U.S. Geological Survey New York Water Science Center – http://ny.usgs.gov

Message from Ward Freeman, Director, New York Water Science Center

The news at the USGS, like everywhere, has been very focused on the Deepwater Horizon oil spill disaster. Although the New York Water Science Center (NY WSC) has had little direct involvement, the USGS has been the lead Federal science agency responding to the spill. USGS Director Marcia McNutt has been at the command center in Texas for most of the last several months directing science and research data collection. For more information on the USGS response to the Deepwater Horizon disaster see: http://www.usgs.gov/deepwater_horizon/.

On a local front, the NY WSC has received a small amount of funding to begin a pilot study to develop a water-use database for the Delaware basin in New York. This pilot is in preparation for anticipated funding of the WaterSMART program in 2011. The WaterSMART Program allows the USGS to begin to implement the requirements of the Omnibus Public Land Management Act of 2009 to determine the quantity, quality, and use of the Nation's water supply. The USGS will develop critical information to characterize water flows, storage, use, quality, and ecological needs. This focused effort will place tools and technical information into the hands of water resource managers and other stakeholders that will allow them to evaluate water availability to address serious questions they face every day (such as cumulative withdrawal and discharge impacts). The WaterSMART program also supports efforts to continue to establish the National Streamflow Information Program. For more information on WaterSMART see: http://www.doi.gov/budget/2011/11Hilites/DH019.pdf.

Other program areas we are hoping to develop lines of funding to support include development of flood inundation mapping services for selected sites in New York. Ideally this would be a collaborative effort between the USGS, National Weather Service, Federal Emergency Management Agency, and U.S. Army Corps of Engineers. We have begun discussions and hope to start a pilot program in the coming year. Also on our radar screen for 2011 is development of a streamflow estimation tool (like that developed in MA), that would provide the capability of estimating daily flows for ungaged streams. This tool could be used for establishing flow requirements to protect streams, for quantifying cumulative impacts of withdrawals from stream systems (such as the impacts from withdrawals for natural gas drilling), and much more. We are searching for cooperative funding partners to develop both of these tools for New York.

Finally I want to invite you to attend the Watershed Science and Technical conference sponsored by the NY Water Environment Association and cosponsored by the USGS, September 15-16 at the West Point Military Academy.

I am a phone call away and interested in hearing from you. Please feel free to contact me about these or any other issues or program opportunities you may wish to discuss. I can be reached at (518) 285-5658 or wfreeman@usgs.gov.

Selected Projects – For information on all our active projects, visit our project summary web page. For more information on projects in this newsletter, please click on the links or email the contact person.

USGS Study is First in the US to Show Pharmaceutical Manufacturers as a Source of Pharmaceuticals to Water

As part of a cooperative project with the New York State Department of Environmental Conservation, the USGS has been investigating the occurrence of organic wastewater compounds, including pharmaceuticals in several wastewater treatment plants in New York since 2004. Recently, the USGS published the results of the investigation of pharmaceutical manufacturing facilities as a source of pharmaceuticals to

Fig. 1 – USGS staff collecting an equal-width increment, cross-sectional sample from a stream receiving wastewater effluent.

wastewater treatment plants. The results of this study (which are detailed in Environmental Science and Technology http://pubs.acs.org/doi/pdf/10.1021/es100356f) showed that concentrations of the opiates oxycodone and methadone, along with other muscle relaxants (carisoprodol and metaxalone), a barbiturate (butalbital), a tranquilizer (diazepam) and an amphetamine (phendimetrazine) were either not detected, or if detected were at concentrations that were commonly less than 1 microgram per liter, in effluent samples from wastewater treatment plants (WWTP) that did not receive substantial inflow from pharmaceutical manufacturing facilities. However, multiple samples collected from wastewater effluents receiving greater than 20% of their flow from pharmaceutical manufacturing facilities had concentrations 10 to 1,000 times higher than typically found in wastewater effluents. For example, maximum concentrations of oxycodone and metaxalone in the effluent of one of the two plants exceeded 1,000 µg/L. Results also showed detectable concentrations in stream samples downstream of the WWTP outfall.

This study suggests that several commonly held assumptions about pharmaceutical manufacturing facilities as sources of pharmaceuticals to the environment may not be correct. Before this study:

- It was commonly assumed that discharges of pharmaceuticals from formulation and production facilities would not be substantial, and that such discharges were highly regulated.
- It was commonly assumed by industry that the inherent value of the pharmaceutical products and good manufacturing practices would prevent the release of pharmaceuticals from these facilities.
- Modeling studies had suggested that discharges containing pharmaceuticals would not occur for more than a day or so, and other modeling studies based on consumer use indicated that concentrations of pharmaceuticals would rarely exceed 1 µg/L.

Several factors remain that make it difficult to fully assess the effect of pharmaceutical manufacturing facilities as a source of pharmaceuticals to water and waste biosolids. Complete data on pharmaceuticals formulated at the two sites included in the study were not available to guide analytical method development in the early stages of this study. As a result, much of the method development activities undertaken were based on a forensic approach, which involved examining gas chromatographic output for large peaks and matching them to peaks of pharmaceuticals from a library of peaks. Once candidate pharmaceuticals were determined, a method was developed to verify and quantify these compounds.

Future research will focus on expanding the number of pharmaceuticals included in the analysis, as well as including additional types of samples such as fish tissue, biosolids, and stream bed sediment, as well as water samples. The study found a large number of additional pharmaceuticals that could be qualitatively identified and correspond to known or suspected pharmaceuticals that are formulated at these sites. Contact: Patrick Phillips, pjphilli@usgs.gov

Flash Flooding in Western New York and USGS Response

Late during the night of August 9, 2009, two storm systems intersected over western New York and produced torrential rain that caused severe flash flooding during the early morning hours of August 10 in parts of Cattaraugus, Chautauqua, and Erie counties. Nearly 6 inches of rain fell in 1.5 hours as recorded by a National Weather Service observer in Perrysburg, NY, which lies between Gowanda and Silver Creek—two densely populated communities that suffered much damage. The rainfall intensity of this storm exceeded the 500-year storm event and caused water levels in Walnut Creek in the Village of Silver Creek reportedly to rise 3 to 4 feet in 30 minutes. Numerous road culverts were washed out (fig 2). Many people were evacuated or rescued in both communities, including patients in the Tri-County Memorial Hospital in Gowanda and residents of a creek-side trailer park in

Fig 2. – Washed out road culvert from August 9, 2009, flood in western New York.

Silver Creek, which was destroyed. The water supplies of both communities were compromised by damages to village reservoirs and water-transmission infrastructure. Water and mud damage to residential and commercial properties was extensive. Two deaths occurred during the flood in Gowanda. One resident suffered a heart attack while emergency responders were delayed by flood waters. A second resident drowned when he fell into Thatcher Brook after the flood waters had undercut the land on which he was standing.

USGS personnel were in the field two days after the floods and began to document the severity of the floods by locating and surveying high-water marks. In the end, over 240 high-water marks were surveyed by the USGS within the village limits of Gowanda and Silver Creek. These water-surface elevations were used to define the extent of inundation and to create water-surface profiles of the floods along the streams in each of the flooded communities, as well as to estimate the peak flows in several streams. From the peak flow data, annual exceedance probabilities (recurrence intervals) were determined.

The area of inundation in Gowanda covered about 50% of the village. Water-surface profiles, when compared with those from Federal Emergency Management Agency (FEMA) 0.2% chance-of-exceedance (500-yr recurrence interval) profiles, showed that flood levels on August 10, 2009, along Thatcher Brook in Gowanda were 2 to 4 ft higher than the FEMA estimated flood levels at some points and those along Walnut and Silver Creeks in the Village of Silver Creek were up to 6 to 8 ft higher than the FEMA flood levels at some locations (fig 3). Peak flows in Grannis Brook and Thatcher Brook—tributaries of Cattaraugus Creek in Gowanda—and Silver Creek were computed by indirect measurement methods. Peak flows at USGS continuous-record and flood-monitoring sites in western New York were obtained from established stage-to-discharge relations and were used to determine the areal extent of the severe flooding in the tri-county area. Flooding was greatest in small watersheds that received the highest intensity rainfall, which included the Cattaraugus Creek basin and nearby basins south of the Erie-Cattaraugus County line. The annual exceedance probabilities for the peak flows in small tributaries were less than 0.2% (meaning recurrence intervals greater than a 500 yr flood). Contact William Coon, wcoon@usgs.gov.

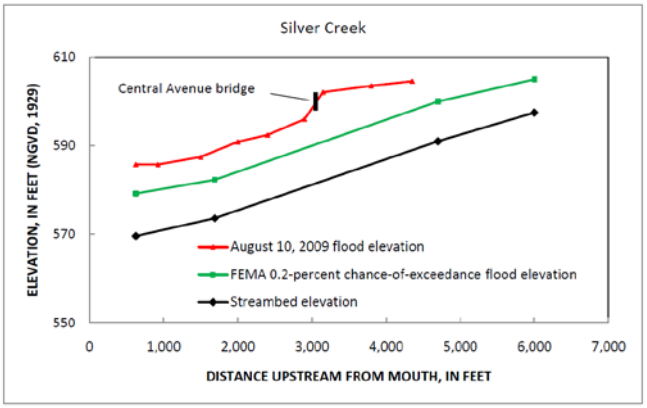

Fig. 3 – Silver Creek water surface profile.

It's Noisy Underground!

Almost everything that moves at land surface makes noise underground. Whether it is someone enjoying their walk in the park, the rustling of grass, or trees swaying in the wind, sound waves are transmitted into the subsurface. Traffic or activity at construction sites are also major contributors to these subsurface sound waves. All these sound waves are what geophysicists call "ambient noise". Traditionally regarded as a nuisance by seismologists, ambient noise has been recently shown to be rich in information that contributes to understanding the local structure of the sediment and bedrock beneath the ground.

Fig 4. -- HVSR equipment.

Over the past two months, two summer interns at the USGS New York Water Science Center, Ithaca Program Office, have worked on a groundwater study in cooperation with the New York State Department of Environmental Conservation in the Southern Tier of New York. One of their tasks was to determine sediment and bedrock characteristics using a fairly new seismic method, which uses the ambient noise of the earth to determine overburden thickness and depth to bedrock. This method is known as Horizontal-to-Vertical Spectral Ratio (HVSR) (fig 4) and can be used to measure earthquake seismicity, sediment thickness, depth to bedrock, and fault locations. For this study, the unit was used to measure the sediment thickness and depth to bedrock.

Learning to use the seismometer and to analyze the HVSR data takes some time and practice in order to optimize chances for a successful measurement. Too much wind, traffic, or industrial machinery noise drowns out the more desirable, low-amplitude, sound waves (that are mostly generated by ocean waves on the continental shorelines) and the data becomes too chaotic to be interpreted. Typically, it takes about an hour to setup the HVSR seismometer, gather the ambient seismic noise, and process the data on a field laptop.

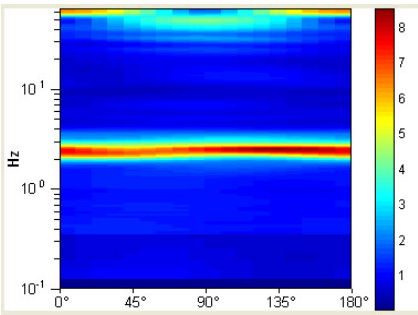

Fig 5. -- Directional HVSR

The ambient seismic noise is analyzed by the HVSR method; which measures north-south, east-west, and vertical components of sound waves (shear waves) (*fig. 5 and 6)*. This method is "passive" because it does not require an artificial noise source, such as an explosive charge. So far, in areas where the geology is fairly simple, such as the Cayuta Creek valley, (from Cayuta Lake in Schuyler County to the Susquehanna River at Waverly, NY), the HVSR method has worked well. However, the method is less successful where geologic conditions are complex (hundreds of feet of variable glacial sediments and (or) buried, steep valley walls). Overall, the method is proving to be another valuable tool to help USGS hydrologists characterize aquifer systems by mapping the thickness of unconsolidated sediments and the depth to bedrock. Contact: Lacey Pitman, lmpitman@usgs.gov .

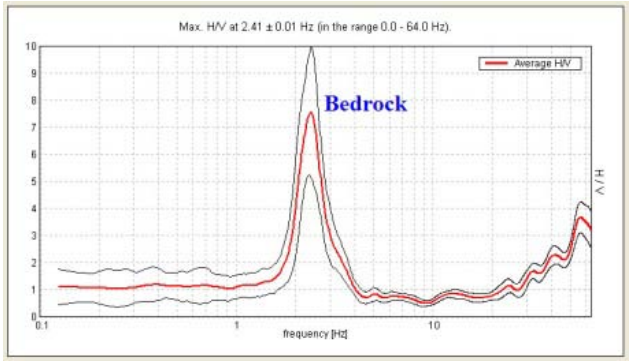

Fig 6 -- Horizontal-Vertical spectral plot of ambient noise

Long Island and New York City Water Table Still Higher Than Normal

Groundwater-table levels on Long Island and in New York City remain well above normal following the extremely wet conditions of spring 2010, according to monitoring by the U.S. Geological Survey. Although groundwater levels have slowly begun to decline in most places from the record- to near-record highs reached this spring (fig 7), the water table is still high for this time of year. Currently, about a half million houses and businesses are located where the water table is less than 11 feet below land surface.

Fig 7. – Flooding on Lake Shore Road, Lake Ronkonkoma, Suffolk County, NY

Groundwater flooding due to the elevated water table is not occurring in as many areas as it was in the spring. Groundwater levels have continued to slowly decline throughout the summer in most areas of Long Island (fig 8). With this slow pace of water-level decline, however, groundwater flooding may again result if normal- to above-normal precipitation occurs this winter and spring.

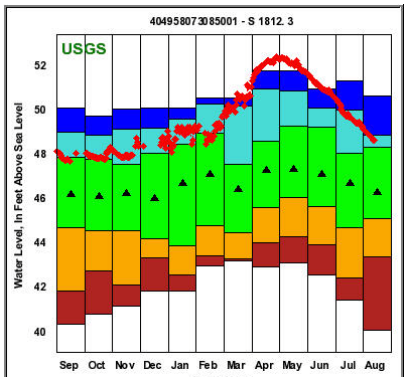

Fig 8. – Hydrograph showing 2010 daily average values (red diamonds) in relation to period of record monthly percentiles (Dark blue, > 90th percentile; light blue 76-90; green 25-75; light brown 10-24; and brown <10)).

Water levels measured in April 2010 from more than 600 wells and 30 streams and lakes on Long Island and in New York City indicated the largest increases occurred at higher elevations on Long Island where low-permeability soils are found locally. Smaller, but more harmful changes occurred in low-lying areas where basements, septic systems and other underground structures are close to the water table.

Increasing temperatures, rising sea levels, changes in precipitation patterns, and more intense and frequent extreme weather events are predicted for Long Island and New York City by climate change scientists who are studying the issue. Generally, a rise in sea level and more frequent and intense storms would increase the potential for groundwater flooding and storm-surge damage in low-lying areas. Contact: Stephen Terracciano saterrac@usgs.gov or Ron Busciolano rjbuscio@usgs.gov.

Hydrologic Conditions

Surface Water in New York, February to July 2010

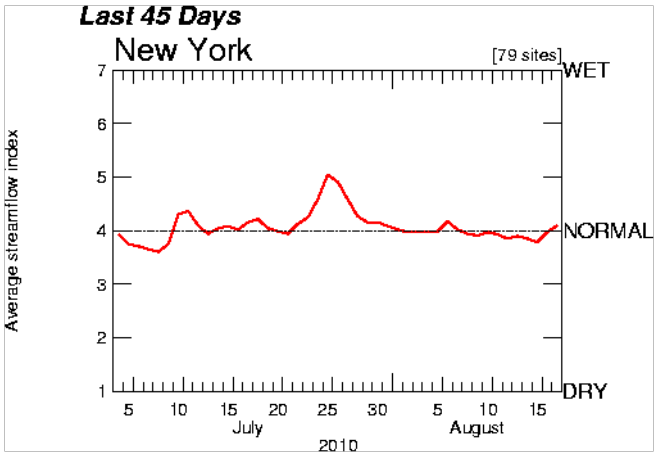

Fig 9. – Index streamflow for NY, July to August 2010, from 79 sites with more than 30 years of record.

Average monthly streamflow conditions across New York State have been in the normal range for 4 of the last 6 months (fig 10). The month of April and to some extent May were the exceptions where much of New York had dry to very dry conditions. This was likely due to reduced snowpack conditions. The 45-day index plot (fig 9) shows that streamflow conditions over the last 45 days (ending August 16) were normal.

Figures from the NOAA Regional Climate Center show that accumulated precipitation over the last 6 months in New York was essentially normal (±2 inches) for much of the State except for the Mohawk Valley which was 4 to 6 inches below normal and Long Island which was 2 to 4 inches above normal.

The map of below normal 28-day average streamflow conditions currently (August) shows slightly dry conditions (below normal) in a few areas of southeastern New York.

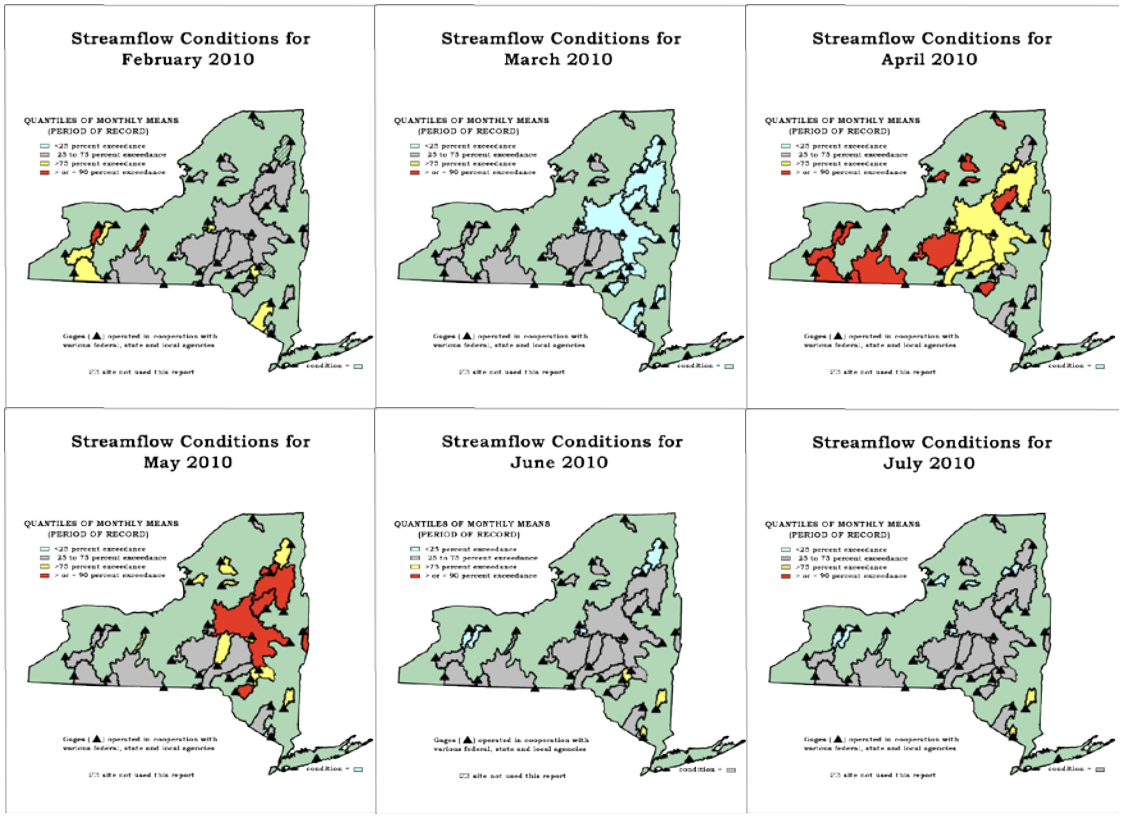

Fig 10 – Average monthly hydrologic conditions from February (upper left) to July 2010 (lower right) at selected surface-water sites in New York – where blue indicates wet conditions; gray indicates normal conditions; yellow indicates dry conditions; and red indicates very dry conditions. These maps are contained within the "End-of-Month Hydrologic Conditions" reports available at: http://ny.water.usgs.gov/cgi-bin/eomreports.

Groundwater in New York, February to July 2010

Groundwater levels were not too different from surface water over the last 6 months, with several areas showing dry to very dry conditions from April through June but those conditions seem to be recovering in July (fig 11). Long Island still shows wet groundwater conditions although high groundwater levels seem to be receding (see article above). The NY WSC web page displays real-time and historic groundwater data for these and other wells, in addition to a monthly summary of hydrologic conditions. Another useful resource for hydrologic conditions in New York is the USGS groundwater watch.

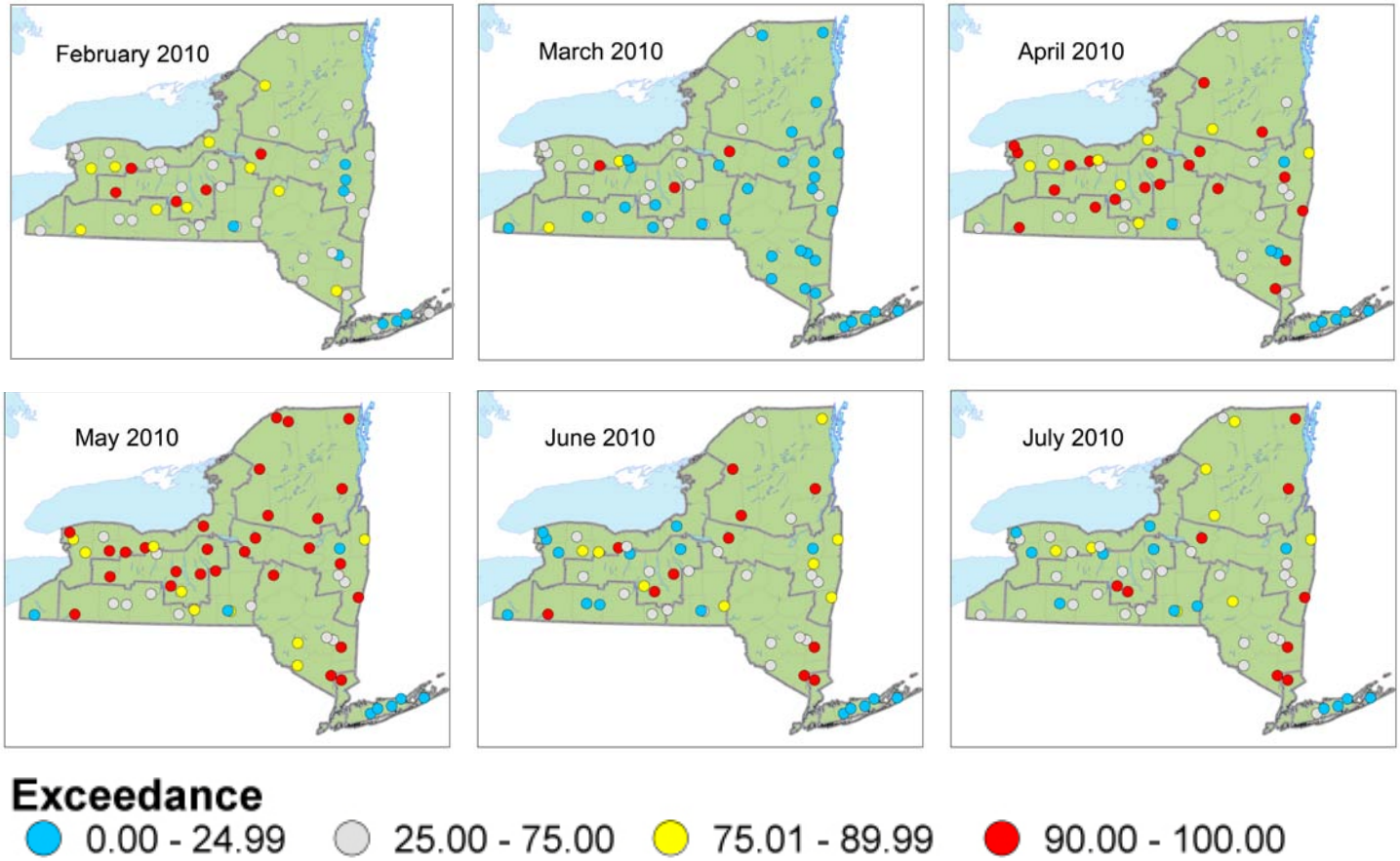

Fig 11. – Monthly hydrologic conditions in selected groundwater wells in New York from February (upper left) to July 2010 (lower right), showing percent exceedance based on the period of record for the well. Blue dots indicate wet conditions, gray dots indicate normal conditions, yellow dots indicate dry conditions, and red dots indicate very dry conditions.

New Reports from the New York Water Science Center

–Listed below are some of the reports and abstracts written by scientists in the USGS NY WSC that were released in recent months. A complete list of NY WSC publications can be found on our publication search page.

Allen, George, Burns, D.A., Negra, Christine, and Thurston, G.D., 2009, Indicator measurements for assessing the impacts of anthropogenic air pollutants on human health and ecosystems: Air and Waste Management Association, EM Magazine, October 2009, p.20-25.

Baldigo, B.P. and Smith, A.J., 2009, Ecological study begins on Esopus Creek: Ashokan Watershed Stream Management Program Newsletter, Cornell Cooperative Extension Ulster County, Fall 2009, p. 2-3.

Baldigo, B.P., Ernst, A.G., Warren, D.R., and Miller, S.J., 2010, Variable responses of fish assemblages, habitat, and stability to natural-channel-design restoration in Catskill mountain streams: Transactions of the American Fisheries Society, v. 139, no. 2, p. 449-467.

Brown, C.J. and Misut, P.E., 2010, Aquifer geochemistry at potential aquifer storage and recovery sites in coastal plain aquifers in the New York City area, USA: Applied Geochemistry, in press.

Ernst, A.G., Baldigo, B.P., Mulvihill, C.I., and Vian, Mark, 2010, Effects of natural-channel-design restoration on habitat quality in Catskill mountain streams, New York: Transactions of the American Fisheries Society, v. 139, no. 2, p. 468-482.

Kenny, Joan F.; Barber, Nancy L.; Hutson, Susan S.; Linsey, Kristin S.; Lovelace, John K.; Maupin, Molly A., 2009, Estimated Use of Water in the United States in 2005: U.S. Geological Survey Circular 1344, 52 p.

McHale, M.R. and Siemion, Jason, 2010, U.S. Geological Survey Catskill/Delaware water-quality network – water-quality report water year 2006: U.S. Geological Survey Data Series 497, 36 p.

The USGS Water Resources Discipline (WRD) has the principal responsibility within the Federal Government to provide the hydrologic information and interpretation needed by others to achieve the best use and management of the Nation's water resources. WRD actively promotes the use of its information products by decision makers to:

- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land movement.
- Effectively manage groundwater and surface-water resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.
- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

If you have an environmental or resource-management issue in which you would like to partner with the USGS to investigate, please contact any of our senior management staff (listed below). Projects are supported primarily through the Cooperative Water Program. This is a program through which any State, County, or local agency may work with the USGS to fund and conduct a monitoring or investigation project.

Misut, P.E. and Busciolano, Ronald, 2009, Hydraulic properties of the Magothy and Upper Glacial aquifers at Centereach, Suffolk County, New York: U.S. Geological Survey Scientific Investigations Report 2009-5190, 23 p.

Phillips, P.J., Smith, S.G., Kolpin, D.W., Zaugg, S.D., Buxton, H.T., and Furlong, E.T., 2010, Method description, quality assurance, environmental data, and other information for analysis of pharmaceuticals in wastewater-treatment-plant effluents, streamwater, and reservoirs, 2004-2009: U.S. Geological Survey Open-File Report 2010-1102, 36 p.

Phillips, P.J., Smith, S.G., Kolpin, D.W., Zaugg, S.D., Buxton, H.T., Furlong, E.T., Esposito, K., and Stinson, B., 2010, Pharmaceutical formulation facilities as sources of opioids and other pharmaceuticals in wastewater-treatment plant effluents: Environmental Science and Technology, v. 44, no. 13, p. 4910-4916.

Schubert, C.E., de Vries, M.P., and Finch, A.J., 2010, Nitrogen loads in groundwater entering back bays and ocean from Fire Island National Seashore, Long Island, New York: U.S. Geological Survey Open-File Report 2010-1081, 16 p.

Schubert, C.E., 2010, Analysis of the shallow groundwater flow system at Fire Island National Seashore, Suffolk County, New York: U.S. Geological Survey Scientific Investigations Report 2009-5259, 106 p.

Siemion, Jason and Murdoch, P.S., 2010, Water quality of the Upper Delaware Scenic and Recreational River and tributary streams, New York and Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2010-5009, 43 p., online only.

Wall, G.R., 2010, A new look at the formation of Cohoes Falls on the Mohawk River, Albany County, New York: Mohawk Watershed Symposium - 2010, March 19, 2010, Union College, Schenectady, NY, 4 p.

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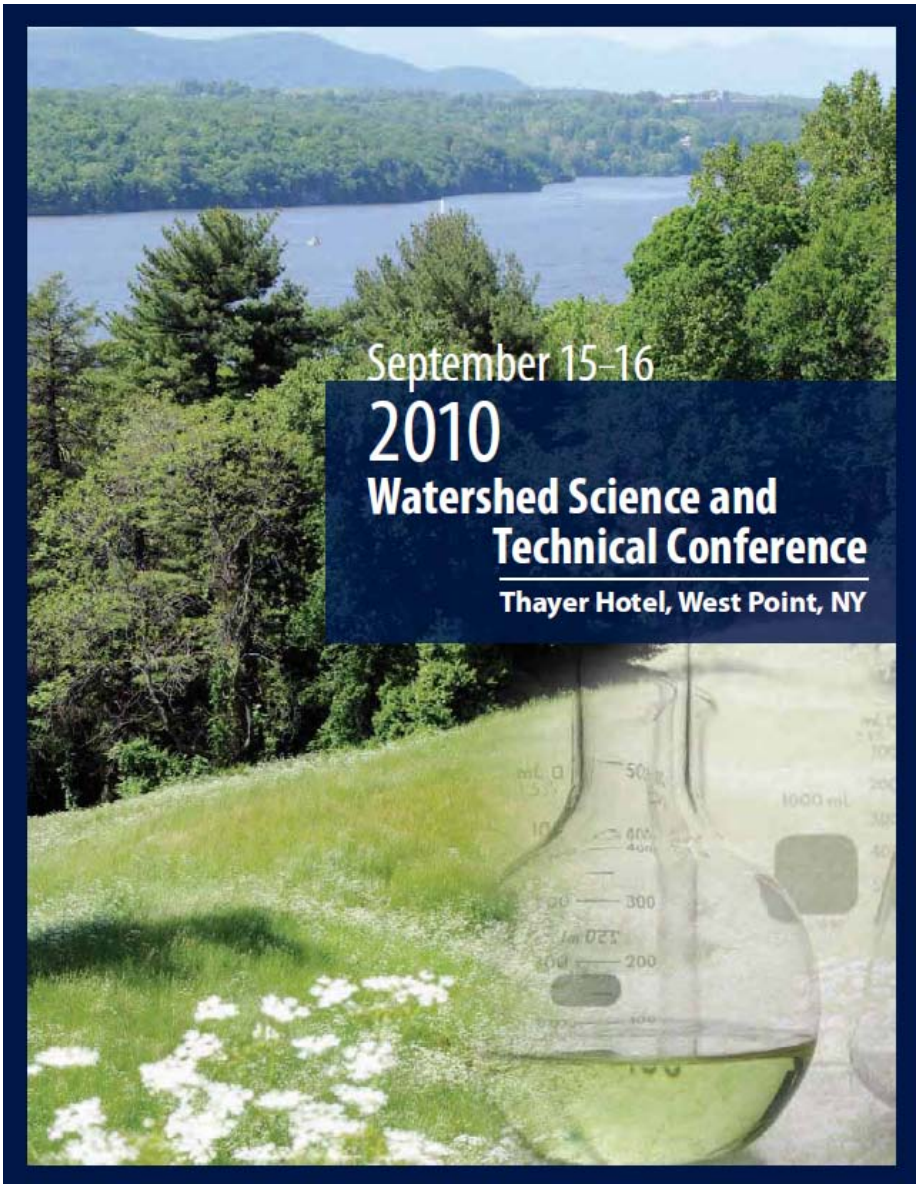
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