New York Water Science Center News Volume 13, September 2011

U.S. Geological Survey, New York Water Science Center Newsletter

Tropical Storm Irene | Tropical Storm Irene (Cont.) | Tropical Storm Lee | Tide Gage Network | Hydrologic conditions

Tropical Storm Irene Causes Major Flooding, Coastal Storm Surge, and Concerns about Water Quality

Hurricane Irene weakened to a tropical storm as the center of circulation moved over New York City on August 28, 2011. Heavy rains associated with this tropical storm caused major flooding and damage throughout many parts of eastern New York. The National Weather Service (NWS) reported preliminary rainfall totals for parts of eastern New York that ranged from about 4.2 inches in Albany to over 6 inches at many locations in Columbia, Delaware, Dutchess, Schenectady, Schoharie, Ulster and Washington counties. Over 11 inches of rain were reported at Slide Mountain, and 12.2 and 13.3 inches of rainfall were reported at East Durham, and East Jewett, NY, respectively.

Major River Flooding

At least 35 US Geological Survey (USGS) streamgages in eastern New York recorded new record maximums during this event. In the St Lawrence River basin the Ausable River and the East Branch Ausable River near Au Sable Forks streamgages have both been in operation for more than 90 years and each recorded a new period-of-record maximum during this event. The preliminary peak discharge for these two streamgages is estimated at 33,500 and 48,500 ft^3/s, respectively.

The Schoharie Creek at Lexington, in operation since 1999, recorded a new period-of-record maximum of 34,100 ft^3/s on August 28, 2011 (see photo). The Schoharie Creek at Prattsville streamgage, in operation since 1902, also recorded a new period-of-record maximum but sustained major damage during the flood and therefore an estimate of the peak streamflow has not yet been determined. The Schoharie Creek at Gilboa streamgage was also severely damaged during this flood, but a peak discharge of about 108,000 ft^3/s is estimated for August 28, 2011.

In the upper Delaware River basin the East Branch Delaware River at Margaretville streamgage, in operation since 1937, recorded a new period-of-record maximum discharge of 33,400 ft^3/s which exceeds the previous peak recorded during January 1996 by 7,600 ft^3/s. The USGS streamgages East Branch Neversink River northeast of Denning and the East Branch Neversink River near Claryville, West Branch Neversink River at Winnisook Lake near Frost Valley, and West Branch Neversink River at Claryville all recorded new period-of-record maximums during this event.

Bridge over Schoharie Creek near Lexington, N.Y., Aug. 28, 2011.

Flood frequency analysis of annual flood-peak discharges recorded at streamgages provides a means of estimating the probability of occurrence of a given discharge. Flood frequency is commonly expressed in terms of recurrence interval or the probability of being exceeded (one is the reciprocal of the other). What has been traditionally referred to as the 100-year flood, for example, has a probability of 0.01 (1-percent chance) of being equaled or exceeded in any given year and is now being termed the 1 percent annual chance flood. Preliminary estimates of the recurrence

A Message from Ward Freeman

New York Water Science Center Director

"Since our last newsletter New York has experienced severe flooding and coastal storm surge, and was even rocked by earthquakes and aftershocks! First and foremost, our thoughts go out to all of our neighbors dealing with the aftermath and devastation caused by Tropical Storms Irene and Lee. Thanks also goes out to members of my staff, who – even as the Hurricane was bearing down on their own homes and families – kept working, under what at times were very hazardous conditions, to keep the stream- and tide gages operational and ensure that the data and information to document flood conditions were being collected and transmitted in near real time. This information is used by the National Weather Service, Emergency Managers, the Department of Transportation and others including the public to track changing conditions and use that information to help keep the public safe.

Before the storm, USGS crews deployed stage sensors along New York's coastline –as part of a much larger effort by the USGS to install temporary sensors all along the east coast– to collect storm-surge data needed to improve predictive models: Better models mean better information for emergency managers so that steps needed to protect people living in areas susceptible to coastal flooding can be taken.

Most of the critical streamgages are hardened to withstand a major flooding but even so conditions were so extreme, several sites were damaged and three were completely washed away. During the storm, USGS teams replaced these damaged sites with rapid deployment gages to keep the information coming in. In the weeks and months after the storm, crews will be repairing damaged stations, recording high-water levels, and collecting water-quality samples in an effort to continue to fully document the impacts from Irene and Lee and improve our understanding of how large storms effect the environment, the infrastructure, and people's lives."

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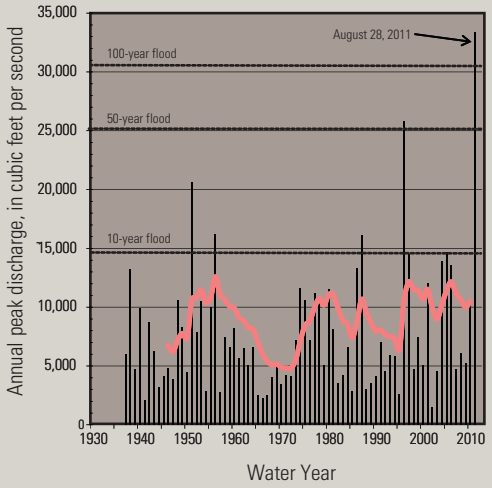
intervals (or exceedance probabilities) for peak discharges recorded during this flood at ten streamgages in the Hudson, Delaware and St. Lawrence River basins exceed 100-years. The initial estimates of peak discharges at the USGS streamgages on the East Branch Ausable River and the Ausable River near Au Sable Forks indicate recurrence intervals of greater than 500 years. The estimated peak discharge that occurred on August 28 at the USGS streamgages Schoharie Creek at Gilboa and Schoharie Creek at North Blenheim also have a preliminary recurrence interval of 500 years. The peak discharge at the USGS streamgage East Branch Delaware River at Margaretville indicated a recurrence interval of greater than 100 years but less than 500 years and was among the many USGS streamgages that recorded new period-of-record maximums during this flood.



Annual peak discharges through 2010, provisional peak of August 28, 2011, and discharges of the 10-, 50-, and 100-year recurrence intervals for East Branch Delaware River at Margaretville

Coastal Storm Surge

Storm-surge flooding along coastal areas of Long Island and New York City reached NWS moderate to major thresholds as Hurricane Irene crossed western Long Island as a strong tropical storm. The USGS operated 11 tide gages in these areas; nine measured record peaks during this event. Prior to the storm's arrival, crews from the USGS installed 36 temporary storm-tide and barometric-pressure sensors and 2 rapid-deployment gages across the region.

Deployment of storm-tide sensor on Shinnecock Bay at Hampton Bays, N.Y., Aug. 25, 2011

The temporary instruments were installed to monitor the potential impacts from Hurricane Irene as it moved up the coast, and were part of a broader effort by the USGS that installed over 250 temporary instruments from South Carolina to Maine. All instruments were recovered as soon as local conditions permitted and the data were processed, corrected for barometric pressure and water density, and posted provisionally online within days of the storm; data were then adjusted to a common datum based on landline and GPS surveys within a month of the storm. The location and availability of data from these instruments can be obtained from http://water.usgs.gov/osw/floods/2011_HIrene/index.html.

The USGS studies the impacts of hurricanes and tropical storms to better understand potential impacts on coastal communities and habitats. Storm surges are increases in ocean water levels typically generated at sea by strong storms and can have devastating coastal effects. The instruments captured data which define the depth and duration of overland storm surge, as well as the time of its arrival and retreat. This information will help public officials assess storm severity, discern between wind and flood damage, develop better land use and building codes, provide critical data for more accurate modeling and prediction, and help increase public safety. The USGS is working to improve its storm-tide monitoring capabilities by increasing the availability of real-time instruments and, in some cases, preselecting sites for monitoring future storms.

Water Quality Sampling

As Hurricane Irene has left her mark in New York, USGS crews are sampling rivers for pesticides, *E. coli,* nutrients, and sediment to document water quality in areas affected by the hurricane. In New York, water-quality samples were collected from nine locations, including:

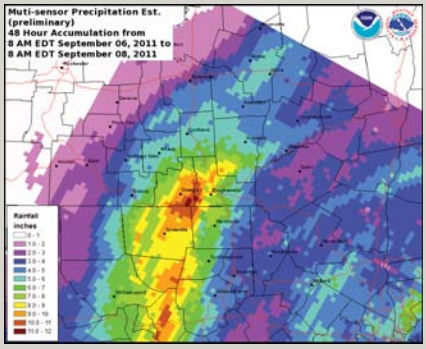
- Hudson River at Poughkeepsie (01374058);
- Mohawk River at Cohoes (01357500);
- Hudson River at Waterford (01335770);
- Kinderhook Creek at Rossman (01361000);
- Normans Kill at Albany (01359528);
- Esopus Cr. at Saugerties (01364501);
- Roeliff Jansen Kill near Linlithgo;
- Rondout Creek at Rondout, (01372007), and;
- Catskill Creek near Catskill (01362090).

This sampling effort is part of the USGS National Water-Quality Assessment Program (NAQWA). Thirteen other sites were also sampled in support of locally funded scientific investigations.

It is important for the USGS to monitor and document water quality after significant high-water events like Hurricane Irene. These events can cause changes in water quality that affect human health and the environment or affect commercial and recreational use of our Nation's water resources. Large storms can flush large quantities of nutrients, pesticides, and bacteria into rivers; alter sediment flow; and (or) result in higher concentrations of *E. coli* in surface water used for drinking. Excessive nutrients in rivers, streams, and coastal areas can cause algal blooms that increase the costs of drinking-water treatment, limit recreational activities, and threaten valuable commercial and recreational fisheries. Increased sediment can cause costly changes in shipping channels, where new sediment can require additional dredging.

Tropical Storm Lee Caused Major Flooding in the Susquehanna River Basin

Large scale weather patterns allowed tropical moisture from the remnants of Tropical Storm Lee and from the Atlantic Ocean to stream northward across the area from September 6th through September 9th, 2011. This stalled pattern allow continous rain, very heavy at times, to presist for 48 hours. The NWS reported preliminary rainfall totals for parts of central New York that ranged from about 1.3 inches in Waterloo, NY, to over 5 inches at many locations in Broome, Chenango, Cortland, Otego, and Tioga Counties. Over 9.2 inches were reported for Vestal Center, Broom County, NY.



Forty-eight hour total September 06-08, 2011, from National Weather Service Forcast Center, Binghamton, NY.

Major River Flooding

At least seven USGS streamgages in the Susquehanna River basin recorded new period-of-record maximums during this event. The streamgages along the Chenango River at Sherburne and Greene both recorded major flooding during this event. The Chenango River at Sherburne streamgage, located near the headwaters of the Chenango River, recorded a new period-of-record maximum discharge of 12,500 ft^3/s. Chenango River at Greene streamgage recorded a peak discharge of 26,900 ft^3/s, which is 300 ft^3/s less than the period-of-record maximum of 27,100 ft^3/s set on June 28, 2006. The Chenango River is a major tributary to the Susquehanna River with a confluence that run through the City of Binghamton. The Susquehanna River at Conklin streamgage is located just upstream from the City of Binghamton and recorded a peak discharge of 71,500 ft^3/s, which is the second highest peak since the streamgage began operations in 1912. Preliminary reports indicate that the levees that protected the City of Binghamton from the flood June 2006 were overtopped during this event. According to the Times Herald-Record Binghamton Mayor Mathew Ryan says that more than 1,700 properties were damaged by the flooding and several large housing complexes sustained major damage.

The Susquehanna River at Vestal streamgage, located just downstream from the City of Binghamton, and the Susquehanna River near Waverly streamgage, located farther downstream near the state border with Pennsylvania, have each been in operation for more than 70 year and recorded new period-of-record maximums of about 129,000 ft^3/s and 166,000 ft^3/s, respectively. The peak water-surface elevations recorded on September 8, 2011 at these streamgages exceeded the recent record elevations set in June 2006 by more than 1 ft. The peak discharges and water-surface elevations recorded at these streamgages in 2006 exceeded the long standing records set back in 1936. In addition, the Susquehanna River at Owego streamgage, located between Vestal and Waverly, has been in continuous operation since 1999, recorded a new period-of-record maximum of 159,000 ft^3/s. The Catatonk Creek northwest of Owego crest-stage gage also recorded a new period-of-record maximum discharge of about 10,000 ft^3/sec. A preliminary flood frequency analysis indicates that several streamgages in the Susquehanna River basin recorded peak discharges that exceeded the 100-year recurrence interval (or 1-percent annual chance) during this event.

Funding for Susquehanna River Streamgages Still Unsure

Nineteen streamgages in the Susquehanna River Basin remain unfunded in Federal Fiscal Year 2012 (October 1, 2011, to September 30, 2012). At this time we will maintain operation of these sites until February 1, 2012, while we seek funding to support operation and maintenance. If not successful at identifying a source of funds, operations at these sites will be discontinued on February 1, 2012. Although historic data will remain accessible, no new data will be collected unless one or more new funding partners are found. Many of these sites are used by the NWS to calibrate models, develop flood forecasts, and issue flood warnings. Most of the surface-water sites provide information on a real-time basis on the Internet at: http://waterdata.usgs.gov/ny/nwis/rt/

Hydrographers from the NY WSC took photographs of high water in the Susquehanna River Basin to document flooding.

Southeastern New York Tide-Telemetry and Coastal-Flood-Warning System

The coastal areas of southeastern New York are highly vulnerable to tidal flooding. Timely evacuation of people from flood-threatened areas in advance of approaching hurricanes and nor'easters (northeast coastal storms) requires adequate flood-warning time. To begin addressing this need for

Photograph showing coastal floodwaters inundating a residence on Long Island during the intense northeast coastal storm of December 11-13, 1992

immediate information on coastal flooding, the USGS, in cooperation with the Town of Hempstead Department of Conservation & Waterways, Village of Freeport, and New York State Department of Environmental Conservation, has operated a network of real-time tidal water-elevation and meteorological stations since 1997 in the coastal areas of Long Island and New York City.

Map showing locations of real-time tidal water-elevation and meteorological stations operated by the USGS in the southeastern New York region.

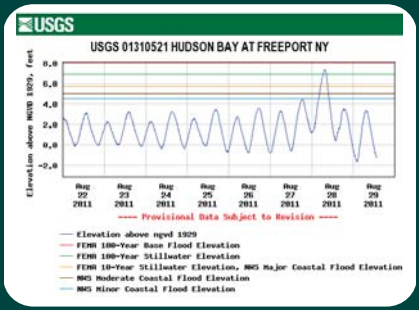
Each tidal water-elevation station is equipped with a pressure sensor connected to a data-collection platform, which, together with all other electrical components, is mounted several feet above the 100-year coastal-flood elevation inside a reinforced shelter. Data from this monitoring network are recorded at 6-minute intervals, stored onsite, and then transmitted to USGS offices using satellite and telephone telemetry every hour when water levels are below the NWS minor coastal-flood elevation. When a station detects water levels above this threshold, it increases the frequency of satellite transmissions to 6-minute intervals.

USGS tide gage on Hudson Bay at Freeport, N.Y. (Station number 01310521)

On arrival at USGS offices, data are automatically archived, processed, and screened for outliers in the USGS National Water Information System, and are available at USGS websites within a few minutes of their transmission. Real-time tidal water-elevation data at New York sites are available at http://waterdata.usgs.gov/ny/nwis/current?type=tidal.

During emergencies, tide gages update municipal and county emergency-management officials and NWS forecasters with up-to-the-minute tidal water elevations by automatically dialing pre-programed landlines and (or) cell phones and issuing a synthesized-speech message.

Storm Tide Caused by Tropical Storm Irene



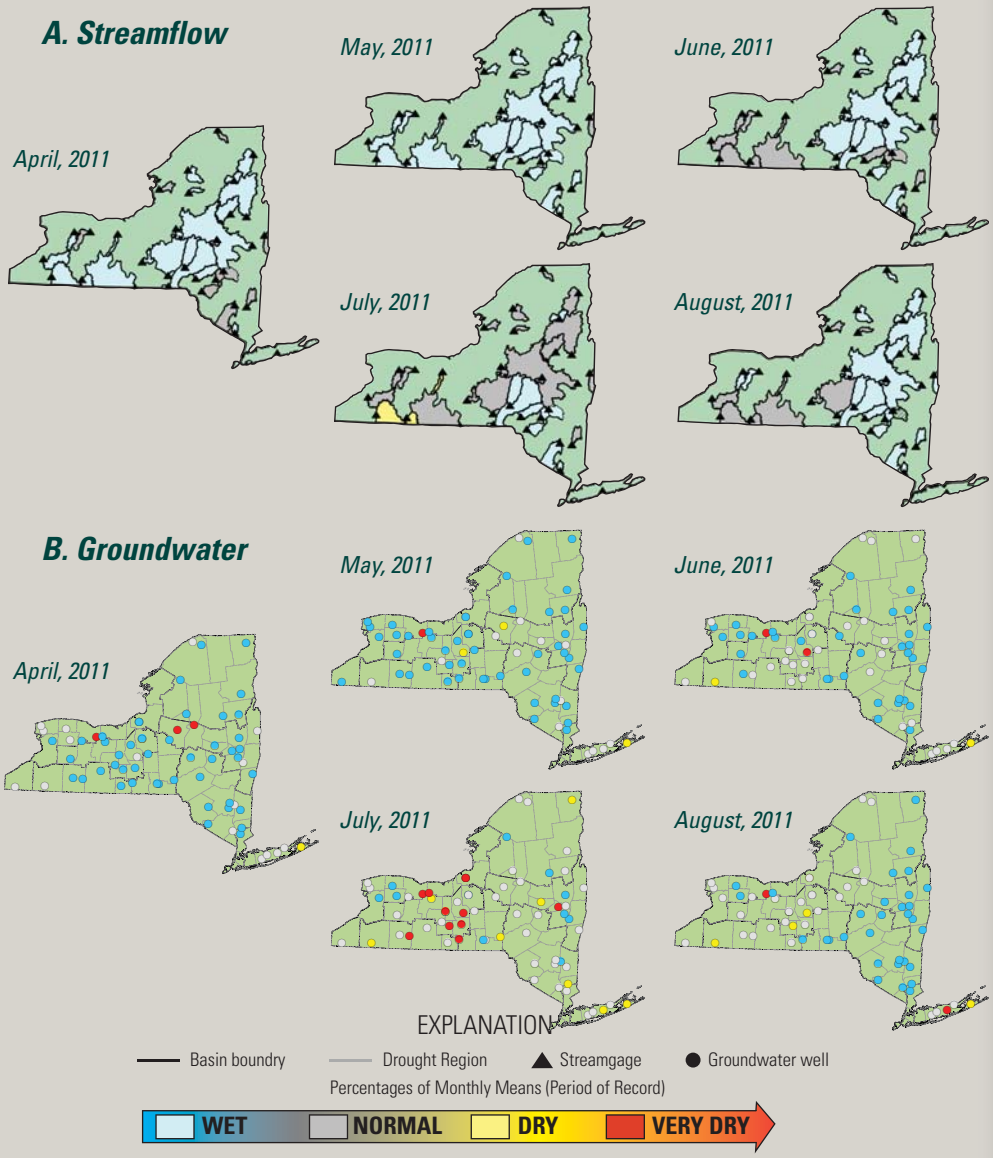
Hydrograph for 7-day period in August 2011 showing observed water elevation in feet above National Geodetic Vertical Datum of 1929 (NGVD 1929) from U.S. Geological Survey (USGS) station 01310521 on Hudson Bay at Freeport, N.Y. (dark blue line); and reference lines for National Weather Service (NWS) minor, moderate, and major coastal flood elevations (blue, brown, and orange lines, respectively) and Federal Emergency Management Agency (FEMA) 10- and 100-year stillwater and 100-year base flood elevations (orange, green, and red lines, respectively).

Hydrograph for last 3 days of this period showing same water elevation record from USGS station 01310521 (orange crosses); astronomical-tide elevation in feet above NGVD 1929 for nearby National Ocean Service (NOS) tidal-prediction station 1271 at Hempstead Bay, Freeport, Baldwin Bay (blue line); and residual water level (green squares) calculated from difference between observed water elevation and predicted (astronomical) tide elevation.

http://ny.water.usgs.gov/projects/tidal/live_coast.html

Surface Water and Groundwater Conditions in New York

Monthly, hydrologists at the New York WSC synthesize and summarize streamflows and groundwater levels for New York. Monthly hydrologic condition reports are available at http://ny.water.usgs.gov/infodata/conditions.html. Average monthly streamflow and groundwater conditions across New York have been in the normal or wet ranges over most of the last 5 months. High streamflow in August in Eastern NY and in September in Central NY was due to back-to-back tropical storms (Irene and Lee), which produced heavy rainfall on August 28th and September 6th-9th: For many streamgages, resultant streamflows were among the highest ever recorded.



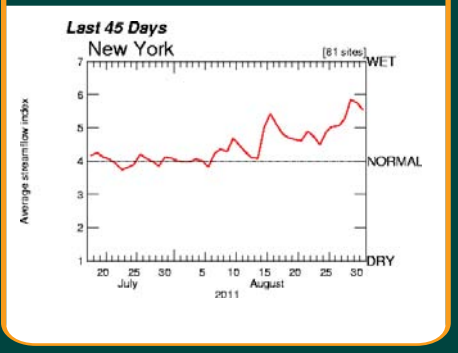
Average monthly conditions at selected (A) streamgages and (B) groundwater wells in New York. USGS maintains and operates most streamgages and groundwater wells in cooperation with various federal, state, and local agencies.

USGS Water Water & Groundwater Watch

WaterWatch is a USGS World Wide Web site that displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for the Nation. Real-time streamflow information (stage and flow) generally is updated on an hourly basis. WaterWatch provides maps that show the location of more than 3,000 long-term (30 years or more) USGS streamgages.

Groundwater Watch is a USGS World Wide Web site that displays maps, graphs, and tables describing groundwater level data from wells currently in a regular measurement program. Three types of water-level data are displayed, including periodic, continuous data that is periodically retrieved, and real-time data generally updated on an hourly basis. Groundwater Watch contains water levels and well information from more than 20,000 wells that have been measured by the USGS or USGS cooperators at least once within the past 365 days.

45 Day Index Plot



Among other things, WaterWatch summarizes streamflow conditions in a region (state or hydrologic unit) in terms of the long-term typical condition at streamgages in the region. For example, this plot shows that streamflow in August was well above the normal whereas streamflow in July was at or slightly above normal conditions for New York.

New Reports from the New York Water Science Center

Abbene, I.J., 2010, Shallow groundwater quality in the Village of Patchogue, Suffolk County, New York: U.S. Geological Survey Scientific Investigations Report 2010-5132, 19 p.

Eckhardt, D.A.V. and Anderson, J.A., 2010, Geophysical logs of selected wells at the Diaz Chemical Superfund Site in the Village of Holley, New York, 2009: U.S. Geological Survey Data Series-500, 16 p.

Hayhurst, B.A., Coon, W.F., and Eckhardt, D.A., 2010, Water resources of Monroe County, New York, water years 2003-08 --Streamflow, constituent loads, and trends in water quality: U.S. Geological Survey Scientific Investigations Report 2010-5216, 34 p.

Heisig, P.M., 2010, Water resources of Rockland County, New York, 2005-07, with emphasis on the Newark basin bedrock aquifer: U.S. Geological Survey Scientific Investigations Report 2010-5245, 130 p.

Masterson, J.P., Pope, J.P., Monti, Jack, Jr., and Nardi, M.R., 2011, Assessing groundwater availability in the North Atlantic Coastal Plain aquifer system: U.S. Geological Survey Fact Sheet 2011-3019, 4 p.

Mulvihill, C.I., 2010, Studying the muddy waters of Esopus Creek: Esopus Creek News, Summer 2010, p. 5.

New York Water Science Center
Soil and Low-Ionic Strength Water-Quality Laboratory

The New York Water Science Center of the USGS in Troy, NY, operates a state-of-the-science laboratory for the chemical analysis of soil and water. The laboratory specializes in analyses used in acid rain research and other environmental studies such as soil effects on forest health and logging effects on water quality.

We provide accurate measurements of soil water, non-agricultural soils, stream water, and lake water, that can be adapted to the specific needs of each study. Our services include sample processing and customized data reports. We can also provide copies of our Standard Operating Procedures (SOP's), and Quality Control Reports, which include all QA/QC data.

Our laboratory has provided data for the USGS and many external agencies and institutions, including the U.S. Environmental Protection Agency, New York State Department of Environmental Conservation, New York City Department of Environmental Protection, U.S. Forest Service, New York State Energy Research and Development Authority, National Park Service, and many academic and community groups. Data produced in our laboratory have been published in hundreds of technical journals and agency reports.

The laboratory participates in the USGS Standard Reference Sample program that includes both identified and blind reference samples, Environment Canada's Proficiency Testing QA Program, and the Northeastern Soil Monitoring Cooperative Reference Soil Sample Exchange Program. Our laboratory is certified by the New York State Department of Health's Environmental Laboratory Approval Program (ELAP).

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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.

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