Monitoring Streamflow, Water Levels, and Water Quality in the Wapato Lake Unit of the Tualatin River National Wildlife Refuge, Oregon

Contact: Stewart A. Rounds, USGS
sarounds@usgs.gov
503-251-3280

Introduction

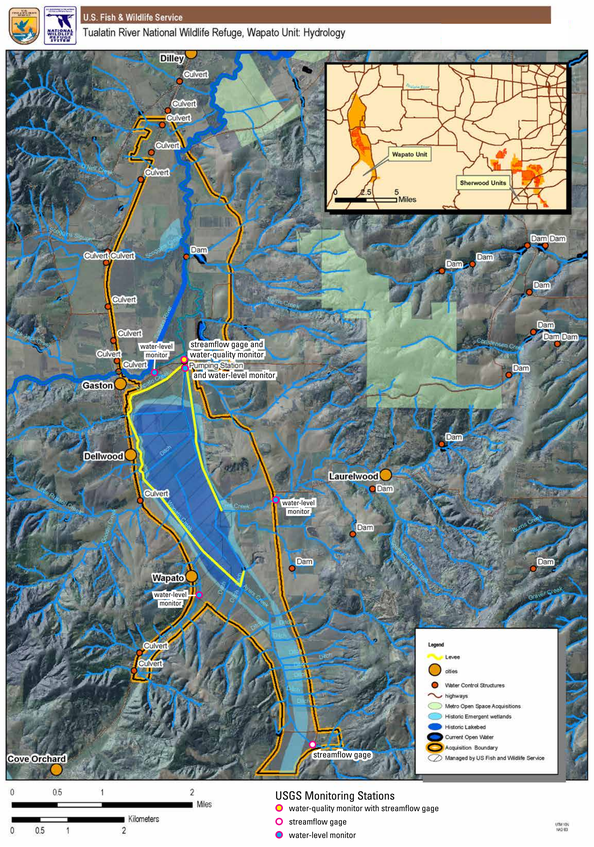
Wapato Lake near Gaston in northwestern Oregon has been a productive resource for fish, wildlife, and human populations for hundreds of years. Historically, seasonal high flows in the upper Tualatin River filled the lowland area comprising Wapato Lake. In the 1930s, a network of levees and canals was 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 Unit of the Tualatin River National Wildlife Refuge. To optimize the future management of the lakebed, a variety of data are being collected that will 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, one water-level gage, and one water-quality station continuously collect high-quality data at key sites upstream, within, and downstream of the lake (see locations on map). Several times each day, the data are transfered via satellite to the USGS database and made available to the public from USGS websites. Three other stations measure water levels in other tributaries or canals, but the data are retrieved manually every couple of months.

The streamflow and water-level stations measure data that will be 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 can be used to project flows and water levels under future management alternatives.

The water-quality station measures 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 are telemetered. (Map modified from U.S. Fish and Wildlife Service.)

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

The USGS monitors have been collecting data for more than a year, and will be in place for at least two years. Data from the three telemetered sites are available online from the USGS National Water Information System website at:

http://waterdata.usgs.gov/or/nwis/uv?site_no=14202550
http://waterdata.usgs.gov/or/nwis/uv?site_no=14202630
http://waterdata.usgs.gov/or/nwis/uv?site_no=14202650

or from the USGS Data Grapher website at:

http://or.water.usgs.gov/cgi-bin/grapher/graph_setup.pl?basin_id=tualatin

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

Streamflow is 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 is measured with an acoustic velocity meter that uses sound waves to measure the velocity of water; the velocity data combined with water-level data are used to calculate streamflow. The water-level sensors at various sites use underwater pressure sensors to measure the water depth.

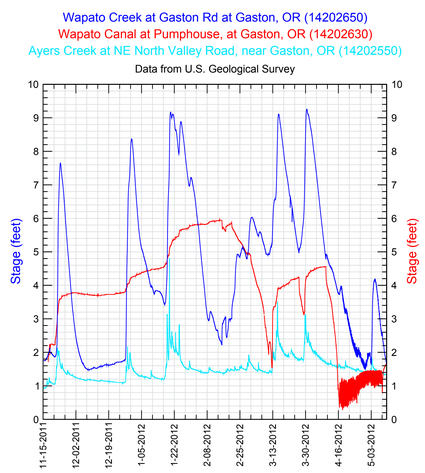
Water quality at the Wapato Creek outflow site is measured with a multiparameter instrument equiped with seven different probes. The probes are maintained and calibrated every 3-4 weeks, year-round, to keep them operating properly.

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.

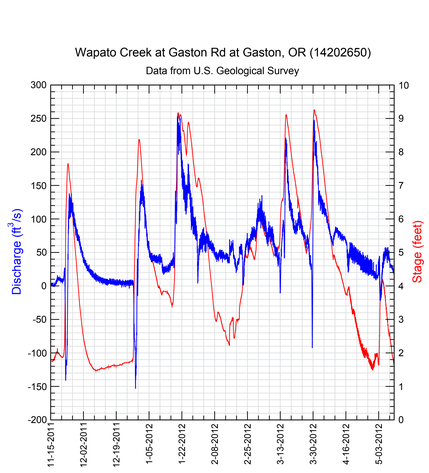
staff plate to read water level

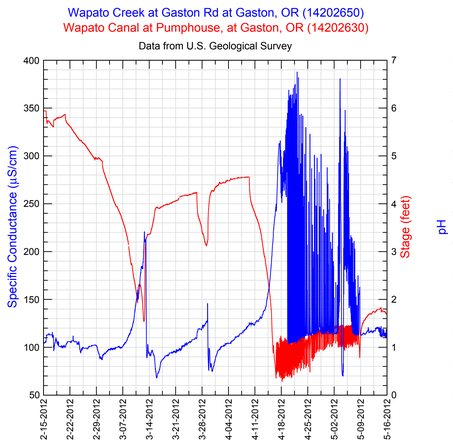
Photos of Wapato Lake water-level monitor (top) and Wapato Creek water-quality monitor (bottom) by Micelis Doyle, USGS, September 30, 2011.



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 4-5 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.

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