

1. **Data Set Title:** Tabular Output for Willamette Water 2100 Modeling Scenarios, Output Version 3.0
2. **Abstract:** Data files in .csv format containing tabular output generated by Willamette Envision, a computer model developed to explore how climate change, population growth, and economic growth will alter water availability and use in the Willamette River Basin, Oregon, USA. Output is called WW2100 3.0 and was generated by Willamette Envision code versions 330 and 331. The .csv files are grouped into zip files that specify modeling scenario name (e.g. Ref.zip, Extreme.zip). Refer to the scenario table (.pdf) and Willamette Water 2100 web page (<http://inr.oregonstate.edu/ww2100/model-overview/scenarios>) for a description of each modeling scenario. Within each zip file, there are 142 files that summarize model output at either daily or annual timesteps for different spatial extents within the Willamette River Basin. Example data sets include basin-wide land use land cover trends, timber harvest, use of water rights, as well as daily stream discharge at specific locations. Refer to the data dictionary for a complete list of output.
3. **Recommended data citation:** Willamette Water 2100 Project Team. 2016. Tabular Output from the Willamette Water 2100 Project, Version WW2100 3.0
4. **Data Contact person:** David Conklin, Oregon Freshwater Simulations, david.conklin@FreshwaterSim.com, <http://www.freshwatersim.com/>; Anne Nolin, Oregon State University, nolina@oregonstate.edu
5. **Related publications**
 - a. <http://inr.oregonstate.edu/ww2100/publications>
6. **Methods:**

Willamette Envision is a whole watershed model, i.e. it attempts to represent all the significant processes related to the supply and fate of water in the entire basin. These processes are both natural (e.g. precip, snow dynamics, infiltration, runoff, evapotranspiration) and human (e.g. reservoir operations, irrigation, municipal water use, crop choice). The model takes exogenous projections of climate, population, and income as its drivers. It operates by simulating the processes across the entire basin for one time step, recording the effects on the landscape, and then advancing to the next timestep. Some processes are modeled at a daily timestep, for example streamflow and evapotranspiration, while others are modeled at an annual timestep, such as population growth and urban expansion.

Willamette Envision is made up of sub-models called “plug-ins” that share data with each other via a spatial database as they run. The spatial database stores information about the landscape in map polygons called integrated decision units (IDUs) and a line

network representing the river system. Many of the sub-models have companion .xml files that specify related modeling parameters, inputs and outputs.

The .csv output data files are generated in several different ways by the Willamette Envision code. Many of the annual files are generated by the Reporter modeling plug-in, from specifications in the wv_Reporter.xml file. The daily files are generated by the hydrologic modeling framework called FLOW and related sub-models such as AltWaterMaster, EvapTrans, and others which operate on a daily timestep as part of FLOW. As with Reporter and wv_Reporter.xml for annual files, many of the daily files are generated by FLOW from specifications in the AltHBV_minimum.xml file. A number of other .csv files are generated directly by C++ code, in various parts of Willamette Envision. Often there is an all-caps prefix to the .csv file name which identifies what part of the Willamette Envision code produced the file:

- REP - annual files produced by Reporter from wv_Reporter.xml
- HBV - daily files produced by Flow from AltHBV_minimum.xml
- ALTWM - files, which can be either daily or annual, produced by C++ code in AltWaterMaster
- ECON - annual files produced by C++ code in the economics models, part of the WW2100AP plug-in

The .csv data dictionary identifies the sub-model within Willamette Envision that generates each dataset. In many cases, the calculation methods used to generate .csv output is specified in the .xml file related to the sub-model. These .xml files can be downloaded with the Willamette Envision code at <http://inr.oregonstate.edu/ww2100>.

The .csv files are grouped into zip files that specify modeling scenario name (e.g. Ref.zip, Extreme.zip). There are a total of 22 scenarios, 20 representing future conditions (January 1, 2010 - December 31, 2099) and two representing historical conditions (January 1, 2050 - December 31, 2009). Refer to the scenario table (.pdf) and Willamette Water 2100 web page (<http://inr.oregonstate.edu/ww2100/model-overview/scenarios>) for a description of each scenario. Every modeled year has exactly 365 days. Input daily climate data, was resampled for leap years to reduce 366 days to 365 days. The first resampled day represented all of the original January 1 plus 1/365 of the original January 2. The second resampled day represented 364/365 of the original January 2 plus 2/365 of the original January 3, and so on.

For WW2100 3.0, all of the scenarios except the two historical scenarios were run with Willamette Envision code v330. The two historical scenarios were run using v331, which differs from v330 in one way: it uses landscape conditions at the end of the first year of the Reference Case scenario (idu_2011.dbf). The Willamette Envision Code v330 and related input files can be downloaded at <http://inr.oregonstate.edu/ww2100>, other versions of the code can be accessed from an online repository located at: <https://freshwater.ceoas.oregonstate.edu:8443/svn/WW2100svn>.

7. **Location:** Willamette River Basin, Oregon, USA; Hydrologic Unit Code: 170900

8. **File format:**

The .csv file names follow the convention that the first part of the file name describes the output, and the second part of the file name identifies the scenario. For example, the file ALTWM_Annual_Metrics_Ref_Run0.csv was generated by the ALTWM code, contains values summarized on an annual timestep, and is for the Reference Case scenario.

All .csv files have the same general structure. The first line consists of column headers, and the first column is a time index, either annual or daily. In annual files, there are as many rows of values as there are years of simulation. In daily files there are as many rows of values as there are days of simulation, i.e. 365 times as many rows as there are in annual files (the WW2100 model treats all years as having 365 days, leap years included). The .csv files generated from specification in .xml files number the days starting with zero (e.g. "HBV_Climate_by_Elev....csv"), some of the .csv files generated from C++ code directly start numbering the days with 1 (e.g. "ALTWM_Daily_Metrics....csv"). Also, some of the annual .csv files start in 2009 (e.g. "REP_Forest_ET_and_Precip....csv"), while others start in 2010 (e.g. "ALTWM_Quick_Check_(mm....csv)"). The Run0 portion of the file name has no significance.

9. **Related Documentation:**

CSV_FileDirectory.xlsx - list of CSV files and attributes, also includes definitions of terms and abbreviations, and a list of CSV files generated by Willamette Envision but not in use in version 3.0 output

WW2100_ScenariosTable.pdf

Notes.pdf - notes on how this version of code differs from previous versions

Scenario_Comparison.xlsx - comparison of how model output differs from output from earlier code versions

10. **Sponsorship:** Generation of this data set was supported by the National Science Foundation under Grants No. 1039192 (OSU), 1038925 (PSU) and 1038899 (UO).

11. **Overview of project and disclaimer:** The Willamette Water 2100 project was a six year collaborative research effort by Oregon State University, Portland State University and the University of Oregon to evaluate how climate change, population growth, and economic growth will alter the availability and the use of water in the Willamette River Basin on a decadal to centennial timescale. The project team developed a computer model, called Willamette Envision, that integrates aspects of hydrology, ecology, and human systems, and allows scientists and stakeholders to explore the interaction between land and water management policies, economics, climate, and ecology. The project was supported by grants from the National Science Foundation and was carried out between 2010 and 2016. Any opinions, findings, and conclusions or

recommendations expressed by this work are those of the authors and do not necessarily reflect the views of the National Science Foundation.

12. **Keywords:** Envision, Water Sustainability and Climate, water scarcity, Willamette River Basin

13. **ORCID of researcher:** <http://orcid.org/0000-0002-1506-0087> (Anne Nolin)