lower lake/river/stream levels, less animal production (birthing, milk, meat), and an increase in human related diseases, due to a scarcity of water.

The effect of drought on Crook County’s vulnerable population would hit everyone, yet the rural residents/farmers could see a major impact. Not enough water to plant crops and not being able to provide water for livestock would create shortages. Residents who are uninsured would be more susceptible to disease and won’t/can’t seek proper medical attention. And in the future years, Crook County’s existing aquifers would dry up and the city/county would use up more resources to supply water.

**AIR QUALITY IN CROOK COUNTY**

Crook County’s air quality is a serious threat to the population, especially during the winter months. From October through February 2009-2011, the Particulate Matter of 2.5 µg/m<sup>3</sup> was in the moderate level for 162 days (58%) (EPA Air Quality). This was due to the increase of wood burning stove use, local wildfires, and a small percentage from industry. These effects are likely to increase in mid-century due to early onset of rain in the fall and longer durations of rain in the spring months. Besides wood burning stoves use (both burning legal and illegal

products (plastics, chemically treated wood), other contributing factors are an increase of wildfires from more prolonged drought conditions, increased population resulting in increased traffic pollution, and, as the county's industry production (saw mills, Les Schwab, chemical company's) increases, so does its environmental output.

Air quality affects all vulnerable populations in one way or another, with the elderly and those with compromised immune systems being impacted the most. With an increase in air pollution, Crook County will likely see an increase in the need for emergent medical attention, limited hours outdoors, premature mortality, aggravation of cardiovascular and respiratory disease, development of chronic lung disease, exacerbation of asthma, and decreased lung function growth in children, and more people relying on government assistance.

### **VECTOR-BORNE AND COMMUNICABLE DISEASE IN CROOK COUNTY**

Climate change in Crook County by mid-century is predicted to result in warmer minimum temperatures and more precipitation falling as rain. This trend will result in changes of the environmental conditions that either inhibit or support the proliferation of specific disease-causing organisms and vectors, both already established and new to our area.

Shorter length of sub-freezing conditions, coupled with longer, wetter spring and fall, can increase the numbers of mosquitoes and of rodents which are vectors for West Nile Virus, and for Hanta Virus and plague respectively. The fleas of rat species, either sage rats or domestic rats, can and do carry plague in Crook County. In 2011, an outdoor domestic cat became ill, was diagnosed with plague, was treated and recovered; there were two human exposures but both were given preventive treatment and did not become sick. In 2012, two people were infected with plague when they were bitten trying to help one's domestic cat that was ill after hunting field rodents (Crook County CD Investigations 2011-2012).

Warmer winter temperatures, with fewer days that dip below freezing, can also change the plant ecology of Crook County. The fungus, *Cryptococcus Gattii*, which is found in Douglas Fir stands in the Northwest and now Southwest Canada, are increasing in areas where tree species that rely on colder winter temperatures, such as the Ponderosa Pine are being replaced by the "Doug Fir" that thrives in habitat with fewer sub-freezing days. Human infection with this fungus can result in hard to treat illness, often resulting in severe disease and death. While our County has not yet seen evidence of *Cryptococcus Gattii*, "Species such as Ponderosa pine are expected to decrease in abundance over the next century, while Douglas fir is likely to increase across the county" (The Resource Innovation Group, 2011).

Increases in the more common food-borne, water-borne and vector-borne diseases such as, salmonella, *E. coli*, campylobacter, and giardiasis are also likely to be seen as the climate environment changes and alters both the abundance of these organisms and the degree to which county residents have contact with them.

## BRACE STEP 2: HEALTH RISK ASSESSMENT AND QUANTIFYING THE DATA

The research for Crook County's Climate Change Adaption Program came mainly from internet research, The GeosInstitute Report, Crook County Historical Society, and reviewing medical and disease outbreaks from Crook County Health Department.

We researched various data on Crook County temperatures from Almanacs, historical city information, and national weather data. Most of the information on temperatures was repetitive, yet each source predicted a little different outcome, depending on whose service was accessed (NOAA, NWA, Crook County Information).

The air quality historical data information was comprised of measurements recorded by the local DEQ air weather station. This air quality station was erected in 2005 and has given results on Crook County in various forms of particulate matter, ozone levels, and carbon monoxide. There was also valuable information from the EPA AirNOW site. With this air quality data, we interpreted the air quality impacts from various causes; wild fires, chemical/factory burnings, and the city's wood burning stoves, and open burns. In *Oregon's 2010 Burden of Asthma in Oregon Report* approximately 10.2 of adults and 9.5% of children have asthma. Oregon has a higher burden of asthma than the overall United States. In 2009 Oregon was among the top five states with the highest percentage of adults with asthma. Oregonians without a college education, with lower income, or are on the Medicaid or the Children's Health Insurance Program have higher rates of asthma, and Crook County has one of the higher asthma hospitalizations per 100 (18 years and older) rates in the state for individual on the Oregon Health Plan, 2004-2006. (OHA, Public Health, 2010)

Wildfire smoke and field burning smoke also directly affect Crook County during specific times of the year. In response to wildfire air quality in Oregon and Pole Creek Fire Event in the Sister, area, a recent protocol was developed; *Oregon Wildfire Response Protocol for Severe Smoke Episodes* (DEQ, 2013). This document specifically outlines recommended public health actions based on smoke duration (Appendix #7).

The Vector Borne and Communicable Disease information came from various sources, including ORPHEUS (State of Oregon Communicable Database), information from past outbreaks in Crook County, epidemiology results, and after action reports.

The data was then entered into the BRACE model: Building Resilience against Climate Effects. This model was developed by Climate and Health Program at the Centers for Disease Control and Prevention (CDC). It is a framework for agencies to use in developing climate change adaption plans for their county. (See Appendices 8,9,10)

## **CROOK COUNTY'S HEALTH CONCERNS**

- Decreased water quality and quantity which could contribute to Crook County's decrease in crop production, lower lake/stream levels, less animal production (birthing, milk, meat), and an increase in human related diseases.
- Decreased air quality leading to an increase in aggravation of cardiovascular and respiratory diseases, asthma, and decreased lung function growth in children.
- Shorter lengths of sub-freezing conditions, coupled with longer, wetter Spring and Fall, can increase the numbers of mosquitoes and rodents which are vectors of West Nile Virus, Hanta Virus, and Plague

## **CROOK COUNTY'S TOP ADAPTATIONS BASED ON HEALTH CONCERNS**

### **DROUGHT**

1. Develop strategies to recognize health effects of drought on the population of Crook County.
2. Assure information that targets at-risk populations for identified health effects related to drought is culturally appropriate and accessible.
3. Review and update preparedness plans to factor in health related impacts of drought.
4. Gather information on events related to drought, health impacts, response and recovery strategies utilizing historical data, projections of future trends, and findings from other regions that share similar characteristics to Crook County.

### **AIR QUALITY**

1. Monitor Crook County's air quality results, comparing them to past results and predicted future patterns to detect trends in health related illnesses.
2. Implement a community-wide program to provide safe destinations during bad air quality days.
3. Develop strategies as part of the Central Oregon Health Council to address asthma rates in Crook County through the coordinated care organization.

### **COMMUNICABLE DISEASE**

1. Monitor health trends in Crook County in regard to diseases that are Vector-Borne, with an eye to the impacts of climate change as influencing factors.
2. Investigate reports of unusual patterns of communicable & vector-borne disease and receive and investigate reports of disease cases or clusters as per Communicable Disease protocols, with local climate change risks incorporated into assessment of contributing factors.
3. Foster and maintain lines of communication with local laboratories, hospitals, medical clinics, and schools in regard to notifying CCHD about unusual diseases and/or trends, in addition to reportable diseases.



### **BRACE STEP 3: KEY INTERVENTIONS TO LOCAL HEALTH IMPACTS OF CLIMATE CHANGE BASED ON THE TEN ESSENTIAL SERVICES (Appendix #7)**

**(THE INTERVENTIONS ARE LISTED IN BOTH HEALTH IMPACT PRIORITY ORDER AND ABILITY TO IMPLEMENT THE PLAN)**

#### **KEY INTERVENTIONS FOR DROUGHT, WATER ISSUES SHORT TERM, MID, AND LONG TERM PLANNING IN ORDER**

- Ensure Crook County's drinking water and emergency water supply are in compliance with health regulations.
- Monitor water issues throughout the county as a function of Environmental Health including water testing results.
- Develop trigger points that can alert public health and the community to emerging health risks in Crook County. Assess trigger points as part of the regional health assessment tri-county plan.
- Promote community education on effects of drought on health by linking with other local entities involved in drought assessment and communication, along with communication to policy makers.
- Promote build environments that mitigate climate change and improve the ability to adapt to climate change.
- Promote sustainable local food systems.
- Review and update preparedness plans to factor in health related impacts of drought. Promote awareness and consideration of drought impacts in overall county policies and plans – include the health promotion specialist's work with the city and county on built environment.
- Gather information on events related to drought, health impacts, response and recovery strategies utilizing historical data, projections of future trends, and findings

from other regions that share similar characteristics to Crook County.

- Assure information that targets at-risk populations for identified health effects related to drought is culturally appropriate and accessible (Resources available for all county residents including vulnerable populations – Spanish Resources)
- Develop systems to recognize climate change environmental factors that act as triggers for identified health problems.
- Continue ongoing relationships with the media to provide accurate details.
- Incorporate climate health impacts into staff training so the materials are considered with health policy in all programming.
- Utilize available community health assessments to identify existing services and gaps in access of at-risk persons to needed health services.
- Assure training for area medical providers in recognition and management of emerging health risks that may be related to climate change.

### **KEY INTERVENTIONS FOR AIR QUALITY**

#### **SHORT TERM, MID, AND LONG TERM PLANNING IN ORDER**

- Crosswalk Identified vulnerable populations with community health resources and update the findings through the tri-county community health assessment.
- Use community data of chronic illness trends (asthma, COPD, compromised immune systems) to compare with trends from past air quality findings; apply historic trends to future climate forecasts associated with climate change.
- Outreach to Crook County residents about air quality reports through print media and internet, targeting those with asthma and respiratory-related illnesses.
- Identify health hazards in Crook County and implement a strategy to implement a system to monitor and control those hazards (wood burning, heavy machinery output, business environmental accidents).
- Monitor local and federal air quality laws and regulations and monitor open fire burns.
- Identify air quality health hazards in Crook County and work with partners to implement strategies to monitor and control those hazards (wood burning, heavy machinery output, business environmental accidents).
- Develop a plan to demonstrate safe air quality programs (healthy homes, wood burning) for the community and implement incentives for participation.
- Work with local businesses to ensure outdoor employees are protected from harmful air quality.
- Implement a community-wide program to provide safe destinations during bad air quality days.
- Identify resources pertaining to air quality and inform the community of these resources via print media, media, and internet.
- Develop an outreach program with community workers and business's to improve partnerships associated with air quality and their effects of long term climate issues.
- Work with local and nearby health facilities to identify trends in admissions for chronic illnesses impacted by air quality changes.

- Utilize the professional federal air quality organizations (EPA, DEQ) and include them with Crook County's air quality response plan(s).
- Have an ongoing educational air-quality related health curriculum to better inform the population and the volunteer workforce.
- Evaluate the program's effectiveness through after action reports, surveys, and comparisons of before and after care of the community's health care organizations.

**KEY INTERVENTIONS FOR COMMUNICABLE DISEASE AND VECTOR-BORNE DISEASES**  
**SHORT TERM, MID, AND LONG TERM PLANNING IN ORDER**

- Monitor health trends in Crook County in regard to diseases that are Vector-borne, with an eye to the impacts of climate change as influencing factors.
- Establish and maintain mechanisms for surveillance of climate-related illness and vulnerabilities.
- Investigate reports of unusual patterns of communicable & vector-borne disease.
- Develop information/educational tools for the public about seasonal disease risks, including mitigation and prevention measures that can be taken on an individual or community basis.
- Provide educational pieces (written, presentations, webinar announcements) for the medical community about communicable disease trends, diagnosis and reporting, including climate change factors that may impact future trends.
- Disseminate information to the public about communicable and vector-borne diseases through venues such as Rimrock Health Alliance, "What's Brewing" and others, as identified.
- Foster and maintain lines of communication with local laboratories, hospitals, medical clinics, and schools in regard to notifying CCHD about unusual diseases and/or trends, in addition to reportable diseases.
- Develop planning and/or policy strategies that incorporate climate change considerations into all planning activities.
- Ensure familiarity with public health laws related to communicable & infectious diseases within health department staff through timely trainings and updates.
- Provide information regarding laws/regulations about reportable diseases to medical community.
- Monitor needs of vulnerable populations through health department community assessment activities.
- Administer Training Needs Assessment (TNA) to public health workforce, including volunteers, to determine current knowledge base of health & climate risks related to communicable and Vector-Borne diseases.
- Research information from a variety of reliable sources on climate trends that impact Communicable Disease and/or Vector-Borne Disease risks in Crook County.



## **BRACE STEP 4: ACTION STEPS FOR IMPLEMENTING CCHD CLIMATE AND HEALTH ACTION PLAN**

### **LOCAL COMMUNITY ACTION PLAN – CONTINUED COMMUNITY COMMUNICATION AND COLLABORATION**

A prepared and locally networked community plays a big role in minimizing the impacts from a changing climate. Current areas for action could be heat stress management, local food production, cold events, and responding wisely to emergencies such as flooding and wildfire.

Objective: The key objective is to work with the local communities to develop a local community based climate resilience action plan.

Solutions: Work for community awareness and education, early identification systems, and encouraging the development of neighborhood emergency response plan so communities know what to do in an emergency.

### **ACTIONS**

1. Update county's response plans, either as addendums or in their next review cycle, to emergent emergency events and pests/diseases related to climate change in collaboration with key stakeholders.
2. Develop strategies for increasing community awareness and action during emergency events—this includes scenario mapping and assessment of vulnerable communities to emergency scenarios.
3. Develop information and early notification/prevention strategy for key pests, diseases and health risks that are likely to be seasonal such as mosquitoes and rodents.
4. Gain sufficient stakeholder engagement to develop relevant solutions.
5. Continue participation on the vulnerable population tri-county group.

### **CHALLENGES AHEAD**

- As science keeps moving in the same direction, all signs suggest that climate change is

accelerating—we are planning for an uncertain future.

- Integrated Action—Plan with partners and key stakeholders.
- State and National policies may not be updated on a timely basis.
- Resourcing Adaption Actions—Innovation solutions.
- Adapt to change.

## CONCLUSION

Crook County’s approach to climate change will involve community involvement in determining Crook County climate risk variables and how they may affect the health of the public, now and in the near and distant future. One main concern was the lack of any organized community effort around climate change issues. A goal for Crook County is to bring diverse groups together to share their ideas on climate change effects and the adaptation efforts currently underway and planned for the future.

Crook County can take action is through quarterly meetings with these diverse groups (i.e. Agricultural, Public and Environmental Health, Medical Provider Groups, Vulnerable Population Representatives). In these meetings, the discussion of health related topics due to the impact from climate change would be the primary focus. In addition, since the Central Oregon area is interconnected, working as a tri-county effort would garner more participation. One of the biggest actions a community needs to combat Climate Change is to get involved. Whether it be attending meetings, asking questions, or volunteering their time, involvement is the key to Climate Change.

It will take decades to manifest, document, analyze and respond to climate change impacts in the Central Oregon area, yet it is imperative to develop strategies that benefits across many sectors. Communication between state and federal agencies, public health, planning and the farmer, ranchers, and citizens of Crook Count is vital to make a difference for the future.

Crook County has developed ideas to combat the effects of health on our county by using the BRACE model to develop a Health Risk Assessment, an OEM Threat Analysis, and a Hazardous Risk Assessment (see below). By focusing on three conditions with the highest public risk; Air Quality, Drought, and Communicable Disease, we developed steps to better improve the overall health of our present community, as well as our future population. The final guiding principles for a Climate Health Action Plan include:

- Increase public awareness and understanding of climate change impacts on human health and the need to adapt to these changes.
- Ensure health promotion and protection for vulnerable populations and communities.
- Promote healthy and resilient populations, communities, and environments.
- Encourage adaptation strategies that maximize health benefits, minimize unintended consequences, and mitigate climate change.
- Ensure the need for additional research and resources to implement the Climate Health Action Plan.

- Improve through tri-county efforts Public Health Preparedness and Emergency Response.

This report recommends proactive steps to create a future where residents of Crook County develop resilience and capacity to adapt to change climatic conditions in ways that promote and protect public health and safety, protect and enhance our natural resources and environment, and promote a vibrant Crook County.



## REFERENCES

- American Public Health Association (2011). Climate Change: Mastering the Public Health Role. Retrieved August 19, 2013. Available from <http://www.apha.org/advocacy/report>.
- Analysis of the Effects of Global Change on Human Health and Welfare and Human Systems. Ed. J.L. Gamble. Washington, D.C.: Environmental Protection Agency. 2-22 to 2-26.
- Barr, B.R., Journet, Leonard, J. (2010). Projected future conditions and sector background information for the Deschutes River Basin of Central Oregon. Geos Institute, Ashland, OR.
- Barr, B.R. (2011). Integrated Strategies for a Vibrant and Sustainable Central Oregon. Geos Institute, ClimateWise; [www.geosinstitute.org/images/stories/pdfs/Publications/ClimateWise/DeshctesClimateWiseFinal.pdf](http://www.geosinstitute.org/images/stories/pdfs/Publications/ClimateWise/DeshctesClimateWiseFinal.pdf)
- Battisti, D., Naylor (2009). "Historical warnings of future food insecurity with unprecedented seasonal heat". *Science* **323** (5911): 240–4. doi:[10.1126/science.1164363](https://doi.org/10.1126/science.1164363). PMID [19131626](https://pubmed.ncbi.nlm.nih.gov/19131626/). Retrieved August 21, 2013.
- Chang, H., J. Jones, Gannett, M., Tullos, D., Moradkhani, H., Vaché, K., Parandvash, H., Shandas, V., Nolin, A., Fountain, A., Johnson, S., Jung, I-W., House-Peters, L., Steel, M., and Copeland, B. (2010). "Climate Change and Freshwater Resources in Oregon." In Oregon Climate Change Research Institute: Oregon Climate Assessment Report, edited by K.D. Dello and P.W. Mote.
- Confalonieri, U., Menne, B., Akhtar, R., Ebi, K.L., Kovats, R.S., Revich, B., Woodward, A. (2007). Human Health. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on climate Change. Cambridge University Press.
- Ebi, K.L., Balbus, J., Kinney, P.L., Lipp, E., Mills, D., O'Neill, M.S., Wilson, M. (2008). Effects of Global Change on Human Health. Synthesis and Assessment Product 4-6.
- Environmental Defense Fund. Are We Ready? [Preparing for the Public Health Challenges of Climate Change. 2008.](#)
- Garland, R. (2009). The Burden of Asthma in Oregon: 2010. Office of Disease Prevention and Epidemiology. Public Health Division, OHA.
- [http://www.cdc.gov/climateandhealth/climate\\_ready.htm](http://www.cdc.gov/climateandhealth/climate_ready.htm)
- <http://www.census.gov/2010census/>

<http://www.deq.state.or.us/air/burning/wildfires/visibility.htm>

<http://ncadac.globalchange.gov>

<http://bluebook.state.or.us/>

IPCC 2007: Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller H.L., Cambridge University Press, Cambridge, UK and New York, NY, USA.

Leung, L.R., Y. Qian, X. Bian, W. Washington, J. Han, J.O. Roads (2004), Mid-century ensemble regional climate change scenarios for the west United States., *Climatic Change*, 62, 75-113.

Luber, G. (2011). A Human Health Perspective on Climate Change – Implications for Response and Adaptation in the Public Health Sector, National Center for Environmental Health, CDC.

Meehl *et al.*, Chap. 10: Global Climate Projections, Sec. 10.ES: Mean Temperature, in IPCC AR4 WG1 2007.

Mote, P.W., Hamlet, A.F., Clark, M.P., Lettenmaier, D.P. (2005). "Declining Mountain Snowpack in Western North America." *BAMS*, January 2005, doi: 10.1175/BAMS-86-1-39.

NOAA National Climatic Data Center, State of the Climate: Global Analysis for Annual 2011. NOAA. 19 January 2012. Retrieved 31 January 2012.

Pohl, K.A., Hadley, K.S., Arabus, K.B., 2002. A 545-year Climate History for Central Oregon. *Physical Geography* 23(3): 302-320.

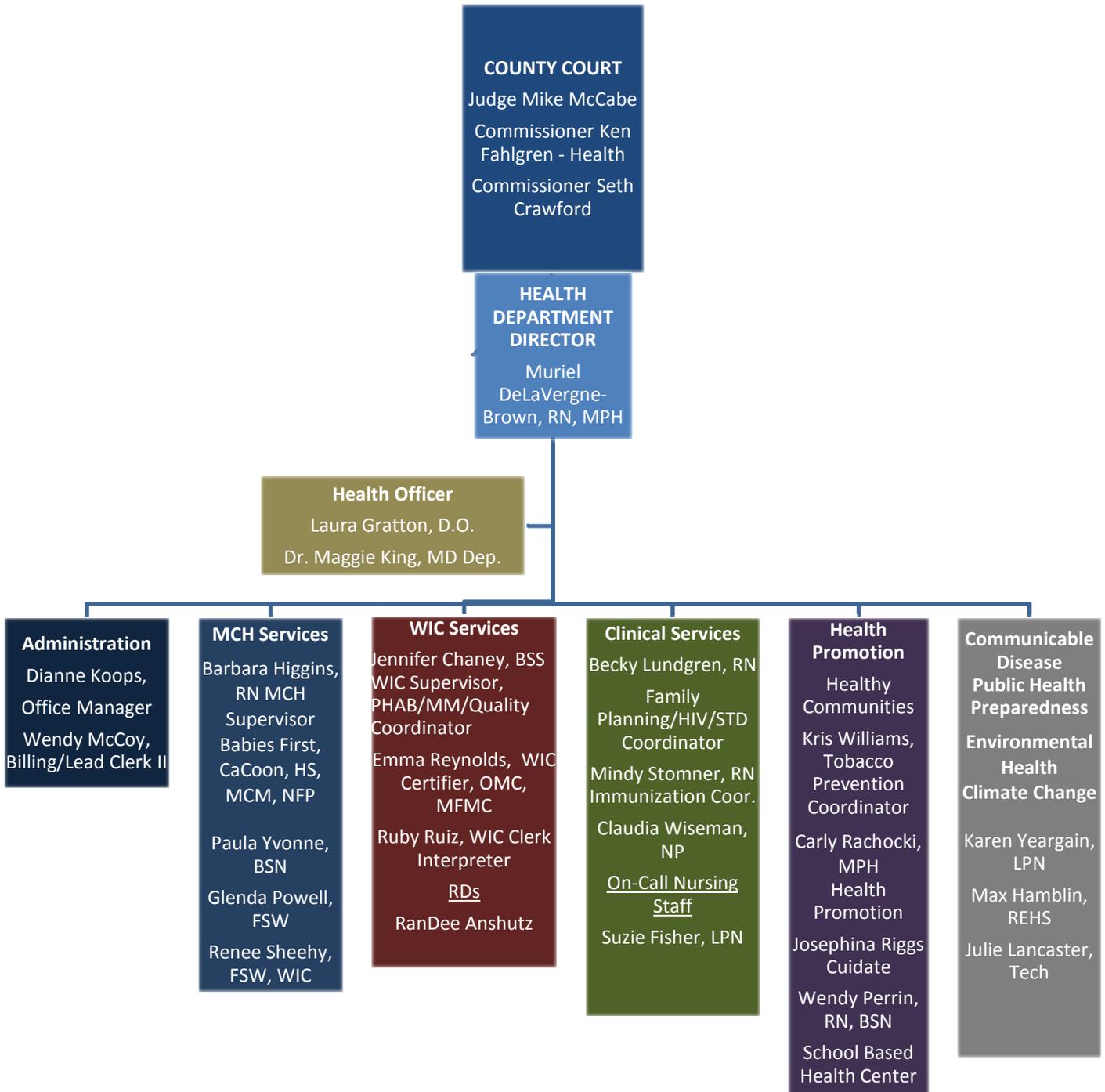
Smith, T.M., Reynolds, R.W., A global merged land-air-sea surface temperature reconstruction based on historical observations (1880-1997). *J. Climate*. 2005;18(12):2021-2026.

Solomon, S., Qin D., Manning M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L., Eds. Intergovernmental Panel on Climate Change. (2007). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press: Cambridge, UK.

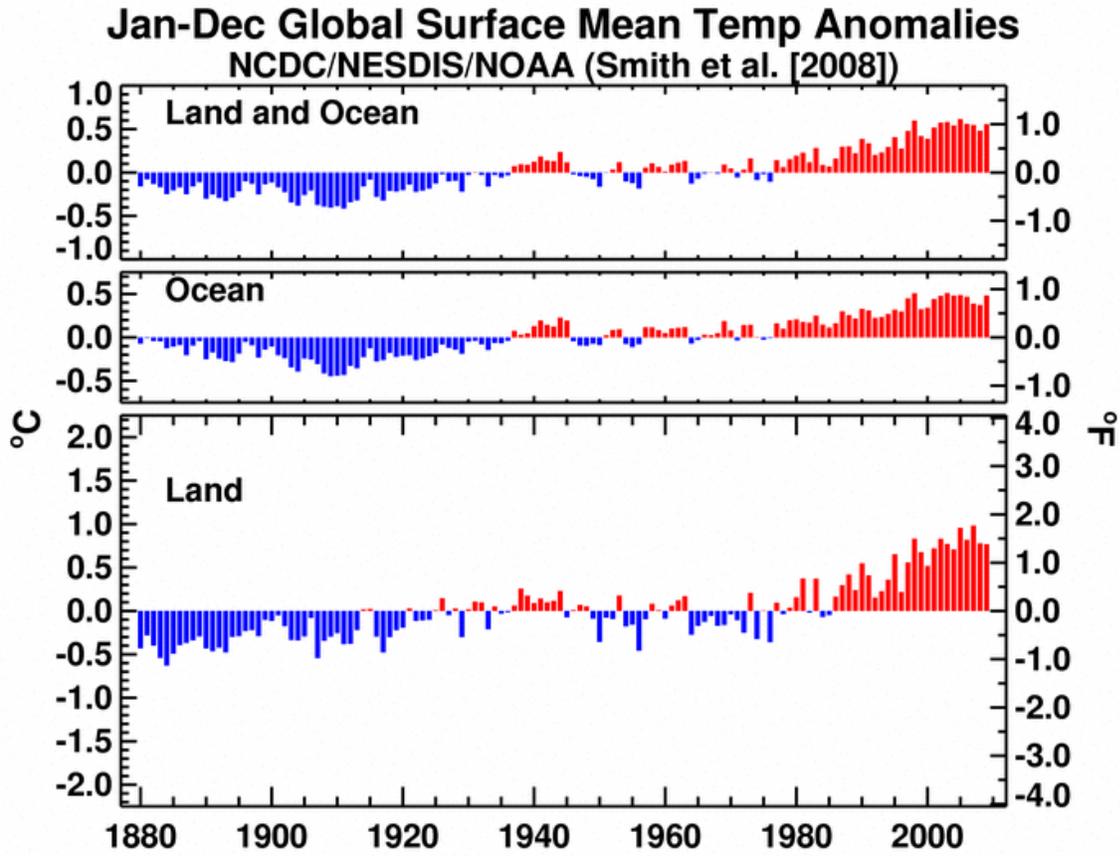
The Resource Innovation Group. "Public Health and Climate Change – A Guide for Increasing the Capacity of Local Public Health Departments (2011)

United Nations Framework Convention on Climate Change (UNFCCC) (2011). Conference of the Parties – Sixteenth Session: Decision 1/CP.16: The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention.

**APPENDIX 1**  
**CROOK COUNTY ORGANIZATIONAL CHART**



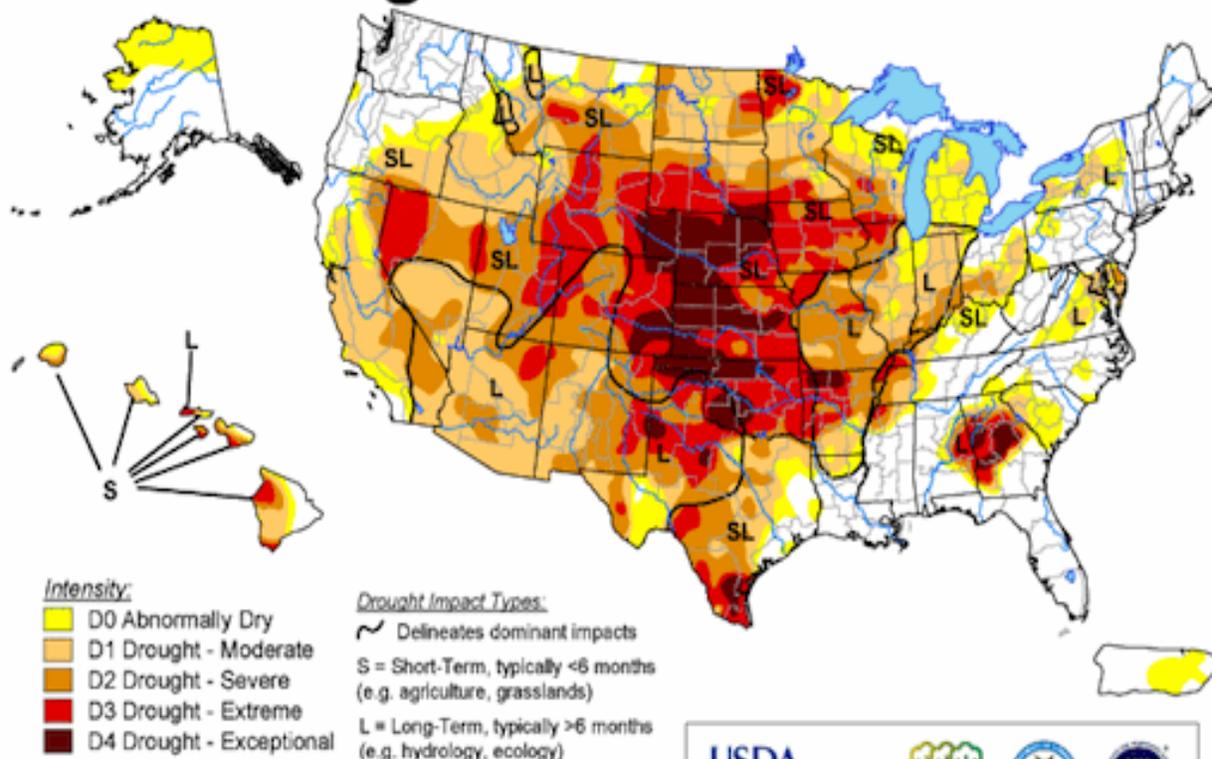
APPENDIX 2



## APPENDIX 3

# U.S. Drought Monitor

September 25, 2012  
Valid 7 a.m. EDT



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

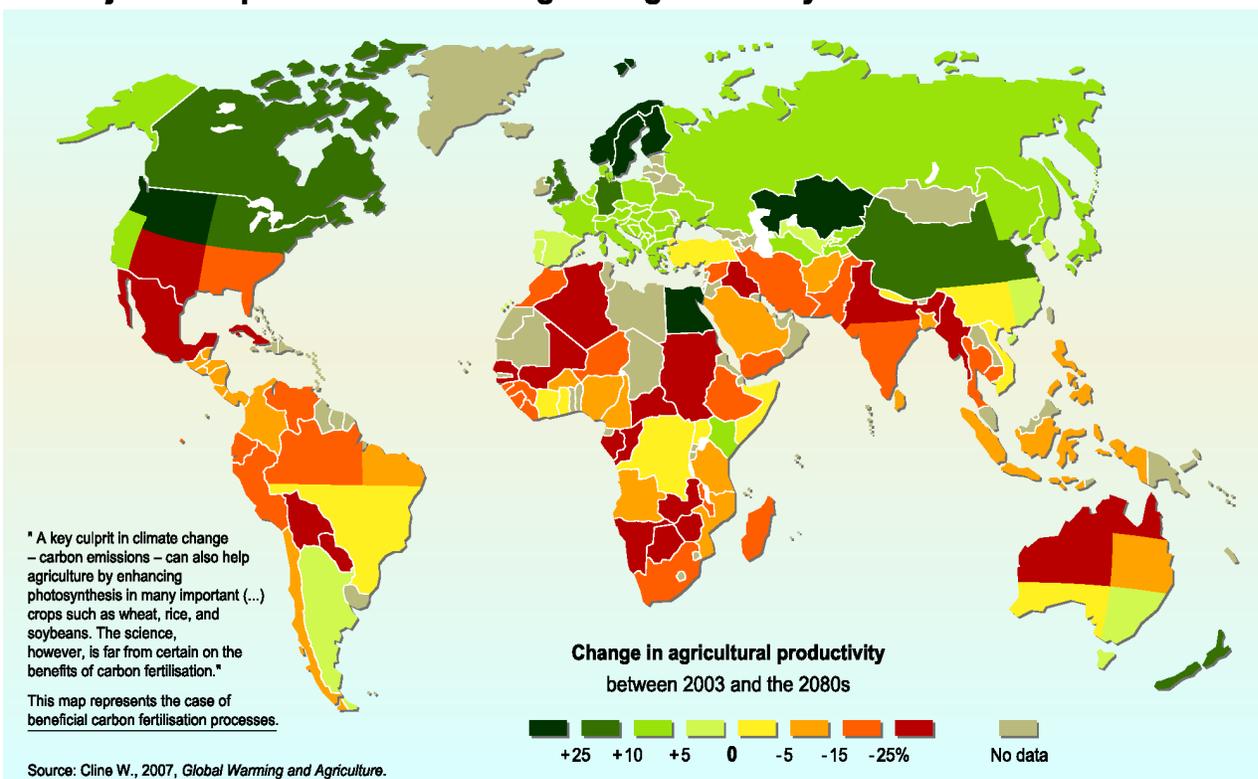
<http://droughtmonitor.unl.edu/>



Released Thursday, September 27, 2012  
Author: Anthony Artusa, NOAA/NWS/NCEP/CPC

## APPENDIX 4

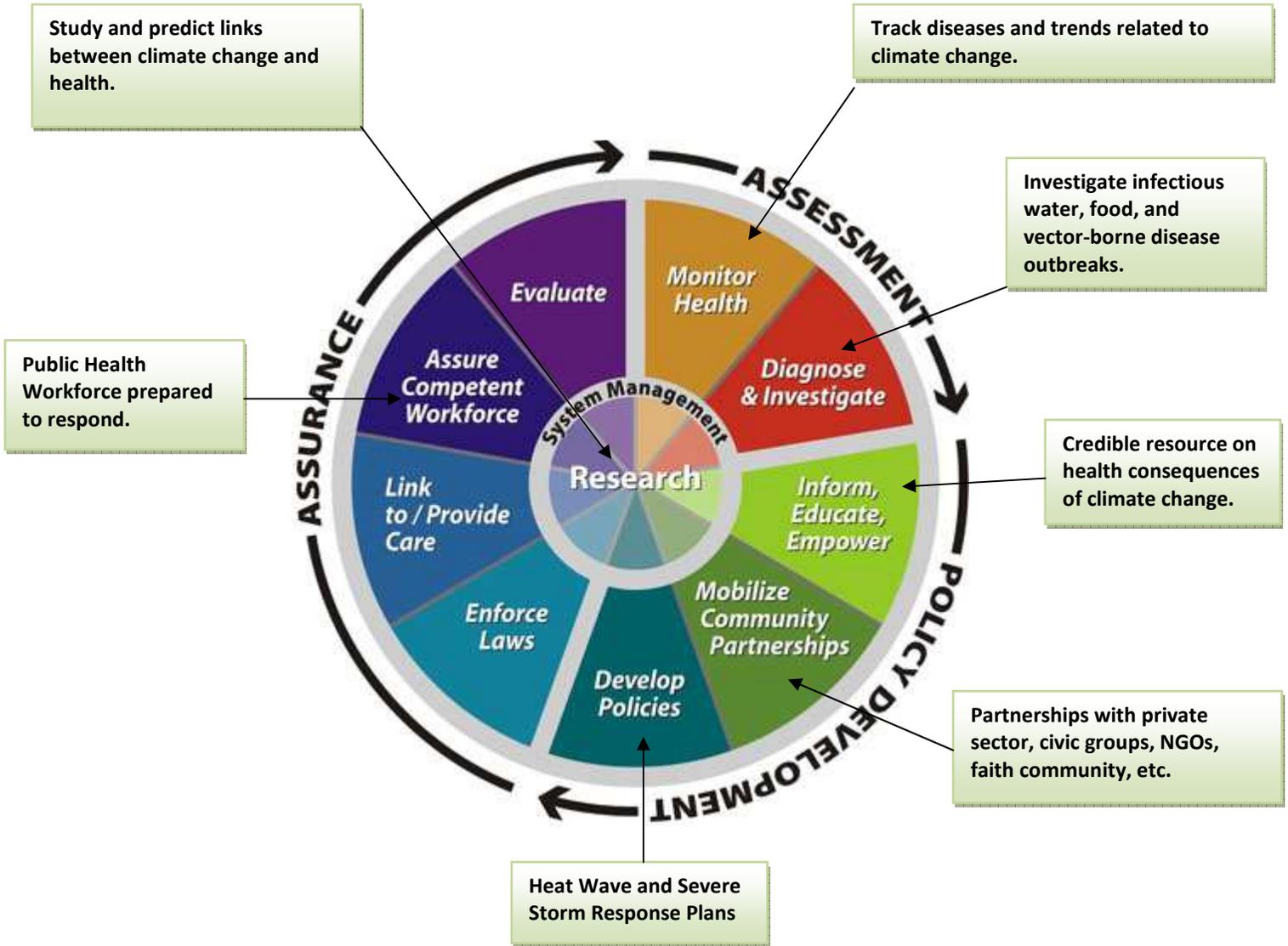
### Projected impact of climate change on agricultural yields



**APPENDIX 5**  
**POTENTIAL HEALTH EFFECTS OF CLIMATE CHANGE**

<b>CLIMATE CHANGE</b>  <b><u>-Temperature Rise</u></b>  <b><u>-Sea Level Rise</u></b>  <b><u>-Hydrologic Extremes</u></b>	<b>Heat</b>	<b>Heat Stress, Cardiovascular Failure</b>
	<b>Severe Weather</b>	<b>Injuries, Fatalities</b>
	<b>Air Pollution</b>	<b>Asthma, Cardiovascular Disease</b>
	<b>Allergies</b>	<b>Respiratory Allergies, Poison Ivy</b>
	<b>Vector-Borne Diseases</b>	<b>Malaria, Dengue, Encephalitis, Hantavirus, Rift Valley Fever</b>
	<b>Water-Borne Diseases</b>	<b>Cholera, Cryptosporidiosis, Campylobacter, Leptospirosis</b>
	<b>Water and Food Supply</b>	<b>Malnutrition, Diarrhea, Harmful Algal Bloom</b>
	<b>Mental Health</b>	<b>Anxiety, Despair, Depression, Post-Traumatic Stress</b>
	<b>Environmental Refugees</b>	<b>Forced Migration, Civil Conflict</b>
<b>Adapted from J. Patz</b>		

**APPENDIX 6**  
**Ten Essential Services – Public Health**



(Adapted by Luber, G. 2011)

**APPENDIX 7**  
**RECOMMENDED PUBLIC HEALTH ACTIONS BASED ON SMOKE DURATION**  
**(ROLLING 24 HOUR AVERAGE) (Oregon DEQ, 2013)**

<b>AQI Category (24-hr average PM<sub>2.5</sub> in <math>\mu\text{m}^3</math>)</b>	<b>24 hours</b>	<b>24-72 hours</b>	<b>More than 72 hours</b>
Good (0-12 $\mu\text{m}^3$ )	If smoke event is forecasted, implement communication plan		
Moderate (13-35 $\mu\text{m}^3$ )	-Respond to media as needed -Distribute information about exposure avoidance	Same as 24-hr	Same as 24-hr
Unhealthy for Sensitive Groups (36-65 $\mu\text{m}^3$ )	-Issue press/website releases identifying sensitive groups, potential health effects +symptoms, and ways to reduce exposure	-Issue press/website releases, identifying sensitive groups, potential health effects + symptoms and ways to reduce exposure (shelter-in-place, move to cleaner air setting in community, or consider leaving area until air quality improves	-Issue press/website releases, identifying sensitive groups, potential health effects + symptoms and ways to reduce exposure (shelter- in-place, move to cleaner air setting in community, or consider leaving area until air quality improves -Consider opening and publicizing clean air shelter for sensitive groups
Unhealthy (66-150 $\mu\text{m}^3$ )	-Consider "Smoke Days" for schools (a no school day, and canceling outdoor school events) -Consider cancelling outdoor public events -Recommend that sensitive groups shelter-in-place.	-Recommend "Smoke Days" for schools (assess if indoor AQ is better than outdoors) -Recommend public limit strenuous outdoor activities -Recommend cancelling outdoor public events -Recommend that sensitive groups shelter-in-place or consider leaving area until AQ improves	-Recommend "Smoke Days" for schools (assess if indoor AQ is better than outdoors) -Recommend public limit strenuous outdoor activities -Recommend cancelling outdoor public events -Open and publicize clean air shelters for sensitive groups
Very Unhealthy (151-250 $\mu\text{m}^3$ )	-Recommend "Smoke Days" for schools (assess if indoor AQ is better than outdoors) -Recommend public limit strenuous outdoor activities -Recommend cancelling outdoor public events -Consider public announcement recommending shelter-in-place for general population	-Cancel outdoor public events -Cancel school (unless indoor AQ is better than outdoors) -Recommend shelter-in-place -Share information about periods of improved AQ to guide essential outdoor activity and ventilation for dwellings Warn about medical risk for sensitive groups and encourage them to shelter-in-place or leave area until AQ improves.	-Recommend "Smoke Days" for schools (assess if indoor AQ is better than outdoors) -Recommend public limit strenuous outdoor activities -Recommend cancelling outdoor public events -Consider public announcement recommending shelter-in-place for general population
Hazardous (>250 $\mu\text{m}^3$ )	-Recommend shelter-in-place -Warn about medical risk for sensitive groups	-Recommend voluntary evacuation for sensitive groups -Consider opening and publicizing clean air shelters for general population	-Recommend evacuation of sensitive groups -Open and publicize clean air shelters for general population

**APPENDIX 8**

Enterprise-wide		Worksheet Public Health Climate Change Consequences										Public Health Consequence	Public Health Risk
CLIMATE CHANGE HEALTH RISK ASSESSMENT MODEL		HEALTH AND SAFETY											
Revised: May 2012		Potential Health Risk										Overall Impact (Average)	Probability x Overall Impact (Average)
Climate Risk		Probability of Occurrence	Fatalities	Chronic Disease	Communicable Disease	Respiratory Disease	Waterborne/Foodborne Diarrheal Disease	Vector-Borne Disease	Vulnerable Populations	Food Access/Quality	Air Quality	1 = Lowest 5 = Highest	1 = Lowest 50 = Highest
	Drought & Reduced Summer Water Supply	8	1	1	2	2	1	2	1	1	1	1.33	10.67
sub-category	Decrease in Summer Flow	4	0	0	0	0	0	1	1	1	1	0.44	1.78
	Extreme Heat Event	8	2	1	0	1	0	0	3	1	0	0.89	7.11
	Wood smoke Pollution (Wildfire & Domestic Burning)	10	3	2	0	3	0	0	3	0	3	1.56	15.56
	Extreme Precipitation & Flooding	10	1	2	1	1	0	2	1	0	0	0.89	8.89
sub-category	Winter Storm	9	3	1	0	0	0	0	3	1	1	1.00	9.00
	Winter Flooding	9	1	1	0	2	1	1	2	0	1	1.00	9.00
	Increased Stream Flow	10	1	1	2	0	0	3	1	0	0	0.89	8.89
	Ozone Pollution	1	0	0	0	0	0	0	0	0	1	0.11	0.11
	Longer Growing Season	10	0	1	2	2	0	3	0	1	0	1.00	10.00
sub-category	Change in Vegetation	7	0	1	2	1	0	3	0	1	1	1.00	7.00

**APPENDIX 9**

HAZARD RISK ASSESSMENT MODEL		OEM Threat Analysis												
		History			Vulnerability			Maximum Threat			Probability			Total Threat Score
Threat Event / Hazard		Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	
Natural Hazards	Drought	2	2	4	4	5	20	2	10	20	7	7	49	93
	Extreme Heat Event	2	2	4	4	5	20	6	10	60	8	7	56	140
	Flood - Riverine	10	2	20	9	5	45	9	10	90	10	7	70	225
	Landslide/Debris Flow	2	2	4	2	5	10	9	10	90	4	7	28	132
	Volcano	3	2	6	10	5	50	10	10	100	2	7	14	170
	Wildfire (WUI)	4	2	8	5	5	25	7	10	70	10	7	70	173
	Windstorm	3	2	6	6	5	30	6	10	60	8	7	56	152
Winter Storm	10	2	20	4	5	20	10	10	100	5	7	35	175	
Terrorism	Intentional Biological Agent Release	1	2	2	8	5	40	8	10	80	4	7	28	150
	Intentional Radiological Material Release	1	2	2	8	5	40	8	10	80	3	7	21	143
	Intentional Chemical Release	1	2	2	8	5	40	8	10	80	3	7	21	143
	Cyber terrorism	1	2	2	8	5	40	8	10	80	8	7	56	178
Technological	Power Failure	4	2	8	8	5	40	10	10	100	8	7	56	204
	Communications System Failure	1	2	2	2	5	10	10	10	100	7	7	49	161
	Dam Failure	1	2	2	4	5	20	10	10	100	3	7	21	143
	Information Technology Disruption	1	2	2	6	5	30	10	10	100	4	7	28	160
	Hazmat Release - Transportation	2	2	4	1	5	5	7	10	70	10	7	70	149
Human	Public Health Emergency	1	2	2	6	5	30	10	10	100	7	7	49	181
	School violence	3	2	6	4	5	20	8	10	80	8	7	56	162
	Sabotage	1	2	2	1	5	5	3	10	30	1	7	7	44

**APPENDIX 10**

		<b>Worksheet B: Public Health Consequences</b>															<b>Public Health Consequence</b>	<b>Public Health Risk</b>	
<b>HAZARD RISK ASSESSMENT MODEL</b>		<b>HEALTH AND SAFETY</b>										<b>RESPONSE CAPACITY</b>			<b>PUBLIC HEALTH INFRASTRUCTURE</b>				
		Potential injuries and deaths										Ability to respond			Service Interruption		Overall Impact (Average)	Probability x Consequences	
<b>Hazards</b>		Probability of Occurrence	Fatalities	Outpatient Injuries	Respiratory Illness	Chronic Disease	Communicable Disease	Mental Health	Vulnerable Populations	Food Security	Water Security	Hospital Beds	Primary Care Providers	Pharmacies	Ambulance	Staffing	Interagency Partners	1 = Lowest 5 = Highest	1 = Lowest 50 = Highest
<b>Natural Hazards</b>	Earthquake - Cascadia (3-5min)	2	2	5	4	4	2	5	5	4	4	5	5	5	5	3	1	<b>3.93</b>	<b>7.87</b>
	Extreme Heat Event	8	1	2	3	4	1	2	2	2	2	2	2	2	2	2	1	<b>2.00</b>	<b>16.00</b>
	Wildfire (WUI)	10	2	2	4	2	1	3	4	3	2	3	2	2	4	3	1	<b>2.53</b>	<b>25.33</b>
	Windstorm	8	2	2	2	2	1	2	2	2	2	2	2	1	5	3	1	<b>2.07</b>	<b>16.53</b>
<b>Technological</b>	Cyber Terrorism	8	1	1	1	1	1	1	1	1	1	1	1	3	1	2	1	<b>1.20</b>	<b>9.60</b>
	Power Failure	8	2	2	1	3	1	1	3	3	3	2	2	3	3	3	1	<b>2.20</b>	<b>17.60</b>
	Communications System Failure	7	1	1	1	1	1	1	2	1	1	1	1	3	1	2	1	<b>1.27</b>	<b>8.87</b>
	Airplane Crash	10	2	2	1	1	1	2	1	1	1	4	1	2	4	2	1	<b>1.73</b>	<b>17.33</b>
	Hazmat Release - Transportation	10	1	2	2	2	1	2	3	2	1	4	3	3	4	2	1	<b>2.20</b>	<b>22.00</b>
Hazmat Release - Fixed Facility	10	1	2	2	2	1	2	3	2	1	4	3	3	4	2	1	<b>2.20</b>	<b>22.00</b>	
<b>Human</b>	Public Health Emergency	7	2	2	4	4	2	4	4	2	2	4	5	3	2	3	1	<b>2.93</b>	<b>20.53</b>
	School violence	8	2	2	1	1	1	3	2	1	1	3	2	1	4	3	1	<b>1.87</b>	<b>14.93</b>