Benton County Health Department

Climate Change Health Adaptation Plan

Last Update: 7/26/2013

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Health Administrator Signature Date

Contents

Acknowledgement

The following departments/agencies were integral to helping create the Benton County Health Department Climate Change Health Adaptation Plan:

- **Community Development**
- **Emergency Management**
- **Environmental Health**
- **Good Samaritan Regional Medical Center**
- **Oregon Climate Change Research Institute**
- **Oregon Health Authority**
- **Public Health**

Climate Change Health Adaptation Plan Outline

Purpose of the Plan

Benton County Health Department was one of five counties in Oregon to participate in the development of a Climate Health Adaptation Plan. Funding was provided through grants from the Oregon Health Authority with funding from the Climate Ready States and Cities Initiative at the US Centers for Disease Control and Prevention (CDC) to pilot the BRACE Framework, a step-by-step process Health Departments can use to create adaptation plans for Climate-related public health risks.

This Climate Health Adaptation Plan will be updated every five years or as changes in science or potential health impacts occur. This document shows how the different climate change impacts were chosen and how Benton County Health Department plans to gather data in order to help inform policy decisions aimed at lessening the future health impacts of climate change.

Climate Change

Climate change models are showing that there is a change in the overall climate of the earth as a whole (APHA, 2011). Extreme weather events and other changes in the climate are having an impact on local communities. These changes are likely to have negative health impacts on entire communities and increase the negative health impacts on those already dealing with health issues (i.e. breathing problems will increase, increase in Vectorborne diseases, food insecurity, etc.). Climate change will not only impact the health of the local communities. It will also impact the built environment including structures built to deal with the increase in weather related events. Public Health has an important part to play in helping to reduce the impact of climate change.

Public Health's Role

The Benton County Health Department is concerned with protecting the health and well-being of everyone who lives, works, learns, prays and plays in Benton County with particular focus on preventing health problems before they occur. The 10 Essential Public Health Services help to guide the BCHD.

The 10 Essential Public Health Services describe the public health activities that all communities should undertake and serve as the framework for the NPHPS instruments (CDC, 2013). Public health systems should

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.

Elected and appointed officials will require public health information to help inform legislation, funding and policy decisions to mitigate or decrease the impact caused by climate change. Decreasing the impact of climate change will also require local community efforts to help in lessening the impact of climate change (i.e. walk to work, ride a bike, carpool, etc.). This is aligned with the "Ten Essential Services" of public health (CDC, 2013), and planning for climate change helps support public health's core services. Providing this information to elected officials and the community will help to drive actions to lessen the impact of climate change.

This plan is intended to focus only on health related aspects of climate change. It is only one of many Climate Change Adaptation Plans needed in order to ensure that Benton County decision makers are well informed about likely human, environmental, economic and other effects of climate change.

Benton County Geography

Benton County occupies approximately 676 square miles in the heart of the Willamette Valley, in the mid-western part of Oregon. The Willamette Valley region begins east of the Oregon Coast Range and extends east to the Cascade Mountain Range and south to the Calapooya Mountains. In general, this region's geographical position results in a climate characterized by relatively mild temperatures, seasonal precipitation, mild winters, and dry summers. The Cascades serve as an effective moisture retainer for the majority of the Willamette Valley, causing storms to concentrate much of their moisture west of the peaks and leaving areas to the west fertile for agriculture.

Benton County is bordered on its north side by Polk County and on its south side by Lane County. To the west, Lincoln County separates Benton from the coast, and to the east are Linn County and the Willamette River. The 187-mile Willamette River connects to the Columbia River north of metropolitan Portland, which is the only fresh-water corridor for ocean-going commerce on the West Coast of North America, and the only water-grade route through the Cascade Range between Canada and California.

The Willamette and Mary's Rivers, and several small streams are subject to slow-rise flooding. The Willamette Valley is home to more than two-thirds of the Oregon population. Land elevations rise from 150 feet on the Willamette River and floodplains to greater than 3,000 feet in the Northern Oregon Coast Range. The western half of Benton County is known for its timber production, and once down from the mountains, the county is comprised of rolling hills and valleys that boast the largest concentration of wineries and vineyards in the State. Three major highways traverse the county: Highway 99W extends north and south through the county, and Highways 20 and 34 are oriented generally east and west from the Willamette River to the coast. The Willamette and Pacific Railroad also pass through the county. Appendix D shows a map of all of the County's within Oregon.

Temporal Scope

This plan is intended to describe the health impact risks related to climate change that Benton County Health Department will be working to minimize the next 40 years. This plan uses the following strategies to help lessen the impact of climate change on the health of Benton County communities:

1. Associations between negative health impacts and climate change.
2. Template messages for quick dispersal of information to Benton County communities.
3. Reevaluation of health impacts and climate change data every five years for changes or trends that may be occurring.
4. Work with partners both inside and outside the Benton County Health Department to create a cohesive response to climate change.

The above steps will help to ensure that Benton County Health Department will be able to help people and communities prevent adverse health effects of anticipated climate related changes. This plan is intended to be reviewed and updated at least every five years.

Limitations

This plan is limited by the data that is available. Public Health actions alone cannot prepare the county for the coming changes, and will need other county agencies to build climate change contingency plans within their area of expertise (ex. County Emergency Management, Fire Departments, City & County Development, Public Works & Planning departments, etc.). Benton County Public Health encourages other partners to help plan for climate change by buying proper resources, property planning, water and sewage planning, and policy change to help lessen the impact of climate change.

Climate Change in Benton County

The following provides information on how Benton County decided on six climate change risks and associated health impacts. The top three that had the major health impacts were Extreme Heat Events, Wildfire and Extreme Precipitation and Flooding. These top three will be the primary focus of the plan, but Drought and Reduced Summer Water Supply, Ozone Pollution and Longer Growing Season will still be looked at to make sure that the health impacts do not increase over time. The plan outlines how Benton County Health Department intends to contribute to lessening the health impacts associated with each climate risk. It concludes with a recapturing of important information and provides resources that the department and community can use to learn more about climate change and how to be better prepared to address the health impacts that will be associated with it.

Prioritizing the Health Aspect

A central component in development of this plan was development of a Climate Change Health Risk Model to help in the process of prioritizing likely impacts on health due to climate change. This Climate Change Health Risk Model was created by Benton County Health Department Public Health Emergency Preparedness Planner and Oregon Climate Change Research

Institute. This model is based on similar models utilized by Emergency Management and Public Health Emergency Preparedness. The model helps align climate change as part of all preparedness plans, so that better planning coordination occurs and costs of duplication of effort are avoided in efforts to mitigate or lessen the impact of climate change.

The following climate change areas were looked at based on climate change research information provided by Oregon Climate Change Research Institute. The areas identified were:

- Drought and Reduced Summer Water Supply;
- Extreme Heat Events; Wildfire;
- Extreme Precipitation and Flooding;
- Ozone Pollution; and
- Longer Growing Season.

The Climate Change Health Risk Model helped determine which climate change risk would have the greatest health impact. Further guidance on how to utilize this model for planning purposes can be found in appendix c.

In order to assure a range of expertise and input, Benton County Health Department brought together a group of professionals from different agencies and disciplines (i.e. Emergency Management, Environmental Health, Oregon Health Authority, Community Development, and the local hospital). Their input helped create a prioritized list of which climate change risks and health impacts need to be planned for in Benton County. Based upon the expertise of these individuals and the use of the Climate Change Health Risk Model the following three climate change events were prioritized: Extreme Heat Events; Extreme Precipitation and Flooding; and Wildfires. These events were identified as having the highest likelihood and greatest probable impact on the communities and population of Benton County. The table showing the ranking can be found in appendix a.

Understanding climate change health impacts is a critical component for comprehensive health risk planning. There are certain climate change risks that research suggests are more likely to occur in Oregon. Understanding the different climate factors helps to further identify the health risks associated with each. The following information provides the necessary background to understand the different areas of climate change most likely to affect Oregon in the next 40 years.

Extreme Heat

Confidence

Heat waves are caused by stalled high-pressure systems. An increase in duration, frequency, and severity of heat waves in the future is associated with an increase in mean summer maximum temperature (Lau & Nath, 2012). Climate science indicates that extreme heat waves or heat events are likely to increase as time goes on. Not only will daytime maximum temperatures increase, but night time temperatures will not get as low as they currently do, which will increase the intensity and adverse health impact of heat waves or heat events. According to climate scientists, the understanding and ability to detect changes in heat waves

are highly understood (Lubchenco & Karl, 2012). “It is very likely (>=90% probability) that heat waves will increase in length, frequency, and/or intensity over most land areas” (Field et al, 2012).

Vulnerability

Extreme heat events are likely to have major impacts in Benton County. The elderly, young, homeless, low income, outdoor workers, pregnant women, and those with chronic diseases (high blood pressure, respiratory issues, etc.) are likely to be at highest risk for heat related illnesses. It will be extremely important to get prevention and care information to these populations as extreme heat events become more common.

Water systems throughout Benton County may have trouble due to elongated heat events. These events will lead to faster evaporation of the water, decreasing the overall water supply and not enough water to support the needs of Benton County. The need for testing and surveillance of water sources will be very important in preventing waterborne illnesses.

The potential for an increase in deaths due to extreme heat events is also likely. For example more heat will lead to more people going swimming and participate in other water sports in order to keep cool. Gathering information will be important in helping to guide what information needs to be provided to the community in regards to water related problems.

Health Parameters:

When looking at extreme heat events, the following will be information needed to help in gathering data to find trends associated with health issues and extreme heat events:

Health Impacts:

- Vectorborne Diseases
- Waterborne Diseases
- Respiratory Illness (ex. Asthma, Chronic Obstructive Pulmonary Disease (COPD), etc.)
- Cardio problems (ICD-10 codes showing cardio events that lead to deaths)
- Dehydration (ICD-10 codes)
- Drownings
- Mental Health

Populations affected by extreme heat events:

- Elderly
- Low Income
- Homeless
- Children
- Recreationalists

Decreasing the health issues related to extreme heat events is the goal. To help prepare the community it is important to make sure that messages are sent out via social media and other outlets in order to increase the awareness of health issues related to extreme heat events. This will help the community to be able to understand and make better decisions about being safe during elongated heat events. Examples of message topics are:

- Safety during swimming
- Hydration tips
- Heat related injuries (heat cramps, heat exhaustion, heat stroke, etc.)
- Contact information for other questions (Hospital, Clinics, etc.)
- Links to other Websites for more information on the topic
- Association between extreme heat and mental health problems
- Cooling shelter locations

Extreme Precipitation & Flooding

Confidence

As the atmosphere warms, it is able to hold more water vapor, which is available to condense, resulting in extreme precipitation events. A majority of models project increases in the annual average precipitation in the northern part of North American and decreases in the southern part (Christensen et al, 2007), but the Northwest lies in between so results are ambiguous with some models projecting decreases of as much as 10% by the end of the century (OCAR 2010). However, a majority of models predict increases in extreme winter precipitation in the Northwest. “There is confidence that flooding will increase in the 21st century, particularly in areas that have a history of chronic flooding, namely, urban areas (OCAR 2010)” (OCCAF 2010).

Vulnerability

Unless mitigating actions are taken, extreme precipitation and flooding are likely to have their greatest impact on low income individuals and families who tend to live in the most vulnerable locations. The greatest immediate health impact is likely to result from contamination of drinkable water, leading to gastroenteritis outbreaks and other waterborne diseases. There is also the possibility of people drowning due to flooding, and also risks from playing in flood waters (ex. Hepatitis A, etc.). Children and those that are involved with water sports are more at risk than the general population in regards to waterborne diseases.

County and City water systems may become vulnerable to drinking water contamination due to sewage overflow, and agricultural runoff. This contamination may cause water system shutdowns until flooding has decreased enough for proper cleaning and restoration. Service interruptions could last days or weeks, thus decreasing the access to clean water to areas throughout Benton County.

Individual and small community well water systems are often also susceptible to flooding events. Flood waters can easily penetrate well water systems, and contaminate numerous systems with E. Coli, spilled fuel or other toxins, and other contaminants. This could lead to widespread disease outbreaks that would require extra work to identify and counteract, further overburdening emergency response systems.

Health Parameters:

When looking at flooding events, the following information will be needed to help in gathering data and identifying trends associated with health risks and extreme precipitation and flooding events:

Health Impacts:

- Waterborne Diseases (ex. parasites, bacteria, viruses, amoebas, and algae)
- Drownings
- Displacement
- Mental Health

Population affected by extreme precipitation and flooding:

- Low Income
- Those with well water
- Those living in low-lying areas
- Recreationalists
- Elderly & Children (both more susceptible to adverse consequences of diarrheal diseases)
- Homeless

Decreasing the health issues related to extreme precipitation and flooding is the goal. Pre-planned messaging for news releases to the public is important. These will help decrease the time of getting critical information out to the public during events. Messages can also be sent out via social media and other media outlets to ensure that the community is well informed of what to do during these events, so that they can make better informed decisions. Example of message topics should include:

- Sewage clean-up
- Safe drinking water
- Don't play in the flood water
- Possible diseases associated with flood water
- Contact information to call for questions
- Links to specific Websites for further information
- Association between flooding and mental health

Wildfire

Confidence

Based on prediction models wildfires may increase in Benton County. "Warmer and drier summers leave forests west of the Cascades more vulnerable to fire danger. The frequency and extent of wildfires is strongly related to climatic factors. Analyses of fire history reveal a significant correlation of fire activity with decadal-scale (Pacific Decadal Oscillation), episodic (El Nino/Southern Oscillation) and interannual natural climate variation, with larger areas burned during warm and dry phases/years" (Hessl et al, 2004; Pierce et al, 2004; Gedalof et al, 2005; Trouet et al, 2006; Kitzberger et al, 2007; Heyerdahl et al, 2008)." "Critical climate-sensitive

processes, however, differ by ecoregion and vegetation type. In mesic forest types (i.e., predominately west of the crest of the Cascade Range), dry and warm summers exert the strongest climatic influence on forest area burned, depleting fuel moisture and creating favorable conditions for fire spread (Littell et al, 2009)." (OCAR 2010). Estimates of future precipitation changes for the Pacific Northwest vary, with some projections indicating wetter than present conditions and other projections indicating drier than present conditions. Whether the future climate is wetter or drier will significantly affect potential changes in fire activity, as will increases in inter-annual to inter-decadal climate variability (OCAR 2010).

Vulnerability

Increases in fire smoke will cause an increase in respiratory problems for those who are outdoors like forestry workers, the homeless, the elderly, the young, and those who have pre-existing respiratory problems who participate in outdoor activities. In severe fire events, even those remaining indoors may be exposed to high levels of airborne particulates. This often leads to acute exacerbations of asthma, emphysema and other pulmonary diseases. Increases in those illnesses often overload medical clinics, emergency departments and hospitals which may already be struggling with capacity to cope with burns and other fire-related trauma.

Those with histories of mental illness and poor coping skills are at higher risk of experiencing disabling levels of stress during wildfires. Homes and lives may be lost and livelihoods are disrupted by wildfires. Any increase in wildfire frequency or intensity is likely to increase the need for mental health services in Benton County.

Health Parameters:

When looking at extreme heat events. The following will be needed information to help in gathering data to find trends associated with health issues and wildfires:

Health Impacts:

- Respiratory diseases (Asthma, COPD, other respiratory diseases)
- Burns
- Deaths
- Mental Health

Population affected by these health impacts:

- Those with pre-existing breathing problems
- Homeless
- Population living in rural areas
- Firefighters
- Forestry Workers

Decreasing the health issues related to increase wildfires is the goal. To help prepare the community, it will be important to make sure that messages are sent out via social media and other outlets to help increase awareness of health issues related to wildfires. This will help the community to be able to understand and make better decisions about health and safety during wildfire events. Message topics should include:

- Dangers related to wildfires

- Health risks due to smoke from wildfires
- Information on how to decrease smoke effects within homes
- Association between wildfires and mental health problems
- Emergency shelter locations

Appendix B gives more examples on how Benton County Public Health plans to reduce the impacts of climate change in regards to extreme heat events, increased precipitation and floods, and wildfire.

Monitoring

The following areas were recognized as the most important for monitoring, and collecting data about health issues related to climate change:

Communicable Disease (CD) Nurses

Investigate reports of communicable illness and other conditions of public health significance. Collected information will be entered in to the statewide ORPHEUS communicable disease database.

Environmental Health (EH) Specialist

Investigate reports of environmental hazards and foodborne health risks. Collected information will be entered in to the statewide ORPHEUS communicable disease database and other relevant shared databases.

Epidemiologist

Extract, collate, analyze and interpret health information from CD and EH data systems with attention to outbreaks and other health risks that may be caused or contributed to by climate change.

Work with Oregon Climate Change Research Institute (OCCRI) and State Public Health Division epidemiologists to look at outbreak reports, and verify trends that may be occurring due to climate change.

Provide report to supervisor, and Public Health Emergency Preparedness Planner so that the Climate Health Adaptation Plan can be updated as needed.

Social Media

Social media (e.g. Facebook and Twitter) may be used both to disseminate and to gather information about health impacts of climate change. Social media channels should be used as a complement to all other information to the public to help prepare them for climate change.

Examples of helpful ways to utilize social media include: sharing weather advisories and warnings; providing links to information about climate change (ex. NOAA Climate Change); and providing information on emergency preparedness. Social media may also be used to gather information from the public and uncover rumors that are circulating about climate change.

Knowing what is being discussed online can help county staff understand public sentiment, and may help shape public messaging that dispels rumors and addresses specific concerns.

Partners

The Health Department will work closely with Benton County Emergency Management, local healthcare facilities, Oregon Climate Change Research Institute, Oregon Health Authority and other agencies. If the health effects of any serious or disastrous event goes beyond what the Health Department can handle it will be necessary to have disaster response facilities and capabilities to help out with the response and recovery phases.

Response

The following will be the response efforts to health related issues due to climate change. As trends are identified, and associated with health effects the Health Department will take the following proactive steps.

Step one will consist of analyzing trends within Benton County to look for frequency, causation and intensity of outbreaks to see if there is a correlation between the outbreaks and climate change. This will be done through a collaborative effort that will include Communicable Disease Nurses, Environmental Health, Epidemiologists, Oregon Climate Change Research Institute and State Public Health to look at the available information to find health problems related to climate change. As trends are identified, decisions will be made on how to best reach those at highest risk and the steps they can take to better protect themselves from climate change events (Facebook, Twitter, news releases, etc.)

Step two will consist of letting the community know how climate change can affect them. This will help community members to prepare themselves and take the appropriate protective measures. This can be accomplished through outreach events, Social Media (Facebook, Twitter, etc.), and news media releases.

Early intervention will be necessary to help lessen the impact of climate change on the Benton County community. As the effects of climate change increase and have negative health impacts on the community the Health Department will work closely with other agencies responding to the particular event.

Incident Command

When responding to events related to climate change, enacting the Incident Command System may be required. If this is the case other plans already in place will help in guiding the process for responding to the current hazard (Benton County Emergency Operations Plan, Natural Hazard Plan, Department Operations Plan, etc.).

Surge Capacity

If more help is needed the Benton County Health Department will request help from neighboring Counties and the State. It is possible that at this point the State may require federal assistance. All requests will be directed through Benton County Emergency Management.

Strategic National Stockpile

If there is a need for the Strategic National Stockpile (SNS) to be utilized for immunizations or other medical needs, plans included in the Benton County Health Departments SNS plan will be implemented. All requests will be directed through Benton County Emergency Management.

Recovery

Recovering from a climate-related disaster event will be the same as the response to other major disasters. Providing timely information, education and support during the recovery portion will help in community recuperation. A coordinated approach, led by Emergency Management will be necessary for full recovery. Community education will assist residents to be personally prepared for climate-related disasters and to help restore community functions after a disaster has occurred.

Maintenance of Plan

Health risks linked to climate change are most relevant at the local level. As climate science develops there will be many areas with in this plan that will need to be updated. Data may also show that a health concerns are developing more slowly or more rapidly and may require a change in mitigation activities or intensity at the local community level. This plan will be reviewed and revised every five years or sooner if changes occur that require the plan to be updated.

Training

Benton County Health Department administration and community health partners will be made aware of the Benton County Climate Health Adaptation Plan through identified training, exercises, emails and other communication routes. Depending upon the trends of climate change and its affects upon the community more precise training will be provided to designated individuals and groups.

Conclusion

Benton County Health Department (BCHD) has identified health impacts that are most likely to occur due to climate change within Benton County over the next 40 years. BCHD has also identified mitigation strategies to help prepare the population of Benton County for climate change.

This document is only aimed at Benton County Health Department. Other plans need to be created throughout the different county departments to ensure climate change is taken into account throughout the county. The need to make sure that proper response resources are available as change occurs will be vital in protecting the community as a whole. Cooperative preplanning among all of the departments in Benton County government is necessary to assure that the full range of climate change risks are understood. Projecting changes 40 years ahead allows the county to predict and monitor trends so that planning and resource allocation will be appropriate for the predicted changes.

As this plan is revised, updates will be propagated to other planning documents and processes through the climate change planning team. Benton County plans that have a relevant scope include—but are not limited to—the Comprehensive Plan, the Transportation System Plan, the Natural Hazard Mitigation Plan, and the Community Wildfire Protection Plan. [*Editor's note: Each of those plans has a scheduled process for gathering input from a variety of sources, so they don't need added language.*]

Appendix A

Climate Change Health Risk Assessment Model

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										1= Lowest 5 = Highest	1= Lowest 50 = Highest
	Drought & Reduced Summer Water Supply	4	0	1	1	2	2	2	1	1	2	1.33	5.33
sub-category	Decrease in Summer Flow											#DIV/0!	#DIV/0!
	Extreme Heat Event	9	2	2	1	2	2	1	3	3	3	2.11	19.00
	Wildfire	8	1	1	1	2	1	1	2	1	3	1.44	11.56
	Extreme Precipitation & Flooding	8	1	1	2	2	3	2	2	2	1	1.78	14.22
sub-category	Winter Storm											#DIV/0!	#DIV/0!
	Winter Flooding											#DIV/0!	#DIV/0!
	Increased Stream Flow											#DIV/0!	#DIV/0!
	Ozone Pollution	6	0	2	0	2	0	1	1	1	3	1.11	6.67
	Longer Growing Season	5	0	1	1	3	1	2	0	0	1	1.00	5.00
sub-category	Vegetation											#DIV/0!	#DIV/0!
	Decrease in Frost											#DIV/0!	#DIV/0!
												#DIV/0!	#DIV/0!
												#DIV/0!	#DIV/0!
												#DIV/0!	#DIV/0!
												#DIV/0!	#DIV/0!

Climate Risks	Included Within Climate Risk Categories
Drought & Reduced Summer Water Supply	Decrease in Summer flow
Extreme Precipitation & Flooding	Winter Storm, Winter Flooding, & Increased Stream Flow
Longer Growing Season	Vegetation & decrease in frost
Some of these were combined together because of the similar climate drivers.	

Potential Health Risk Scale
No Health Impact = 0
Low Health Impact = 1
Medium Health Impact = 2
High Health Impact = 3

Appendix B

Benton County Health Department Mitigation Strategy Table Format

Service	Climate Change (Extreme Heat Events, Extreme Precipitation, and Wildfires)	Climate Change Actions
1. Monitor health status to identify and solve community health problems.	Tracking diseases and trends related to climate change	Continued monitoring of drought related disease by Environmental Health (EH) and Communicable Disease (CD) staff.
2. Diagnose and investigate health problems and health hazards in the community.	Investigation of infectious water-, food-, and vector-borne disease outbreaks	Investigation of drought related water-, food-, and vector-borne disease by EH and CD staff.
3. Inform, educate, and empower people about health issues.	Informing the public and policymakers about health impacts of climate change	Development of an educational website to keep the public apprised of climate change related health concerns specific to our area, link them to additional information on topics outside our area of expertise.
4. Mobilize community partnerships and action to identify and solve health problems.	Public health partnerships with industry, other professional groups, faith community, and others, to craft and implement solutions	Maintain partnerships with mental health agencies through the Public Health Emergency Preparedness (PHEP) program. Maintain awareness of local climate related planning efforts through the PHEP program. Insert public health messages as possible.

5. Develop policies and plans that support individual and community health efforts.	**Preparedness plans**	**Integrate Climate Change grant activities/Climate Change Hazard Vulnerability Assessment (HVA) into standing Public Health HVA's. Add the Climate Action Plan as an annex of the overall PHEP Plan to ensure continuity of efforts as this project ends to ensure periodic review and update.**
6. Enforce laws and regulations that protect health and ensure safety.	**Isolation and Quarantine**	**Work closely with Emergency Management and other local agencies as needed for enforcement of Public Health laws and regulations.**
7. Link people to needed personal health services and ensure the provision of health care when otherwise unavailable.	**Health care service provision following disasters**	**By utilizing Facebook and other various social media information can be provided to the community on where to obtain health services during disasters.**
8. Ensure competent public and personal health care workforce.	**Training**	**Make sure that all plans that have a role in climate change (i.e. Natural Hazards plan) are updated and exercised by the health department and partnering agencies. This helps to make sure that the workforce is competent if their perspective roles in response to climate change.**
9. Evaluate effectiveness, accessibility, and quality of personal and	**Program assessment of preparedness efforts such as heat-wave plans**	**Periodic reevaluation of Climate Action Plan and adaptation strategies. Synchronize review of Climate Change HVA to align with Local Public Health HVA and Emergency**

population-based health services.		**Management HVA review cycle.**
10. Research for new insights and innovative solutions to health problems.	**Research on health effects of climate change, including innovative techniques such as modeling, and research on optimal adaptation strategies**	**Look for better ways of gaining information and utilizing best practices for lessening or mitigating the impact of climate change.**

Appendix C

Climate Change Health Risk Assessment Model Guidance

Purpose:

The Climate Change Health Risk Assessment Model is made specifically for looking at climate change and the health related issues that may evolve during certain climate change risks. This assessment model is to help in the planning process by ranking the health related issues in regards to the climate risk in order to plan for those areas that will have the greatest effect on the county.

Caution:

All assessments will be limited by availability of supporting data & analysis. Ultimately it comes down to bringing together experts in a wide range of disciplines in order to make the best estimates of probable consequences and health pacts.

Teamwork:

The need for contacting and working with experts in the field of climate science will help in gathering the necessary information required to come up with the probability of occurrence (explained later). Climatologists will be able to gather observed historical climate data and modeled future climate data that will support the scoring of the probability that an anticipated climate change risk would occur.

Evaluation Process:

The following information will help guide you through the Climate Health Assessment Model. This model will assist you with climate change and health related issues. In the end you will combine the scores for the probability of climate risk occurrence and the magnitude of health consequences to come up with number representing the priority of concern for each anticipated

climate risk. This will allow for the ability to ensure that planning for the climate risk that will affect the health of the community is planned for and resources are available in order to mitigate any health related problems.

Climate Risk Descriptions, Likelihood, and Confidence

Drought & Reduced Summer Water Supply

Drought can result from abnormally warm temperatures, reduced precipitation and changes in hydrology. Drought relates to the impacts of when the societal demand for water exceeds the supply. The Willamette River Basin is a mixed rain-snow transient basin characterized by higher stream flows in the winter and lower stream flows in the summer. Most of Oregon's precipitation falls between October and March and much of the summer water supply is stored in the mountain snowpack. 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), but the year-to-year variations in snowpack are quite large. Projected warmer winter temperatures will cause more precipitation to fall as rain rather than snow in the mountains, especially at lower elevations where temperatures are typically close to freezing, likely causing a future reduction in snow pack accumulated over the winter. By 2050, snowpack in the Cascades is projected to decline by about half (Leung et al. 2004; Chang et al. 2010). By the end of the 21st century, April 1 snowpack is projected to decline substantially in the Willamette River Basin. A reduction of snow pack in the winter (and earlier spring melt of snow pack due to projected warming spring temperatures) will lead to a reduction in summer flows in most transient basins that are already at their lowest. An increase in water demand and usage during increasingly hot and dry summers could exacerbate future drought conditions (Chang et al. 2010). By the end of the 21st century, the frequency of droughts lasting 3-6 months is projected to increase in the Willamette Valley and West Cascades (Chang and Jung 2010; Chang et al. 2010).

Likelihood & Confidence

There is high confidence (strong evidence and medium scientific consensus) for historic and future changes in hydrology and reduced snowpack in the Northwest. Reduced snowpack is highly likely, especially in our region, because our high elevation winter temperatures are near the freezing level (32˚F/0˚C) which means that a little warming could make a big difference between how much precipitation falls as snow or rain in the low elevation mountains (Nolin and Daly 2006; Chang et al. 2010). Drought is driven largely by precipitation. There is large inherent variability in Oregon's precipitation and there is a wide range of future precipitation projections for the NW region, but a majority of models project decreases in summer precipitation. There is low confidence that droughts will intensify in this region because of inconsistent projections and drought definitions, as well as observational and modeling deficiencies (IPCC 2012).

Extreme Heat Event

Heat waves are associated with high-pressure systems. An increase in duration, frequency, and severity of heat waves in the future is associated with an increase in mean summer maximum temperature (Lau and Nath 2012). Extreme heat events, or heat waves, are often defined as a certain number of days above the reference period 90th to 99th percentile threshold (i.e. the temperature at which 90-99% of days are cooler than the given temperature threshold). While there has not been a significant increase in historical extreme daytime heat events (defined as 3 or more days over the 99th percentile) in the western parts of Oregon and Washington, the frequency of extreme nighttime temperature events have increased in frequency from 1901-2009 (Bumbaco et al, in review). According to a study by the National Resource Defense Council (NRDC), from 2000-2009 much of the western US, including Benton County saw more extreme heat days (defined locally at the 90th percentile) per year than would be expected given the 1961-1990 reference period (NRDC climate map: http://www.nrdc.org/health/climate/or.asp#mark_97330). Increases in heat wave intensity, duration, and frequency are projected for the Northwest using climate models (Meehl and Tebaldi 2004; Lau and Nath 2012; IPCC 2012)

Likelihood & Confidence

There is high likelihood (greater than 90% chance) that heat waves will increase in length, frequency, and/or intensity over most land areas (IPCC 2012). According to expert assessment, there is a high level of physical understanding and ability to detect changes in heat waves (Lubchenco and Karl 2012). Several scientific studies using different models and different measures of extreme heat project increases in heat waves for the Northwest and most land areas. In sum, there is high confidence that heat waves are highly likely to increase in the future.

Wildfire

The frequency and extent of wildfires is strongly related to climate. West of the Cascades, forests are more vulnerable to fire danger under warmer and drier summer conditions, which deplete fuel moisture creating favorable conditions for fire (OCAR 2010). Since the mid-1980s, the frequency of large fires increased and duration of the fire season increased by 78 days in the western US and can be explained by changes in climate drivers (Westerling et al. 2006). Under projected climate changes, an increase in fire activity (i.e. area burned) is expected for all major forest types in Oregon. Furthermore, frequent, large fires could become increasingly common in western Oregon forests (OCAR 2010).

Likelihood & Confidence

There is high likelihood in the risk of increasing wildfire frequency and intensity (OCCAF 2010). Estimates of future precipitation changes for the PNW vary, with some projections indicating wetter than present conditions and other projections indicating drier than present conditions. Whether the future climate is wetter or drier will significantly affect potential changes in area burned by fire, as will increases in inter-annual to inter-decadal climate variability (OCAR 2010). However, decreases in summertime precipitation are likely. There is medium to high confidence in the evidence for increased area burned by wildfires in the Northwest.

Extreme Precipitation & Flooding

As the atmosphere warms, it is able to hold more water vapor, which means that more water vapor available to condense and rain out when it does rain resulting in extreme precipitation events. Annual precipitation is dominated by natural climate variability and there is not a clear trend in the recent past in Oregon or Benton County. Even though there has been no clear trend in extreme daily precipitation over the 20th century in Oregon or Benton County, extreme precipitation events are likely to increase in the future for the Oregon Cascade Range (Leung et al. 2004; OCAR 2010) and become more intense in parts of the Northwest (Tebaldi et al. 2006; OCAR 2010). One study analyzed changes in several measures of extreme precipitation from global and regional climate models for Portland, OR and found small, though not significant increases (Rosenberg et al. 2010; OCAR 2010). However, another global and regional climate modeling study found that extreme winter precipitation events that occur every 20 years and every 50 years are likely to increase in intensity or the amount of rainfall (Dominguez et al. 2012). Moreover, most of the extreme flooding events on the West Coast coincide with atmospheric river events in which the atmospheric circulation directs moisture from the tropical atmosphere toward our region.

Likelihood & Confidence

A majority of models project increases in the annual average precipitation in the northern part of North America and decreases in the southern part (Christensen et al. 2007), but the Northwest lies in between and so results are ambiguous with some models projecting decreases of as much as 10% and increases of 20% by the end of the century (OCAR 2010). A majority of models indicate increases in extreme winter precipitation in the Northwest. “There is confidence that flooding will increase in the 21st century, particularly in areas that have a history of chronic flooding” (Chang and Jung 2010; OCCAF 2010). However, there is very little information regarding how the frequency and intensity of atmospheric river events might change in the future.

Ozone Pollution

The high-pressure systems associated with heat waves produce stagnant air masses that can trap and prevent dispersal of atmospheric pollution resulting in higher concentrations of ground-level ozone. With projected increases in heat waves and average warmer temperatures in the Northwest, increasing ground-level ozone is an associated risk, though generally in urban areas and a lower risk compared to the rest of the country (Chen et al. 2009). Land cover changes could also contribute to ground-level ozone concentrations (NCA 2009). The Willamette Valley is prone to diminished air quality during the winter under temperature inversions, which tend to prevent air and any particles in the air at the surface from mixing and dispersing upward.

Likelihood & Confidence

While high temperatures would increase tropospheric ozone levels under low and high emissions scenarios, future ground level ozone projections are dependent on the emission scenario: the low emission scenario has a decrease in certain emissions that lead to ozone formations and thus projects decreases in ground level ozone while the high emissions scenario projects increases in ground level ozone (NCA 2009). The current emission trajectory is similar to the higher emission scenario, though that could change in the future depending on societal behavior and new policies.

Longer Growing Season

Increases in temperature and carbon dioxide concentrations affect the growing season length and production of vegetation. Increasing mean annual temperature contributes to an increase in the length of the frost-free season, defined as the number of days between the last spring frost and the first fall frost. Over the 20th century, the average frost-free season in the US has increased by about 2 weeks, and has increased by even more than that in the western US at a rate of 19 days per century (Kunkel et al. 2004). This increasing trend in the length of the frost-free season is expected to continue in the future with warming temperatures (IPCC 2007). Increase in the length of the frost-free season is associated with earlier spring blooming. In the western US, honeysuckles and lilacs bloomed earlier in the 1980s and 1990s than in the 1960s

and 1970s (Cayan et al. 2001; OCAR 2010). This may affect the length of the pollen season for some plants. The ragweed pollen season has been increasing as a function of increasing latitude in central North America by 13-27 days above 44 degrees latitude since 1995 (Ziska et al. 2011). In Oregon, 9.9% of adults and 8.3% of children have asthma; a higher burden than the overall US population (Garland 2009; OCAR 2010). Rising temperatures and CO_2 levels could increase pollen production in some plants and make some aeroallergens more allergenic (OCAR 2010).

Likelihood & Confidence

There is high likelihood and confidence that the length of the frost-free season will increase because it is a result of generally warmer temperatures, which has a high likelihood of occurring in the future. There is lower confidence in how increasing temperatures and CO_2 concentrations will affect the allerginicity of plant allergens because this topic has been largely unexplored so documentation is limited including only certain plant species in limited experiments. There is more confidence that higher temperatures and CO_2 concentrations will almost certainly alter the production, distribution, and dispersion of plant-based allergens from trees, grasses, and weeds (Ziska and Beggs 2012). Note that documentation is limited including only certain plants.

Climate Risk and Probability of Occurrence

Obtaining observed historical climate data and future climate projections from climate models pertaining to each climate risk will help in determining the probability of occurrence: a number from 1-10 with 10 being the most likely to occur. Based on the historical and future climate data and confidence level in future projections provided by climate experts, the group will subjectively, yet systematically, assign a number to each climate risk representing the probability of occurrence. When determining which number to assign, it is useful to take into account the likelihood of the projected climate risk occurring based on climate research and the

confidence in the evidence supporting the likelihood judgment. Confidence is determined by assessing the quality of evidence and the level of scientific consensus (Moss and Yohe 2011). A qualitative description of the likelihood and confidence of each climate risk is provided in the previous section as a resource to the group going through the exercise.

The following chart was utilized by a group of health professionals to provide a way of assigning a number to the Probability of Occurrence for each risk based off of the climate data provided for Benton County and explained in the prior paragraphs.

Probability of Occurrence	Scale
High	9-10
Medium	5-8
Low	1-4

Useful definitions of high, medium, and low probability of occurrence based on qualitative determination of likelihood and confidence are summarized in the table below:

		Confidence in the Evidence		
		L	M	H
Likelihood of Risk	L	1-4	1-4	1-4
	M	1-4	5-8	5-8
	H	5-8	5-8	9-10

This table may be useful in determining whether the probability of occurrence is low, medium, or high, but the final assigned number to be used in the risk assessment exercise will be determined by group consensus through voting and discussion and may not ultimately fall within these boundaries.

Public Health Consequences

The Climate Health Assessment Model is broken down into three areas Health and Safety, Response Capacity, Providers, and Public Health Infrastructure. It is necessary to take a look at each area and assess a number value of 1-3 with 3 being the highest impact to each category within the health related fields. As numbers are assessed to each area it will be added up in section and the average of all the numbers will be put into the Public Health Consequence section. This section will then be times by the Probability of Occurrence and will give the overall Public Health Risk in association with the Climate Risk area, which will allow for ranking the importance of each Climate Risk and assist in the planning for the health consequence associated with each Climate Risk.

Health and Safety

The Potential Health Risk is broken down into 9 different areas (fatalities, chronic disease, communicable disease, respiratory diseases, waterborne/foodborne diarrheal disease, Vectorborne disease, vulnerable populations, food access/quality, and air quality). Each of the fore mentioned areas are talked about later on in this document, which will help in determining what number to give each area as it pertains to climate change risks.

Public Health Infrastructure

Public Health provides many different important roles that are necessary to protect the community they serve. The different climate risk will affect Public Health in many different ways. The following will explain how to determine what number goes into the potential health risk areas.

Health Scale

When looking at the different areas that are related to health it is necessary to rank them with a number of 1-3. By ranking these areas 1-3 it helps in determining the overall health related issues in regards to climate risk. This will help in the planning process and it is very important to make sure that health data that is used is specific to the county.

The following paragraphs will breakdown each of the health consequences associated with the climate risk. It will also provide a scale of 1-3 to help in making the decision of what number should be put into the boxes.

Health Related Ranking Scale

Scale	Number
Low Health Impact	1
Medium Health Impact	2
High Health Impact	3

Potential Climate Change Health Risk

The consequences of climate change can and will have a huge impact on different health related issues. It will be up to each Health Department to be ready to respond or provide resources when there are health issues that are occurring due to climate change.

This tool will help to identify what each county will need to plan for in the Climate Health Adaptation Plan. When conducting a meeting to fill out this portion of the chart it has been found to be easy to use clicker technology. This allows for participants to provide quick response feedback, and there are immediate results after each question.

Make sure that you go through the filling out of the tool before discussion occurs. Discussion at the end of the session will allow for response on the tool, and to allow for discussion on certain areas that may have been too close to call.

Fatalities

Looking at the climate change risks think about how the certain areas will affect the fatality rates. Will there be an increase of fatalities, and if so how big of impact may this have on fatalities due to the climate change risk.

What kind of impact may each climate risk have on fatality rates within the county:

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Chronic Diseases

When looking at chronic disease there is a need to really think about the different chronic diseases that could be affected by the different climate variables. The following is a list of chronic disease, but it is not all-inclusive:

- High Blood Pressure
- Diabetes
- Cancer
- Arthritis

What kind of negative impact may climate change risk have on chronic diseases within the county:

1. Low Health Impact
2. Medium Health Impact

3. High Health Impact

Communicable Disease

Communicable diseases are types of diseases that affect the community, and may or may not be easily spread. Examples of communicable diseases are as follow, but not all-inclusive:

1. E. Coli
2. West Nile Virus
3. Lyme disease

Will the climate change risk increase certain communicable diseases (1 or more), and if so how big of impact may these increases be:

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Respiratory Diseases

Respiratory illnesses can be increased due to climate change. Asthma and chronic obstructive pulmonary disease are of concern. There are many different ways that climate change can affect respiratory illness whether chronic or acute in nature.

What kind of negative impact may each climate risk have on respiratory illnesses within the county:

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Waterborne/Foodborne Diarrheal Diseases.

Waterborne and foodborne diarrheal disease can be affected by climate risk change. There could be a negative impact on the community if climate change increases the contamination of the many different diseases that are out there (E.Coli, Salmonella, Shigella, Cryptosporidium, etc.).

Would this climate risk have an effect upon the different diseases, and cause problems for the community. If there would be an increase in waterborne/foodborne diarrheal (1 or more) diseases how would this climate change risk impact the increase of these disease(s):

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Vectorborne Diseases

There are many different Vectorborne diseases that could be affected by climate change. This negative affect would have a negative impact on the community as a whole.

Would this climate risk change increase Vectorborne diseases (Lyme, rabies, tick fever, West Nile virus, etc.)? If so how would it impact the Vectorborne diseases (1 or more):

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Vulnerable Populations

Special considerations must be given to the needs of community members who may face systemic barrier (no car, deaf, hearing issues, language barrier, etc.) in accessing.

What kind of negative impact may each climate risk have on vulnerable populations within the county:

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Food Access/ Quality

Food access/quality has to do with the ability to obtain food that is nutritious for individuals to consume. Certain climate change risks will have a direct bearing on food availability and the quality of the food.

What kind of negative impact may each climate change risk have on food access/quality within the county:

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Air Quality

Air quality is a concern when it comes to climate change risk. If air quality is poor it can have a major effect on people who have respitory problems. Air quality will be affected by different climate change risks.

What kind of negative impact may each climate risk have on air quality within the county, which would affect the breathing of the community within the county:

1. Low Health Impact
2. Medium Health Impact
3. High Health Impact

Please contact the following individuals for any questions in regards to this model:

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Enterprise-wide		Worksheet Public Health Climate Change Consequences									Public Health Consequence	Public Health Risk
CLIMATE CHANGE HEALTH RISK ASSESSMENT MODEL		HEALTH AND SAFETY									Public Health Consequence	Public Health Risk
Revised: December 2012		Potential Health Risk									Overall Impact (Average)	Probability x Overall Impact (Average)
Climate Risk	Probability of Occurrence										1= Lowest 3 = Highest	1= Lowest 30 = Highest
	Drought & Reduced Summer Water Supply										#DIV/0!	#DIV/0!
	Extreme Heat Event										#DIV/0!	#DIV/0!
	Wildfire										#DIV/0!	#DIV/0!
	Extreme Precipitation & Flooding										#DIV/0!	#DIV/0!
	Ozone Pollution										#DIV/0!	#DIV/0!
	Longer Growing Season										#DIV/0!	#DIV/0!
											#DIV/0!	#DIV/0!
											#DIV/0!	#DIV/0!
											#DIV/0!	#DIV/0!
											#DIV/0!	#DIV/0!

Climate Risks	Included Within Climate Risk Categories
Drought & Reduced Summer Water Supply	Decrease in Summer flow
Extreme Precipitation & Flooding	Winter Storm, Winter Flooding, & Increased Stream Flow
Longer Growing Season	Vegetation & decrease in frost
Some of these were combined together because of the similar climate drivers.	

Potential Health Risk Scale
Low Health Impact = 1
Medium Health Impact = 2
High Health Impact = 3

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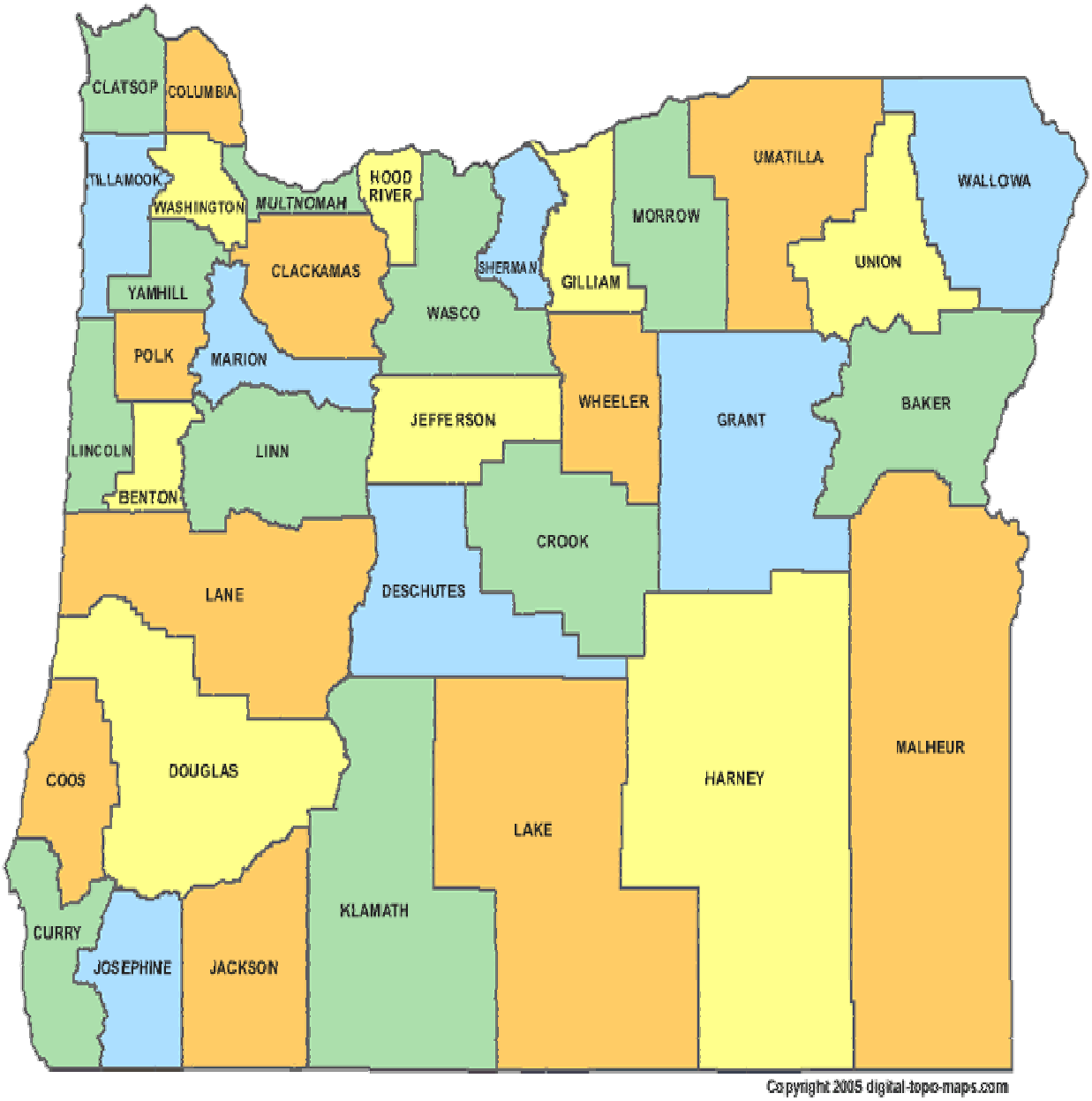
Appendix D

Oregon County Map



*Available from http://www.digital-topo-maps.com/county-map/oregon.shtml.

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