Monitoring Streamflow, Water Levels, and Water Quality in the Wapato Lake National Wildlife Refuge, Oregon

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Introduction

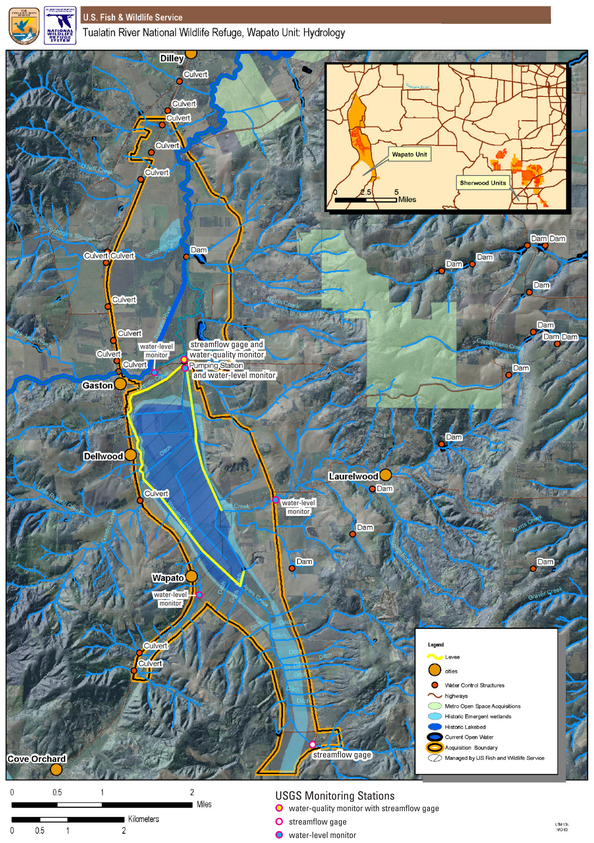
Wapato Lake near Gaston in northwestern Oregon has been a productive resource for fish, wildlife, and human populations for hundreds of years. Historically, seasonal high flows in the upper Tualatin River filled the lowland area comprising Wapato Lake. In the 1930s, a network of levees and canals was constructed to minimize seasonal flooding, facilitate the drainage of the lake in springtime for farming during summer, and convey water during summer to farmland in and around the lakebed. To augment tributary inflows during the summer dry season, a diversion canal from the Tualatin River to the Wapato Lake canal system was constructed to bring water around the lake to adjacent agricultural lands. Since the construction of the levees, streams that previously flowed into Wapato Lake no longer do so, leaving rainfall, groundwater seepage, and leakage through the levees as the only hydrologic inputs to the lakebed.

Recently, the U.S. Fish and Wildlife Service (USFWS) purchased most of the lakebed inside the leveed area, with the goal of managing the area for birds, fish, and other wildlife as the Wapato Lake National Wildlife Refuge. To optimize the future management of the lakebed, a variety of data were collected to provide a better understanding of the hydrology of the area and the quality of the water moving through the system.

In partnership with the USFWS, the U.S. Geological Survey (USGS) began monitoring streamflow, water levels, and water quality in the Wapato Lake area in September of 2011. Two streamflow gages, four water-level gages, and one water-quality station continuously collected data at key sites upstream, within, and downstream of the lake (see locations on map) through April of 2013. Several times each day, the data were transfered via satellite to the USGS database and made available to the public from USGS websites. One water-level gage is still operating today, providing real-time information on the amount of water in the lake.

The streamflow and water-level stations collected data that are being used to better understand the hydrology of the system and quantify its water budget. In combination with high-resolution topographic data collected by USFWS, the data were used to construct a water-budgeting spreadsheet tool that predicts flows and water levels under future management scenarios.

The water-quality station measured water temperature, pH, conductance, dissolved oxygen, turbidity, chlorophyll, and blue-green algae levels at the outlet of the lake, providing important information on the quality of the lake and canal water as well as the water exported downstream to the Tualatin River.



Map of the Wapato Lake area, showing the locations of USGS streamflow, water-level, and water-quallity monitoring stations upstream of, within, and downstream of the historic lakebed. The levee around the lakebed is marked with a yellow line. Data from the water-level stations on Wapato Creek upstream of the lakebed, Hill Creek upstream of the lakebed, and the Tualatin River diversion canal are collected manually, while data from the Ayers Creek streamflow gage, the pumphouse water-level gage, and the Wapato Creek outlet water-quality monitor were telemetered. (Map modified from U.S. Fish and Wildlife Service.)

staff plate to read water level

Photos of Wapato Lake water-level monitor (top) and Wapato Creek water-quality monitor (bottom) by Micelis Doyle, USGS, September 30, 2011.

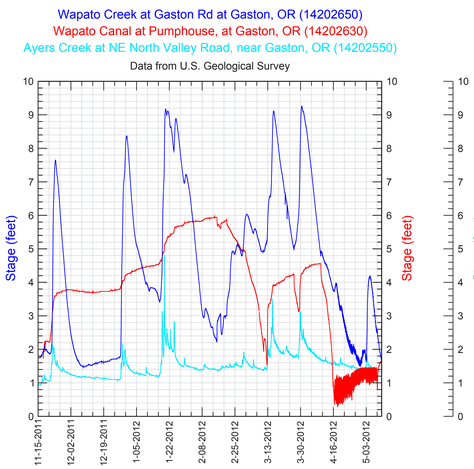
Flow, Water-Level, and Water-Quality Monitoring

Most of the USGS monitors collected data from September 2011 to April 2013; the lake water-level gage is still deployed. Data from the telemetered sites can be viewed and explored online using the USGS Data Grapher website at:
http://or.water.usgs.gov/cgi-bin/grapher/graph_setup.pl?basin_id=tualatin
Data from the lake water-level gage also are available from the USGS National Water Information System website at:
http://waterdata.usgs.gov/or/nwis/uv?site_no=14202630

The Data Grapher website allows users to interactively explore the available data, creating customized graphs and tables of various types, including comparisons of data from multiple sites, such as the graphs shown below.

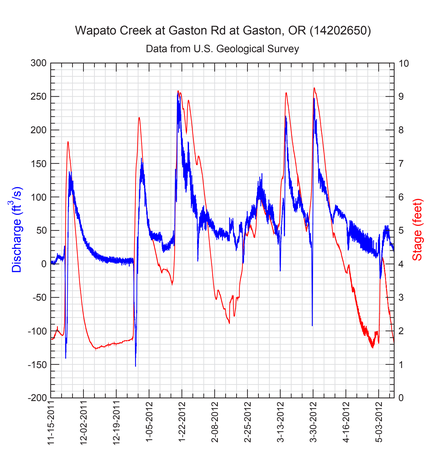
Streamflow was measured at the Ayers Creek site by measuring the water level with a pressure sensor, then converting that measurement to streamflow through a stage-discharge relation determined from flow measurements collected over a wide range of conditions. Streamflow at the Wapato Creek outflow site was measured with an acoustic velocity meter that used sound waves to measure the velocity of water; the velocity data combined with water-level data were used to calculate streamflow. The water-level sensors at various sites used underwater pressure sensors to measure the water depth.

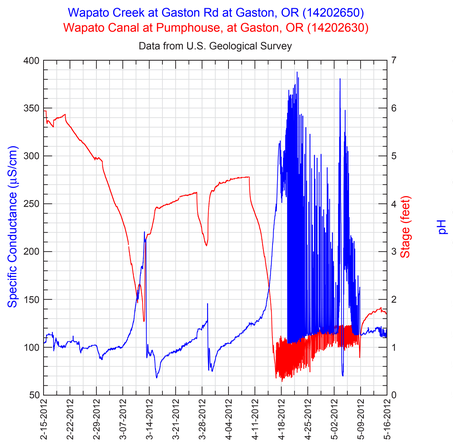
Water quality at the Wapato Creek outflow site was measured with an instrument equiped with seven different probes. The probes were maintained and calibrated every 3-4 weeks, year-round, to keep them operating properly.

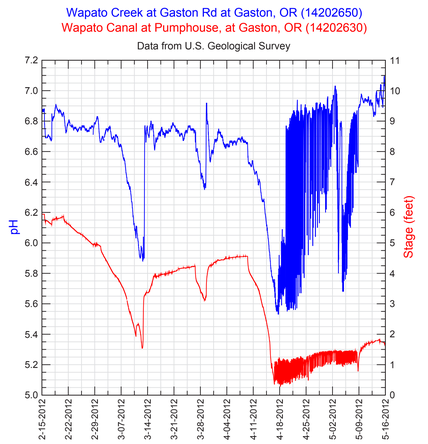


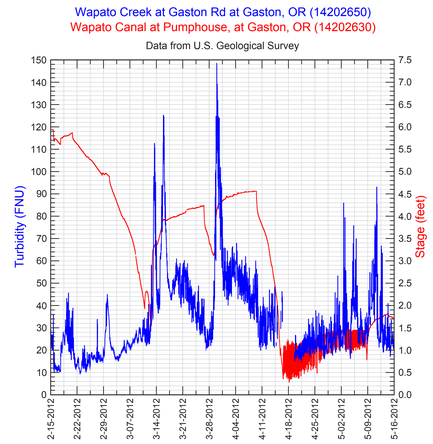
Water level (stage) data from three sites are plotted in the graph to the left, showing that a series of storms increased the flow in the creeks and caused the lake to accumulate about 4 feet of water.

Flow and water-level data in the graph to the right show that rainfall often caused the Tualatin River to rise faster than Wapato Creek, causing water to flow upstream (negative discharge) for a short period of time.









USGS data from spring of 2012 show interesting patterns when Wapato Lake was being pumped dry. Stage data in red show the water level in the lake, while water-quality data from a site downstream in blue show that the pumped water had higher conductance, lower pH, and low turbidity compared to water outside the levees.

View of Wapato Lake from the pumphouse taken July 19, 2008 (top) and April 13, 2010 (bottom). Photographs by Stewart Rounds and Micelis Doyle, USGS.

View of control on Wapato Creek outflow canal (top) and the inner canal near the pumphouse (bottom). Photographs by Norman Buccola, USGS, June 29, 2011.

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