Basic Hydrology - Part 1



West Virginia Water Resources Training Workshops

Presented by the Interstate Commission on the Potomac River Basin

Sponsored by the West Virginia Department of Environmental Protection

With funding from the American Reinvestment & Recovery Act

Photo by C. Dalpra, 2003, ICPRB









Overview

- What are the components of the water cycle?
- What is a watershed?
- How are pollutants transported within watersheds?
- What is a hydrograph and what is it used for?
- Are there existing data sources for understanding an area's water resources?



Water cycle



- Major components
- Effects of land use, human use, climate change...



Source: NASA

Watersheds

- Area of land that drains to a particular stream, river, or lake
- Influences of upstream land and water uses on water quality and quantity





Watersheds - scale



Watersheds - hydrologic units

- Standard watershed classification system developed by the USGS in the 1970s
- Hydrologic units are watershed boundaries organized in a nested hierarchy by size
- Each hydrologic unit is assigned a number, or Hydrologic Unit Code (HUC)
- The codes describe the relation of the hydrologic units to each other



Watersheds - hydrologic units (cont'd)



8 digit HUC 02070003 Cacapon River Watershed

11 digit HUC 02070003160 12 digit HUCs



Watersheds - water quality



Source: AQUA TERRA Consultants, EPA BASINS Training Workshop, Atlanta, GA, October 2007



Watersheds - water quality (cont'd)

- Point Sources
 - pollution coming from a single point (ex. WWTP, industrial outfall)
 - dry weather pollution
 - regulated by permits under the Clean Water Act



http://www.waterqualityawareness.com, June 21, 2010



Watersheds - water quality (cont'd)

Non-point Sources

- Diffuse pollution carried to waterways by snowmelt, rainfall, etc.
- Management through education, voluntary programs, and incentives



Photos courtesy of USDA NRCS



Photo courtesy of Dr. Julie Tuason



Watersheds - water quantity (cont'd)

Stream flow is studied using hydrographs



Great Falls after Hurricane Isabel, September 2003 Photo by: J. Willoughby, ICPRB



Hydrograph: a graph relating stage, flow, velocity, or other characteristics of water with respect to time (USGS).

Hydrographs





Hydrographs (cont'd)

- Amount and timing of streamflows affected by
 - Precipitation,
 Withdrawals, Land uses, Soils,
 Geology ...



Time

Precipitation (cm)

(Ritter, 2006)

Data sources

- Data often freely available:
 - Groundwater level (USGS real time and historic; http://waterdata.usgs.gov/nwis)
 - Streamflow (USGS real time and historic; <u>http://waterdata.usgs.gov/nwis</u>)
 - Precipitation (NOAA/NCDC; <u>http://www.ncdc.noaa.gov/oa/ncdc.html</u>)
 - Water Quality (USGS, <u>http://waterdata.usgs.gov/nwis</u>)
 - Point source dischargers (NPDES; <u>http://epamap32.epa.gov/radims/</u>)
 - Superfund, toxic inventory, etc. (<u>http://www.epa.gov/TRI/</u>)
 - Water use (<u>http://water.usgs.gov/watuse/wuawuds.html</u>; <u>http://gisonline.dep.wv.gov/wwt/index.html</u>)
 - Land use/land cover (<u>http://www.mrlc.gov/</u>)
 - 30m resolution raster grids from 1992 and 2001
 - Meteorological data (solar radiation, wind, clouds, etc.; NOAA/NCDC; <u>http://www.ncdc.noaa.gov/oa/ncdc.html</u>)
- West Virginia spatial data sets:
 - West Virginia GIS Technical Center: <u>http://wvgis.wvu.edu/</u>
 - West Virginia DEP GIS Server: <u>http://gis.wvdep.org/</u>
 - West Virginia GIS Inventory: <u>http://wv.gisinventory.net/</u>





http://wdr.water.usgs.gov/nwisgmap/



North Branch Potomac River ; Mineral County, WV **USGS Gage 01598500** 9000 8000 7000 6000 Flow (cfs) 5000 4000 3000 2000 1000 0 01/2010 12/2005 08/2006 04/2007 01/2008 09/2008 05/2009

Photo courtesy of USGS



Cubic feet per second (cfs): "A rate of the flow equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second. One "cfs" is equal to 7.48 gallons of water flowing each second"

Groundwater

- Historical data
 - USGS water level and water quality, <u>http://waterdata.usgs.gov/nwis</u>
- Real-time data
 - USGS's WV Water Science Center, <u>http://wv.usgs.gov</u>
- Interactive , real-time map
 - USGS Groundwater Watch, <u>http://groundwaterwatch.usgs.gov</u>

Science for a changing world			USGS Home Contact USGS Search USGS
National Water Informat	ion System: Web Inte	erface	
USGS Water Resources		Data Category: Real-time	Geographic Area: West Virginia
News - updated November 2009	Ð		

Real-Time Data for West Virginia_ Ground Water -- 15 site(s) found

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Map generated 10/2/2010 10:28:56 PM http://groundwaterwatch.usgs.gov/StateMaps/WV.html, July 9, 2010

http://wvwgc.wvca.us/



The West Virginia Water Gaging Council was created effective May 18, 2005.

Real-Time Water Data | Flood Warning System | Purpose | Mission | Memorandum Of Understanding | Meeting Minutes

News Items | Events | Make a Donation | Links | Contacts | Council Members

ACCESS TO WEST VIRGINIA WATER-MONITORING GAGES (River, Stream, Lake and Rain)

Purpose

The Council serves as a statewide collaborative body to help achieve effective collection and dissemination of hydrological data applicable to the full range of water resources in WestVirginia, including ground-water and surface-water and precipitation gaging. Council membership includes representatives of state and federal agencies, organizations, and stakeholders that collect and use these types of data. The Council provides a forum for effective communication, cooperation, and collaboration among the membership.

Mission 🔺

The Council's mission is to ensure that reliable water-resources gaging data are available to meet the various needs of West Virginia stakeholders. The council shall work to support the following activities:

· Establishing and maintaining long-term data networks.

Water-resources gaging data may include long-term continuous information on precipitation, surface-water, and ground-water quantity; aquatic environments; and associated parameters, such as channel geometry and basin characteristics.





http://water.weather.gov/precip/



Map produced by Andrea Nagel, ICPRB, using NOAA precip data

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http://www.mrlc.gov/





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WV State GIS Data Clearinghouse

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http://wvgis.wvu.edu/



Conclusions

- Hydrologic characteristics of a particular watershed are dependent on natural (geology, soils, slope) and humaninduced factors (upstream land and water uses)
- Changes in land use, climate, water withdrawals, etc. within a watershed affect the water cycle and can impact the natural hydrologic variability
- Hydrographs can be used to understand streamflow conditions at a particular location
- Many data sources necessary for watershed assessment are freely available



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