SPR RESEARCH PROGRAM
SECOND-STAGE PROBLEM STATEMENT
FY 2009

ODOT Research Unit
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I. PROBLEM NUMBER

GHE-09-20

II. PROBLEM TITLE

Prediction of future flow regimes based on climate change

III. RESEARCH PROBLEM STATEMENT

Elevated levels of carbon dioxide, methane and other heat-trapping gasses are theorized to have significant impact on future climate patterns. This is expected to result in a myriad of changes to regional flow regimes. Regional warming may produce earlier snowmelt peaks at high altitudes. Decreasing levels of snowpack may result in more frequent and pronounced droughts in some areas. Increases in short-term rainfall intensity may produce larger floods in small watersheds. Without adequate insight into probable future flow regime changes, flow structures such as bridges and culverts will be designed based on historical flow data that may not prove accurate for future flow regimes.

Predictors of future climate patterns such as General Circulation Models (GCM's), Regional Circulation Models (RCM's) and Transient Climate Simulations are becoming more consistent as computing power approaches needed levels for the complexity of these models. Existing streamflow models are capable of predicting various streamflow statistics with adequate precision in homogeneous regions. Coupling rainfall and temperature outputs from GCM's and RCM's with proven streamflow models will provide needed insight as a reasonable first step into which regions within the state are most susceptible to flow regime change, and in what form that change is likely to take.

IV. RESEARCH OBJECTIVES

Objective 1: At several basins across the climatic variations in Oregon, determine proven watershed model data and properly downscaled climatic change data.

Objective 2: At modeled watersheds, compare historical hydrology to predicted hydrology for modeled global climate change scenarios.

V. WORK TASKS, COST ESTIMATE AND DURATION

Task 1: Review Existing Watershed Models and Global Climate Models (GCM) – $5,000

Gather together information related to existing watershed models for sites in Oregon. Research availabilty of climate data from General Circulation Models and Regional Circulation Models for Oregon. Potential sources of information are at various western universities and the USGS. The information should be considered related to down scaling applicability of the variety of hydrologic and climate regions of Oregon.

Task 2: Compile Existing Oregon Watershed Model Data – $10,000

Gather together all the model input and stream discharge data for basin in Oregon and surrounding regions and put it into a uniform format suitable for the completion of Tasks 4, 5, and 6. Chose 5-10 basins in a variety of basins across the climate region of Oregon. Potential sources of existing models could exist at the USGS, PSU, Bureau of Reclamation, and Bureau of Land Management, and US Forest Service.

Task 3: Compile Existing GCM data – $5,000

Gather together GCM climate data and other characteristics data for basins chosen in task 2 for Oregon and surrounding regions and put it into a uniform format suitable for the completion of Tasks 4, 5, and 6. Consider GCM data time periods extending out to 2060 to 2100.

Task 4: Compute Hydrology for Climate Change Scenarios - $30,000

The data from Task 3 is point data. This point data needs to be spatially extrapolated over the drainage basin area. The data from Task 2 is also point data and may need to be spatially extrapolated along the reaches of the streams

for the purposes of model validation of development. Basin characteristics to be considered need to be determined and uniformly assigned across the state.

Task 5: Statistical Analysis of Modeled Hydrology data – $10,000

Statistically analyze the current annual hydrograph data to projected climate change scenario discharge data. This might involve calculations such as annual flow volumes, natural flows with 5, 10, 25, 50 and 95 percent probability of exceedence and the 7 consecutive day low-flow for fish passage and temporary water management and the 6-month, 24 hour (91% annual runoff) and a mass-based "First Flush" flows for stormwater quality. Uncertainty bars will accompany the projected hydrographs.

Task 6: Compilation of data, statistics along with Research Report - $25,000

A publishable research report documenting data and methods used, conclusions reached, and the results will be completed.

Task 7. Research Administration - $10,000

Work Task Cost Estimate Duration	
1. Review Existing Watershed Models and Global Climate Models	$10,000 2 months
2. Compile Existing Oregon Watershed Model Data	$15,000 2 months
3. Compile Existing GCM data	$10,000 2 months
4. Compute Hydrology for Climate Change Scenarios	$40,000 6 months
5. Statistical Analysis of Modeled Hydrology data	$20,000 6 months
6. Compilation of data, statistics along with Research Report	$25,000 6 months
7. Research Administration	$10,000 24 months
Time & Budget: 24 months & $130,000 (FY09-$75,000, FY10-$50,000)	

VI. IMPLEMENTATION

The results of this research would inform the next steps of policy action with respect to Global Climate Change. It has been suggested that ODOT should prepare to adjust its hydrologic designs to accommodate changes in stream flows caused by climate change. This research would give an indication of the magnitude and direction (increase of decrease) of stream flows as indicated by the same climate models which are raising the concerns. This information would also address water supply concerns that have been raised.

VII. POTENTIAL BENEFITS

As a reasonable first step, determining where flood levels are likely to increase will aid in the design of new, upgraded or retrofitted flow structures such as bridges and culverts, thus minimizing the occurrences of failures or over-designs. Future changes to the lower end of the flow regime could have significant impacts on fish passage and water-use permit decisions.

VIII. SUBMITTED BY

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