

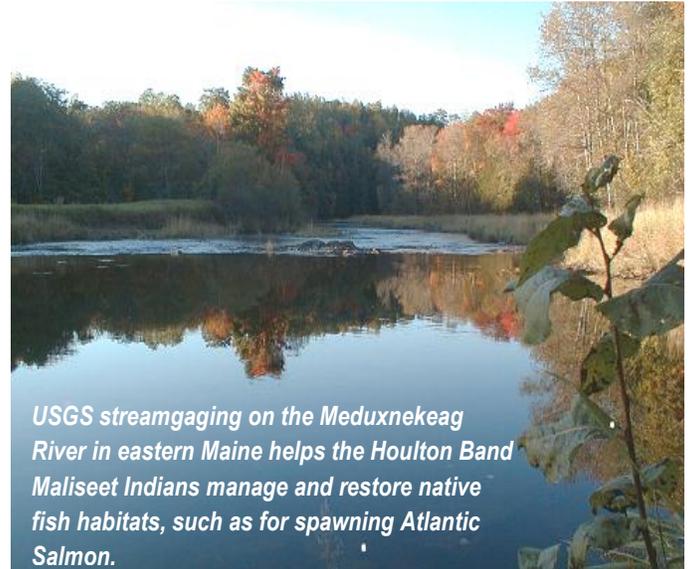
USGS and Tribes Work Together to Gain Water Knowledge

USGS scientists work closely with Tribal leaders around the country to address water availability issues related to quantity and quality on Tribal lands.

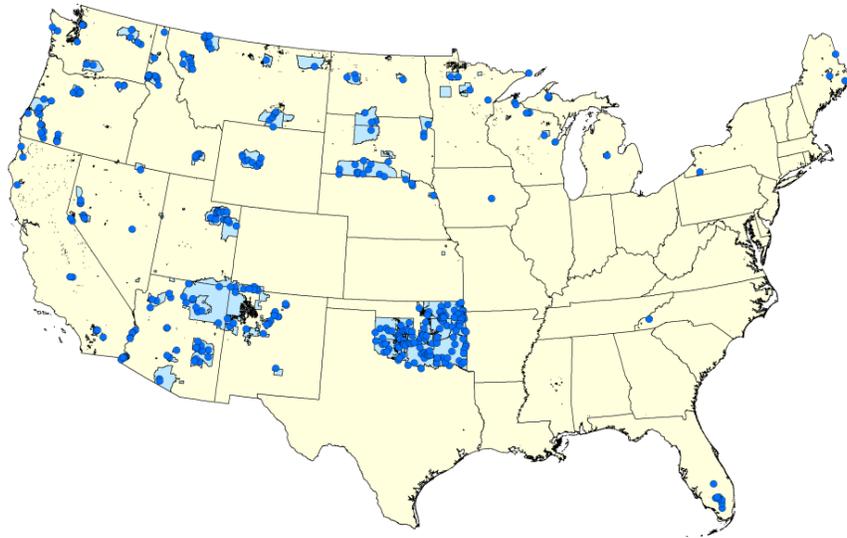
In general, USGS coordinated efforts with Tribes span a wide variety of activities across the Nation, involving, for example, monitoring within an extensive network of USGS streamflow gages and groundwater monitoring stations; training; data management; Geographic Information Systems (GIS); quality control; development of models and decision-making tools; and scientific research on how natural, climatic, land use, water use, and other human factors can affect the water cycle, water quantity, and quality. The USGS information is used by Tribal managers to address such topics as water rights, water supply, flood-warning predictions, contamination, and sustainability of critical habitats and health ecosystems.

Tribes also depend on USGS science for Tribal sustenance and sovereignty. Ms. Sharri Venno, Environmental Planner with the Houlton Band Maliseet Indians in Houlton, Maine stated:

"Our Tribe relies on USGS streamflow gaging activities to maintain aquatic habitat and the seasonal harvesting of a variety of native medicinal flora of importance to our tribal lifestyle and long-standing Tribal ceremonies. In addition, USGS streamgages, such as on the Meduxnekeag River in Eastern Maine, provide us valuable real-time information on river flow and water-quality that is critical to native fish habitat, including for spawning Atlantic Salmon, a native species the Tribe hopes to restore to healthy populations."



USGS streamgaging on the Meduxnekeag River in eastern Maine helps the Houlton Band Maliseet Indians manage and restore native fish habitats, such as for spawning Atlantic Salmon.



USGS monitors streamflow at more than 530 sites on Tribal lands, and more than 1,160 and 1,720 sites within 5 and 10 miles of Tribal lands, respectively.

Read about activities with Tribes in YOUR Region and State...

Northwest

Idaho	page 2
Montana/Wyoming	page 3
Oregon	page 4
Washington	page 6

Northwest Climate Science Center

page 7

Alaska

page 8

Pacific

California	page 9
Nevada	page 10

Southwest

Arizona	page 10
New Mexico	page 12
Oklahoma	page 12
Utah	page 13

Midwest

Michigan	page 14
Minnesota	page 16
Nebraska	page 16
North Dakota	page 17
South Dakota	page 18
Wisconsin	page 20

East

Maine	page 21
Mississippi	page 22
New England	page 22

[Idaho](#)

Scientists from the Idaho Water Science Center, in collaboration with the Kootenai Tribe of Idaho and other state and federal agencies, are evaluating hydraulic and geomorphic conditions in the Kootenai River in north Idaho. The science will help to enhance spawning substrate for the endangered Kootenai White Sturgeon, which will help to improve spawning, early life survival, and recruitment in the Kootenai River. ([Access study description, publications, and posters](#)) The joint effort involves collection of information on streamflow characteristics, channel morphology, and sediment transport characteristics in potential spawning reaches of the river. Multi-dimensional



USGS and the Shoshone-Paiute Tribe unravel fish from a seine net for mercury tissue analysis.

models are being developed to simulate potential effects of proposed recovery actions to assess their feasibility and relative utility. (**Contacts:** Ryan Fosness, rfofness@usgs.gov, (208) 387-1319; Molly Wood, mswood@usgs.gov, (208) 387-1320; and Greg Clark, gmlark@usgs.gov, (208) 387-1324).

USGS also is cooperating with the Shoshone-Paiute Tribe in the collection and evaluation of fish-tissue samples from three reservoirs in southern Idaho to evaluate trends in mercury concentrations in muscle tissue of rainbow trout and other selected species of sport fish. ([Access study description, publications, and posters](#)) Concentrations will be placed in the context of human-health fish consumption advisories and wildlife-protection levels to help inform Tribal members of potential mercury exposure risks and to evaluate the need for additional investigations. (**Contacts:** Marshall Williams, mlwilliams@usgs.gov, (208) 387-1344 and Greg Clark, gmlark@usgs.gov, (208) 387-1324).

In collaboration with the Shoshone-Bannock Tribe, USGS scientists are collecting streamflow and sediment information from the Yankee Fork Basin, a tributary to the Salmon River in central Idaho. The Tribe is interested in reestablishing salmon spawning habitat in the basin; information is needed to characterize hydraulic conditions and sediment transport prior to and following remedial actions. (**Contacts:** David Evetts, devetts@usgs.gov, (208) 387-1336 and Doug Ott, dott@usgs.gov, (208) 387-1335).

Montana and Wyoming

The Wyoming-Montana Water Science Center works with Tribes across Montana and Wyoming to provide monitoring, assessments, and research for their water resource and ecological management. (**Contact:** Kyle Blasch, kblasch@usgs.gov, (406) 457-5901)

USGS monitors streamflow at seven streamgages on Tribal lands (Flathead, Northern Cheyenne, and Fort Peck Reservations) to provide data for managing Indian water rights, water availability, and water quality. Selected assessments and research activities are described below.

- USGS works with the Wind River Reservation, Wind River Environmental Quality Commission, and Department of Energy to assess quality in groundwater and in the Little Wind River in the area of a former uranium processing facility on the Wind River Reservation, 1987 through 2010. A publication is in press (Ranalli and Naftz, U.S. Geological Survey Scientific Investigations Report 2013-5218). (**Contact:** Tony Ranalli, tranalli@usgs.gov, (303) 236-6915)
- USGS (including the Wyoming-Montana Water Science Center and USGS Crustal Geochemistry and Geophysics Center) and the Fort Peck Tribe began a study in 2003 to delineate the extent of brine contamination in the East Poplar oil field using helicopter-borne electromagnetic (HEM) surveys, mapping of oil field infrastructure, borehole geophysics, and water-quality sampling at selected wells ([USGS Report](#)). The USGS report identified enriched water in the City of Poplar wells in oil-field brines. Studies continue to



USGS spearheads training at the Salish Kootenai College, covering a variety of topics, including for example: evapotranspiration estimation tools using remote sensing; three dimensional hydrogeologic modeling for understanding snow cover, water availability, groundwater mining, and groundwater contamination; and data network designs for discrete and continuous data.

better describe the brines and ambient waters (report in review). (**Contact:** Joanna Thamke, jothamke@usgs.gov, (406) 457-5923).

- USGS and the Fort Peck Tribes continuously monitor groundwater levels in selected wells on the Fort Peck Indian Reservation; groundwater is the only source of water in many parts of the Reservation in northeastern Montana. (**Contact:** Fred Bailey, fbailey@usgs.gov, (406) 457-5927).
- USGS and the Northern Cheyenne Tribe monitor groundwater levels in the aquifers underlying the Reservation to assess impacts of water use and increasing pumping. The Powder River structural basin of Montana and Wyoming is the target of extensive development of coal-bed methane. Development of coal-bed methane on lands adjacent to the boundaries of the Northern Cheyenne Indian Reservation may have unwanted effects on valuable groundwater resources within the Reservation, such as depletion of the water resource and lowering of water levels over large areas. (**Contact:** Fred Bailey, fbailey@usgs.gov, (406) 457-5927).
- USGS and the Northern Cheyenne Tribe began a study in 2005 to quantify groundwater in coal-bed aquifers in and near the Reservation that have high potential for coal-bed methane development. As part of the project, geologic cross-sections constructed using coal outcrop, topographic, and drill-hole data were used to estimate volumes of coal that comprise the aquifers. The data were used to estimate volumes of groundwater in coal-bed aquifers and local and regional values of specific yield and storage coefficient. (**Report**) (**Contact:** Lori Tuck, ltuck@usgs.gov, (406) 457-5925).
- USGS and the Blackfeet Tribe monitor groundwater in areas with oil and gas exploration and development in the Bakken Formation and other formations. The groundwater information will help to describe (1) current groundwater and surface water conditions; (2) instances of ground water or surface water contamination; and (3) any unexpected or unnatural decline in levels of ground or surface water. (**Contact:** Rod Caldwell, caldwell@usgs.gov, (406) 457-5933).
- USGS and the Apsáalooke (Crow) Tribe conducted sampling for the EPA's 2012 National Lake Assessment programs. The sampling will be used to assess the condition of the water bodies. (**Contact:** Tom Cleasby, tcleasby@usgs.gov, (406) 457-4919).

Oregon

The Oregon Water Science Center works with Tribes across Oregon to provide monitoring, assessments and research for their water resource and ecological management (**Contact:** Terrence Conlon, tdconlon@usgs.gov, (503) 251-3232).

In total, USGS monitors streamflow at six streamgages on Tribal lands and measures groundwater levels in 52 wells in the Klamath River basin (southern Oregon and northern California), which are critical for Tribal water rights. Groundwater levels from additional wells across Oregon are measured in areas on ceded Tribal land. Selected assessments and research activities are described below.

In addition, USGS spearheads annual training workshops (as in support of Native American relations (TESNAR) program) to teach techniques used to measure discharge, sediment transport, and water quality in streams, and serves on committees serving Tribal interests, such as related to the Columbia River Treaty and the Federal Negotiating Team for water rights settlement talks for the Confederated Tribes of the Umatilla Indian Reservation.

Highlighted studies include:

- USGS works with the Umatilla Indian Reservation to collect and analyze hydrologic data on and near the Reservation that are needed to describe the geometry of aquifers; groundwater/surface water interactions; groundwater flow directions; recharge, storage and other water budget components; and groundwater pumping. Anticipated project outcomes include a database and USGS report, which will both serve as a foundation for a

groundwater flow model. USGS works very closely with Tribal hydrologists to also insure Tribal technical capacity for conducting their own hydrologic studies in the future.

- USGS monitors streamflow discharge, groundwater levels, water quality, and fish and conducts several studies on the Klamath Basin that involve Klamath Tribes. The monitoring and assessments evaluate water availability, optimal use of water, water quality conditions in Upper Klamath Lake and Klamath River, and recruitment and mortality of aquatic species in streams and lakes in the basin. The Klamath and other Tribes use study results for water resource and ecological management, and to understand options in exercising their newly adjudicated water rights. For example, the Klamath Tribes, in collaboration with USGS, led an effort to develop regional geographic information systems layers of spatial data on evapotranspiration, sub-irrigation indicators, water rights, sub-basin streamflow statistics, and return-flow indicators that are available to the public and used for diverse applications (referred to as the Hydrological Information Products for the Off-Project Water Program of the Klamath Basin Restoration Agreement). The Tribes are acting as a partnership coordinator, working with multiple State and Federal agencies and local stakeholders that plan to use the information to identify candidate areas for acquiring the voluntary retirement of water rights or water uses from willing sellers. The goal is to permanently provide an additional 30,000 acre-feet of water per year to Upper Klamath Lake in southern Oregon. This work is being conducted as part of a comprehensive solution to ecological and water-supply issues in the Klamath Basin under the Klamath Basin Restoration Agreement to improve fisheries habitat and also provide for stability of irrigation water deliveries.
- USGS works with the Columbia River Inter-Tribal Fish Commission to develop protocols that describe ecologically relevant components of low-flow regime in the Upper Grande Ronde River Basin, needed to support restoration activities for endangered Spring Chinook salmon that spend critical time as juveniles in fresh water.
- USGS also partners with the Columbia River Inter-Tribal Fish Commission and Tribes (Yakima Nation, Confederated Tribes of Warm Springs, and Confederated Tribes of Umatilla Indian Reservation) to assess low streamflow conditions on unmonitored streams and effects of emerging and legacy organic contaminants (including halogenated compounds and endocrine disrupting compounds) on juvenile Pacific Lamprey in the Columbia River Basin. After surviving several hundred million years, Pacific Lamprey populations have declined in recent decades to the point at which regional extinction may be imminent. Tribes in the Columbia River Basin have relied on Pacific Lamprey for food and medicine for generations. The study will improve the understanding of contaminants as a potential threat to the survival of the species, and to human health.
- USGS, in collaboration with the Confederated Tribes of the Umatilla Indian Reservation and NOAA Fisheries, is developing a physical habitat monitoring plan for salmon habitat restoration projects in the Umatilla, Walla Walla, John Day, Tucannon, and Grand Ronde River basins. Monitoring metrics and methods identified in the plan will be tailored to the Tribe's restoration strategies (such as increasing hyporheic exchange) and will be applied to restoration sites spanning several miles.
- USGS and the Confederated Tribes of Warm Springs are addressing temporal and analytical gaps identified in a USGS study—"Occurrence and Distribution of Pesticides in Surface Water of the Hood River Basin, Oregon, 1999-2009" ([USGS SIR 2011-5082](#))—by continuing long-term pesticide monitoring in the basin. Passive samplers were deployed at two sites year-round from March 2011 to March 2012 and were analyzed for a broad suite of compounds known or suspected to be used in the Hood River basin. Two additional sites were sampled to target potential drift or runoff from post-harvest pesticide use in a forested area. These data are being analyzed and will be published in a journal article. Additionally, USGS is working with the Warm Springs Tribes to develop monitoring strategies to address other identified data gaps.
- USGS, in collaboration with the Confederated Tribes of the Umatilla Indian Reservation, NOAA Fisheries, and Montana State University, is expanding the River Vision for the Management and Restoration of First Foods developed previously for the Umatilla River basin to all Tribal ancestral lands in eastern Oregon and Washington. This expanded River Vision document will serve as the conceptual framework used by the Tribes to

manage and restore riverine First Foods, such as salmon and lamprey, help to communicate the First Foods framework to other organizations interested in managing for dynamic river systems to sustain culturally significant food resources.

Washington

The Washington Water Science Center works cooperatively with more than 20 Tribes throughout Washington on issues related to habitat restoration for threatened and endangered salmon and other fish.

In total, the USGS and Tribes jointly monitor streamflow, groundwater, and water quality at 38 surface-water and groundwater sites across Washington.

Studies contribute quantitative models of groundwater and surface-water interactions that provide information on how multiple stressors, such as groundwater pumping and climate change, can affect instream flows needed to sustain ecological integrity of streams and rivers.

USGS also conducts studies that measure and interpret sediment dynamics and related geomorphic processes to help Tribal river managers develop effective strategies to maintain or restore critical habitats. (**Contact:** Cindi Barton, cbarton@usgs.gov, (253) 552-1602)

One of the more recent efforts with the [Yakama Nation](#), [Washington State Department of Ecology](#), and the [Bureau of Reclamation](#) culminated in the first comprehensive [groundwater flow model for the entire Yakima River Basin](#). The model simulates the groundwater system and its interaction with rivers and streams, with a focus on showing how much streamflow is reduced by groundwater pumping for irrigation and household use. Information on hydrogeology, groundwater pumping, recharge, and flow that was generated over the past 12 years is incorporated into the model. The model has already been used to illustrate how alternative strategies of using both groundwater and surface-water may affect streamflows. ([Press release](#), September 2011). ([Project website](#)) (Contact: Matt Bachmann, mbachman@usgs.gov, (253) 552-1672)

Tom Ring with the Yakama Nation highlights the importance of sustained flows in the Yakima River Basin and notes that the Yakama Nation Treaty Right for instream flow is the senior water right in the basin. Mr. Ring also notes that a second Tribal economy, irrigated agriculture, is also threatened by the depletion of streamflow from pumping groundwater for non-tribal irrigation. A large share of The Nation's Treaty Irrigation Rights is prorated in drought years due to overall high water demand in the basin. The



Photo by Glade Walker, USGS

Salmon jumping ladders at Wapato Diversion dam in Yakima, Washington (above); schools of salmon migrating upstream (below).

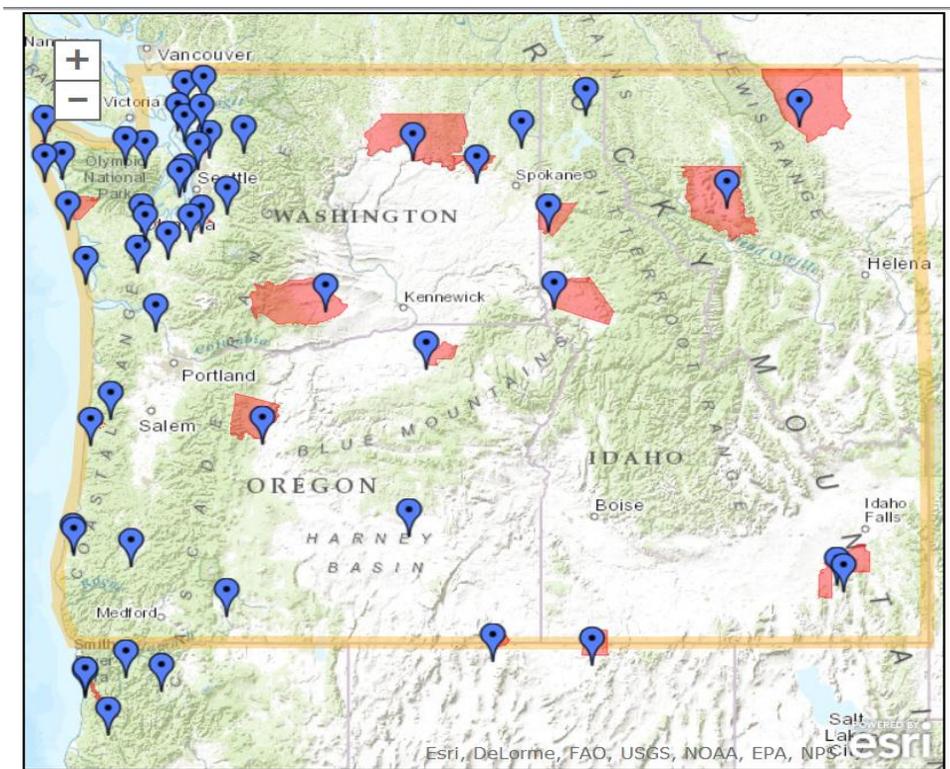


Photo by USGS Western Fisheries Research Center

“Salmon from the Yakima River have sustained the economy, diet and culture of the Yakama People since Time Immemorial.” (Tom Ring, Yakama Nation)

USGS groundwater model is helping the Yakama Nation to better understand and manage conjunctive use of groundwater and surface water; manage irrigation and agricultural water conservation; and seek potential benefits from artificial groundwater storage.

Northwest Climate Science Center - The [Department of Interior Northwest Climate Science Center \(NW CSC\)](#) is responsible for addressing "[the impacts of climate change on American Indians and Alaska Natives](#)", for whom the Department holds trust responsibilities on behalf of the federal government (per a Secretarial Order No. [3289](#)). Tribal communities are especially vulnerable to climate change because they are place-based and depend on natural resources, such as salmon, shellfish, game, timber, and rangelands, to sustain their economies and traditional way of life. The NW CSC is committed to working with Tribal governments of all 52 federally recognized tribes that have reservations or natural and cultural resource interests within the NW CSC geographic area (see map below) to jointly address effects of a changing climate.



Source: Reservation boundaries from the National Atlas (<http://nationalatlas.gov/>)

Explanation

-  Indian Reservation
-  Approximate Location of Tribal Office
-  Outline of the Approximate Geographic Area of the Northwest Climate Science Center

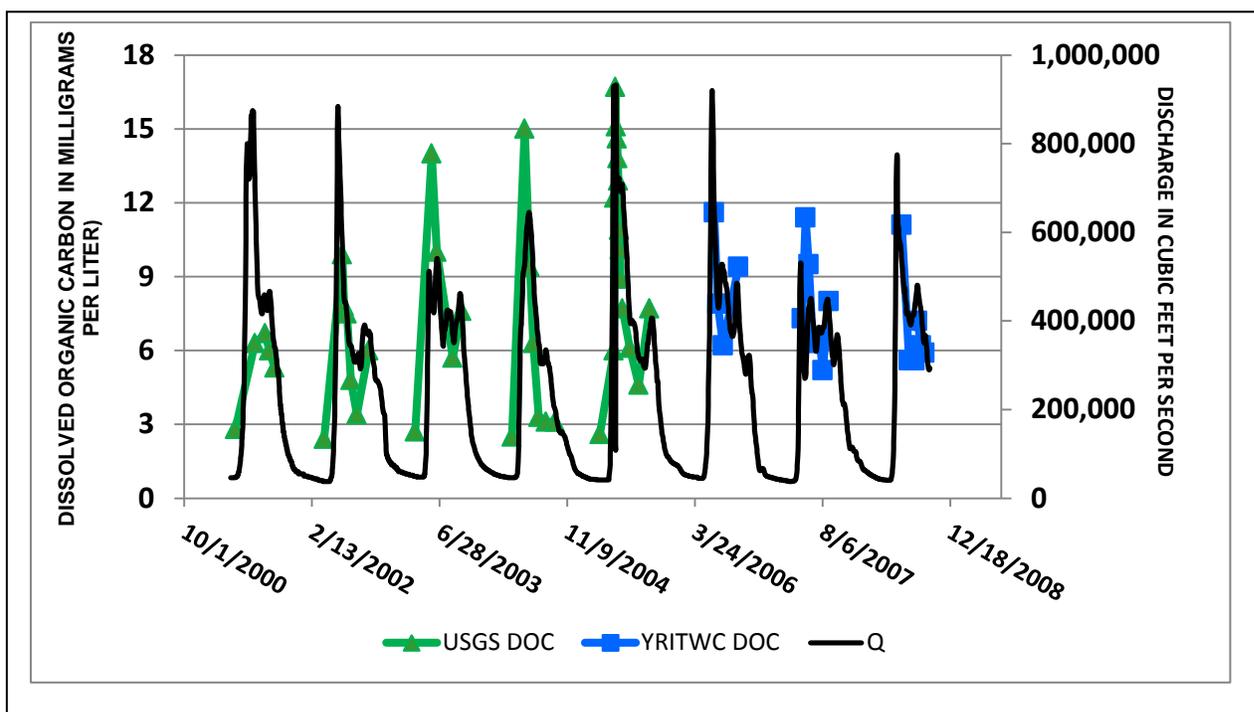
Alaska

The USGS National Research Program (NRP) based in Boulder, Colorado is in its 10th year of a highly successful partnership with the [Yukon River Inter-Tribal Watershed Council \(YRITWC\)](#) as described in a [Memorandum of Understanding \(MOU\)](#) in 2009 to conduct a long-term water-quality and climate-change program in the Yukon River Basin.

Together, the USGS-NRP and the YRITWC with assistance from the Alaska Science Center and field offices have maintained a water-quality program for the Yukon River basin focused on monitoring the health of the Yukon River and its major tributaries ([Fact Sheet](#)). The partnership manages a vast network of trained volunteer water technicians from over 60 Tribes and First Nations across Alaska and Canada known as the [Indigenous Observation Network \(ION\)](#). ([Fact Sheet](#))



Water-quality field training is jointly organized by USGS and YRITWC on the Tanana River at Nenana, Alaska. Training involves volunteer water technicians from villages across the Yukon River basin.



Dissolved organic carbon (DOC) is among many water-quality constituents that are essential to aquatic health in Alaska's rivers and streams. Scientists anticipate that DOC may decrease with climate warming, which increases the respiration of carbon on land and thereby decreases the export of carbon to streams and rivers ([Striegl, et al. 2005](#)). USGS and the YRITWC therefore measure concentrations of carbon as part of the joint climate-change research. Shown here are concentrations from 2000-2008, indicating no apparent increasing or decreasing trends in stream concentrations in the Yukon River at Pilot Station, Alaska.

In 2009, the USGS and YRITWC initiated a study on degrading permafrost and relations to a warming climate through the establishment of an “[Active Layer Network \(ALN\)](#)” of 20 sites across the Yukon River basin. The joint activity measures the depth of active layer, defined as the layer of soil above the permanently frozen ground that thaws during the summer months and freezes again in the autumn.

In 2014, USGS and the YRITWC will conduct a field campaign titled “SNOWY” (Strategic Needs on Water in the Yukon) with Colorado State University and U.S. Forest Service under a 2-year National Science Foundation grant. The project will be based out of three villages in the lower Yukon basin to explore social science methods that will focus on community-driven questions and concerns on the effects of climate change in the Yupik Tribe's environment and subsistence culture.

Similar efforts currently are extending beyond the Yukon Basin. For example, in 2013, USGS began to establish a partnership with the Kuskokwim River Watershed Council (KRWC) following the partnership model with the YRITWC. ([Press Release](#)) (**Contact:** Paul Schuster, pschuste@usgs.gov, (303) 541-3052).

[California](#)

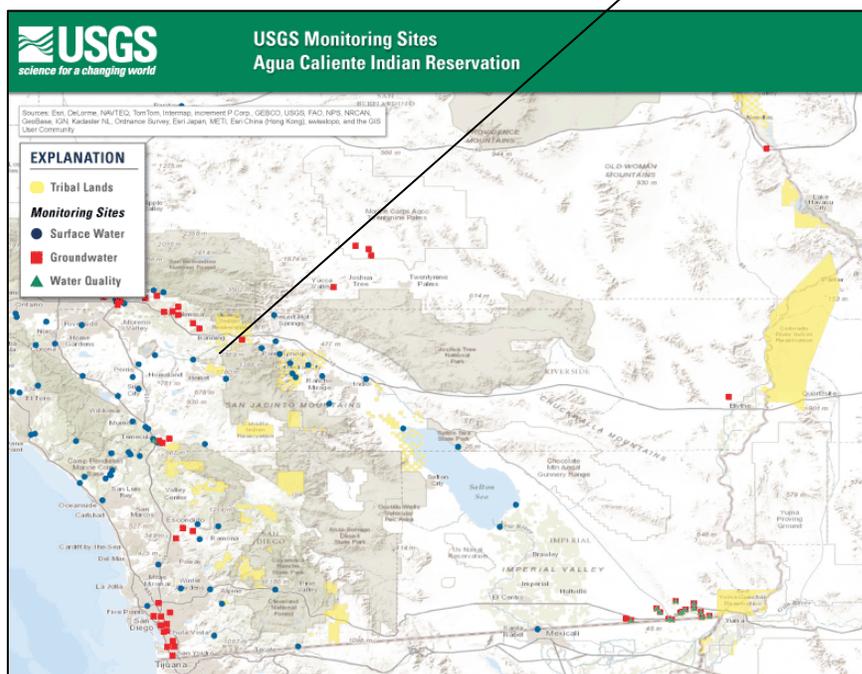
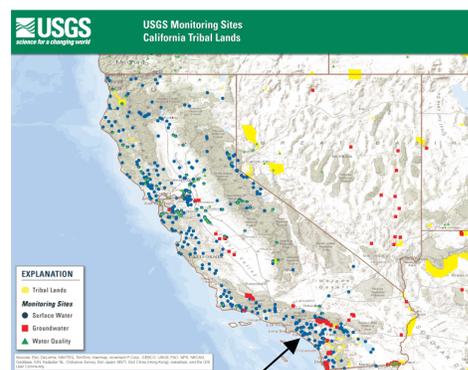
USGS monitors surface water and water quality on Tribal lands in northern California, such as in the Hoopa Valley and Yurok Indian Reservations, and surface water, groundwater, and water quality in southern California near and on the Agua Caliente Indian Reservation.

Discussions are ongoing with the Torres Martinez Desert Cahuilla Indians of Southern California to better understand water quality and water supply in constructed wetlands located on Tribal lands along northern border of the Salton Sea. Currently the wetland complex consists of seven, 1-acre

treatment cells that filter water pumped from the nearby Whitewater River, and four larger (13-20 acre) habitat ponds.

The habitat ponds receive a mixture of water that has passed through the treatment cells as well as water pumped directly from the Whitewater River.

There is a need to evaluate changes in water quality within the entire wetland habitat complex. To plan for future expansion of the wetlands, there is a need to know the water budget of the wetlands and to evaluate the shallow groundwater system as a source of water for the wetlands. (**Contact,** Kim Taylor, ktaylor@usgs.gov, (916) 278-3006)



Nevada

The Nevada Water Science Center coordinates data-collection activities with Tribes in basins that drain to terminal lakes, Pyramid Lake and Walker Lake. (**Contacts:** Steve Berris, sberris@usgs.gov, (775) 887-7693 and Kip Allander, kallander@usgs.gov, (775) 887-7675). Terminal lakes are susceptible to climate change, upstream diversions, water quality concerns, and resultant endangered/threatened species concerns. Efforts with the Pyramid Lake Paiute Tribe focus on streamflow and temperature and provide needed information to support the Tribe's water rights on the Truckee River and to sustain Lahontan Cutthroat and Cui Ui fisheries, as well as a significant pelican breeding area on an island in the lake.



A USGS scientist prepares for a GPS survey of benchmarks and reference marks for measuring water levels at Pyramid Lake. Diversion of the Truckee River for upstream for irrigation, municipal, and other uses has reduced inflows since the 1900's.

Collaborative efforts with the Walker River Paiute Tribe focus on streamflow, continuous water-quality monitoring, reservoir levels, canal seepage losses, and water-quality sampling during irrigation seasons. The information helps the Tribe track and manage upstream water delivery that is needed to sustain supplies and fisheries (required to be 25 cubic feet per second). In fact, USGS science played a major role in developing a river accounting system and a conveyance agreement with the National Fish and Wildlife Foundation for conveying Walker River flows through the Walker River Indian Reservation.

USGS also works with the Duckwater Shoshone Tribe to measure flows at a large regional spring.

Arizona

USGS works with 10 of the 19 federally recognized Tribal governments in Arizona to assist Tribes with monitoring and assessments that are used by Tribes to address such topics as water rights, water use, hydrologic conditions, and water-quality issues, such as mining. ([Access summary of USGS Tribal programs in Arizona](#)). In total, USGS and Tribes monitor surface water at 20 sites, sediment at 2 sites, and groundwater at 2 stations.

USGS also provides critical training and materials to Tribal personnel in the collection of hydrologic data including surface water, groundwater, and quality of water, analysis of surface-water records, and other field techniques. A step-by-step field guide was developed for the Navajo Department of Water Management that describes procedures for operating, maintaining, and collecting surface-water data on the Navajo Indian Reservation (**Contacts:** Bob Hart, bhart@usgs.gov, (928) 556-7137 and Jeff Cordova, jcordova@usgs.gov, (520) 670-6671).



USGS and the White Mountain Apache Tribe constructed a “continuous slope area” streamgage near Whiteriver, Arizona. Training held in July 2013 will help the Tribe improve indirect measurements of streamflow using the continuous slope-area (CSA) streamgaging method for streamgages that are subject to flashy high-flow events.



USGS and the Navajo Nation performed a “channel geometry” survey at their streamgage near Lukachukai, Arizona. The survey was part of a two day training course held in July 2013 through TESNAR on indirect measurements of streamflow using a “continuous slope-area” streamgage method for the Navajo Nation. This method will help to improve stage-discharge relations at the streamgages that are subject to flashy high-flow events.

USGS partners with the Hopi and Navajo Tribes on a [long-term groundwater monitoring network](#) in the Black Mesa. A long-term available supply of water is critical to the Tribes to meet their needs for public supply, irrigation, and livestock. In addition, sustained springflow and streamflow are important to their culture. The hydrologic data collected in this monitoring program are needed to understand the available water supply and the effects of past industrial and current municipal groundwater withdrawals.



Black Mesa

In 2005, USGS began a long-term partnership with the Bureau of Indian Affairs Navajo Region on a [project](#) to monitor groundwater in the Coconino aquifer near Leupp, Arizona. The primary goal of the effort is to track long-term changes in groundwater levels, water use and water chemistry and establish baseline groundwater conditions in the aquifer and other water-bearing zones before additional significant development in this area. Groundwater resources of the aquifer in the Little Colorado River Basin are already being affected by groundwater withdrawals for municipal, agriculture, and industrial water uses throughout the upper and middle parts of the basin ([Hart and others, 2002](#)). Proposed groundwater development from the aquifer in the Leupp area include: 1) an alternate means of supplying water for the Peabody Western Coal Company mining operation on Black Mesa, 2) future supply for the City of Flagstaff, 3) future supply

The [USGS Western Geographic Science Center](#) located at the Flagstaff Science Campus has been working closely with both the San Carlos and Navajo tribes on grassland conservation and the utilization of modern grazing practices that minimize overgrazing. Remotely sensed data and imagery from satellite and on the ground sensors are used to collect information on the condition of pastures that can then be used to schedule pasture rotations. Overgrazing results in the significant reductions in perennial native grasses and forbs, and results quickly pastures being over-run with non-native grasses, weeds, and cacti. Once non-native grasses, weeds, and cacti establish in grazing areas, it is extremely difficult to recover the pastures to their original state.

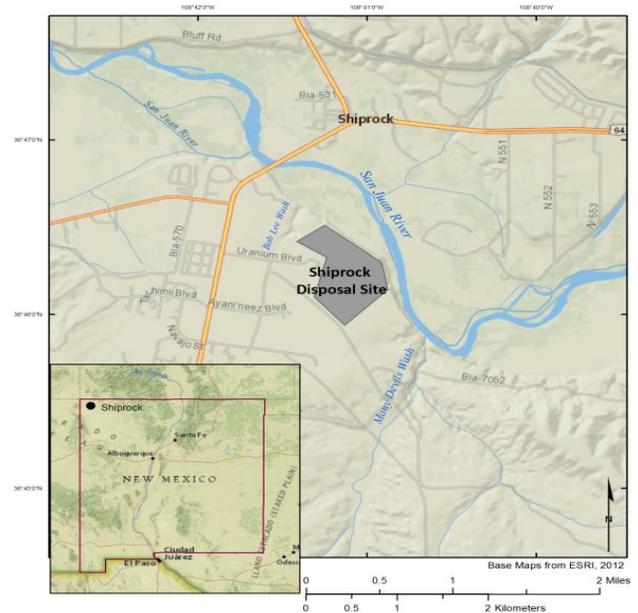
for new subdivisions east of Flagstaff, and 4) to support continuing development along the Little Colorado River valley up gradient from Leupp. The demand for groundwater resources in this area has the potential to compound the effects of groundwater withdrawals in the basin. Additional development of groundwater resources in this area could also occur to improve water supplies for communities in the western part of the Navajo Indian Reservation (Leupp, Dilkon, Red Lake, Sebi Delka, etc.).

USGS also continues to monitor groundwater and potential impacts of mining from the Dos Pobres/San Juan Cooper mine. The efforts are in partnership with the Bureau of Indian Affairs and Bureau of Land Management, and serve critical information to the Gila River Indian Community and the San Carlos Apache Tribe.

New Mexico

USGS and the Navajo Environmental Protection Agency have completed a cooperative study to determine background concentrations of contaminants of concern in groundwater that is in contact with the Mancos Shale and identify the source of water and contaminants of concern in Many Devils Wash near Shiprock, New Mexico at the UMTRA (Uranium Mill Tailings Radiation Control Act) site on the Navajo Reservation. A USGS report summarizing the hydrogeology and geochemistry is anticipated in 2014.

(**Contacts:** Tony Ranalli, tranalli@usgs.gov, (303) 236-6915 and Matt Ely, mely@usgs.gov, (505) 830-7943)



Oklahoma

The Oklahoma Water Science Center is developing groundwater models with Tribal Nations including with the Citizen Potawatomi Nation, the Caddo Nation, and most recently the Osage Nation. These efforts serve water resource needs within Tribal Nation jurisdictional boundaries and help to support the information needs identified in the Oklahoma Water Resources Board's recently completed State Water Plan.

A "State of the Science" effort with the Osage Nation began in July 2013, which employs the latest advancements in USGS technology to assess water types, fresh and saline, and to help quantify connections between water supply and demand. The study incorporates conventional hydrologic data gathering along with high-resolution aerial geophysical



USGS and the Osage Nation established a four-year water resources study. "This is an important study which will help establish water conservation and responsible water planning in the Osage," said Osage Principal Chief John D. Red Eagle.

The mission of the Osage Nation's ENR Department is to protect human health, the environment and Osage cultural resources, and to protect and develop natural resources, while preserving the diverse human cultures and animal and plant ecosystems existing in the Osage.

surveys, establishment of real-time surface water/groundwater interaction monitoring sites, aquifer yield assessment wells, and development of a geologic framework model. Ultimately, an integrated three-dimensional surface-water/groundwater model will be developed to analyze changes in flow, storage and recharge in the different hydrologic regions of the Osage under different climate and water-use scenarios. Study results will provide the knowledge base needed to develop a water- resources management plan in the Osage for decades to come, so that the Osage Nation and their partners can plan for sustained water resources now and into the future.

The Oklahoma Water Science Center has been working with Tribes for many decades on water resources and development of digital data atlases, including with the Caddo Nation, Chickasaw Nation, Choctaw Nation, Citizen Potawatomi Nation, Miami Tribe, Kickapoo Tribe, Iowa Tribe, and the Cherokee Nation. Three reports were released in the last year that describe (1) environmental setting, surface and ground-water data, and data gaps for the Citizen Potawatomi Nation Tribal Jurisdictional Area ([USGS SIR 2013-5010](#)); and (2) well characteristics, groundwater quality and the relation between pH, trace elements, and radionuclides in water from private wells in part of the Kickapoo Tribe of central Oklahoma ([USGS SIR 2012-5253](#)) ([USGS OFR 2012-1255](#)). Other studies with Tribes can be accessed on the Oklahoma [publications](#) web page.

Since 2004, USGS has been conducting training classes for Tribal staffs in the areas of water-quality sampling, sediment sampling, streamflow measurement, sampling-network design, geographic information systems, ecological streamflows, and climate-change adaptation. USGS also works with Tribes to jointly monitor streamflow, groundwater, and water quality at 15 surface-water and groundwater sites across Oklahoma. (**Contact:** David Mott, dmott@usgs.gov, (405) 810-4417)

Utah

USGS Water Science Center in Utah has worked with the Ute Indian Tribe since 2009 in the collection of streamflow and water-quality constituents at 15 surface water sites that are within or border the Uintah and Ouray Reservation. The samples represent spring runoff, irrigation, and baseflow conditions, and were analyzed for major ions and trace metals. The objectives of the sampling were to provide baseline water-quality information and to provide training to the Tribal Department of Environmental Quality. All data are stored in the USGS NWIS database and are publicly available. (**Contact:** Cory Angeroth, Angeroth@usgs.gov, (801) 908-5048)

USGS completed a study in 2011 with the Ute Mountain Ute Tribe and the Environmental Protection Agency. The study served as an independent evaluation of potential offsite migration of radionuclides and selected trace elements associated with the ore storage and milling process at an active uranium mill site near White Mesa, Utah. Specific objectives of this study were (1) to determine recharge sources and residence times of groundwater surrounding the mill site, (2) to determine the current concentrations of uranium and associated trace elements in groundwater



USGS and the Ute Indian Tribe collect a surface water quality sample in the Strawberry River (Site number 09288180) near Duchesne, Utah.

surrounding the mill site, (3) to differentiate natural and anthropogenic contaminant sources to groundwater resources surrounding the mill site, (4) to assess the solubility and potential for offsite transport of uranium-bearing minerals in groundwater surrounding the mill site, and (5) to use stream sediment and plant material samples from areas surrounding the mill site to identify potential areas of offsite contamination and likely contaminant sources. (Report) (**Contact:** Tony Ranalli, tranalli@usgs.gov, (303) 236-6915)

Michigan

The Michigan Water Science Center works with Tribes across Michigan to provide monitoring, assessments, and research for their water resource and ecological management (**Contacts:** Tom Weaver, tweaver@usgs.gov, (517) 887-8923), Chris Hoard, cjhoard@usgs.gov, (517) 887-8949), and Neal Craig, nhcraig@usgs.gov, (906) 786-0714).

Highlighted studies include:

USGS and the Keweenaw Bay Indian Community (KBIC) cooperatively monitor surface water in real-time in the Silver River watershed. Real-time water quality information for temperature and specific conductance were available through 2013. [A study](#) was completed in 2010 by USGS, in cooperation with KBIC, to characterize water quality and hydrology in the Silver River Watershed from 2005-2008. Surface-water information is critical for KBIC to track potential environmental impacts from development in the 69-square-mile, rural and lightly populated watershed. The Silver River, which flows into a bay of Lake Superior, provides habitat for many types of fish providing Tribal sustenance including trout and salmon.



Silver River near L'Anse, Michigan (Site: 04043131) during spring runoff in 2008.



USGS scientists prepare fish samples for tissue analysis from Silver River watershed near the Keweenaw Bay Indian Community. August 26, 2008.

Since 2005, USGS, the KBIC, and the Great Lakes Fisheries and Wildlife Commission (GLIFWC) have cooperated on projects on the Salmon Trout, East Branch Salmon Trout, and Yellow Dog Rivers. The rivers, which drain into Lake Superior, are noted for their diverse aquatic populations and species abundance.

KBIC, GLIFWC, and other interested parties are concerned about the environmental effects of development occurring west and south of Big Bay in northern Marquette County, Michigan—including sulfide mineral mining.

Temperature, specific conductance, stage, and streamflow data from three streamgages are available on a real-time basis. Discrete water-quality sampling at seven stream and eight spring locations is being done with the KBIC in sensitive small sub-watersheds and upland areas within the Salmon Trout and Yellow Dog watersheds to establish baseline conditions before potential mineral resource extraction and timber harvesting.



Yellow Dog River (near Big Bay, Site: 04043275)

Yellow Dog River is one of three rivers studied by USGS, the Keweenaw Bay Indian Community, and the Great Lakes Fisheries and Wildlife Commission to assess effects of development, including sulfide mineral mining.

USGS continues lake monitoring with the Lac Vieux Desert Band of Lake Superior Chippewa Indians. Lac Vieux Desert is a 6.6-square-mile lake that has been used for generations by Tribal members for hunting, fishing, and harvesting wild rice, straddles the Michigan-Wisconsin border, and is the headwaters of the Wisconsin River. The Lac Vieux Desert Band is concerned about the impact of lake-stage regulation on hydrology and ecology, and the impact on water quality of development along and near the shore, and recreational watercraft use and sport fishing. USGS, in cooperation with the Lac Vieux Desert Band of Lake Superior Chippewa Indians, published a [scientific investigation](#) that characterized water quality, hydrology, and biological productivity in the lake

A collaborative regional study is ongoing, supported in part by the Great Lakes Restoration Initiative and in partnership with the Great Lake Indian Fish and Wildlife Commission (GLIFWC) and Fond du Lac Reservation, to assess surface water, bed sediment, and water quality (for major ions and metals) in the headwaters of three watersheds for the St. Louis River in Minnesota, the Presque Isle River in Michigan, and the Tyler Forks in Wisconsin. Further regional work is planned to assess environmental effects of metal extraction in the Lake Superior Basin. (**Contacts:** Tom Weaver, tlweaver@usgs.gov, (517) 887-8923), Chris Hoard, cjhoard@usgs.gov, (517) 887-8949), and Neal Craig, nhcraig@usgs.gov, (906) 786-0714)

Minnesota

Currently, USGS collaborates with 5 of the 11 federally recognized Tribes in Minnesota on monitoring and studies related to streams, rivers, groundwater, and water quality. Some of the projects target specific hydrological issues, such as effects of mining on water quality, and groundwater supplies and management. For example, data collection on groundwater, surface water, and water quality is ongoing with the Prairie Island Dakota Community to inform an integrated hydrologic analysis of Prairie Island, Minnesota. The USGS cooperates with the Mille Lacs Band of Ojibwe to operate a lake gage on Mille Lacs Lake, an important fisheries resource for the band and one of the most popular recreational fishing lakes in Minnesota. USGS also collects continuous data on groundwater and lake levels, water temperature, and precipitation in a network of wells spanning the Upper Sioux Community, Lower Sioux Community, and the Prairie Island Dakota Community.

USGS is conducting a groundwater/surface-water interaction study in Stoney Brook watershed, which is the largest watershed on the Fond du Lac Reservation, comprising nearly half of the land area of the Reservation. The Reservation's most important wild rice lakes occur within the Stoney Brook watershed. Nearly 47 miles of man-made ditches have altered the timing and amount of water that enters these lakes from Stoney Brook, which reduces wild rice production. USGS is monitoring groundwater-level, open-channel flow, and precipitation to estimate specific yields, groundwater recharge rates, and evapotranspiration rates in the Stoney Brook watershed. The science will help to better understand the hydrology of the current system and implications on the management of wild rice, as well as to provide needed information to re-establish natural hydrologic drainage.

A collaborative regional study is ongoing, supported in part by the Great Lakes Restoration and in partnership with the Great Lake Indian Fish and Wildlife Commission (GLIFWC) and Fond du Lac Reservation, to assess surface water, bed sediment, and water quality (for major ions and metals) in the headwaters of three watersheds for the St. Louis River in Minnesota, the Presque Isle River in Michigan, and the Tyler Forks in Wisconsin. Further regional work is planned to assess environmental effects of metal extraction in the Lake Superior Basin. **(Contact: Jim Stark, stark@usgs.gov, (763) 783-3230)**

Nebraska

The USGS Nebraska Water Science Center has collaborated with three Tribes in Nebraska over the past nine years in streamflow data collection and base-flow discharge measurements.

Efforts continue with two of the Tribes, the Santee Sioux Tribe of Nebraska and the Winnebago Tribe of Nebraska. Specifically, USGS operates and maintains two streamgages for each of the Tribes (in the Bazile Creek Watershed for the Santee Sioux Tribe; and in the Logan Creek and South Omaha Creek Watersheds for the Winnebago Tribe). Some training on streamgage techniques (such as related to the acoustic velocity meter) is involved. In addition, the USGS collects base-flow measurements twice a year on 12 ungaged rivers for the Winnebago Tribe. These measurements can be used to estimate low-flow characteristics at ungaged sites via correlation with concurrent flows at the continuous-record streamgages. Data from the continuous-record sites can be leveraged to gain new information for a much larger area with a relatively few additional measurements at other sites. **(Contact: Jason Lambrecht, jmlambre@usgs.gov, (402) 328-4124)**

[North Dakota](#)

USGS has collaborated with the 4 federally recognized Tribes in North Dakota in recent decades on programs ranging from data collection to projects of specific hydrological concerns. For example, since 1999, USGS has partnered with the Spirit Lake Tribe on surface water and groundwater data collection, water-quality sampling, and training. Available surface-water quality, ground-water quality, and water-withdrawal data for the Spirit Lake Reservation were summarized in 2006 ([Report](#)), which had led to a long-term water-quality monitoring program on the Reservation.

Several other studies have been completed with the Standing Rock Sioux Tribe, including [a study](#) of water quality, bed sediment and fish tissue samples from public water-delivery systems, groundwater, surface-water, bed-sediment, and fish-tissue sources at 32 locations within the Standing Rock Sioux Reservation. Findings revealed little concern, with the exception of elevated boron concentrations in the drinking water and groundwater in the area of Selfridge and Solen and minor exceedences of total trihalomethanes in the Fort Yates water-delivery system.

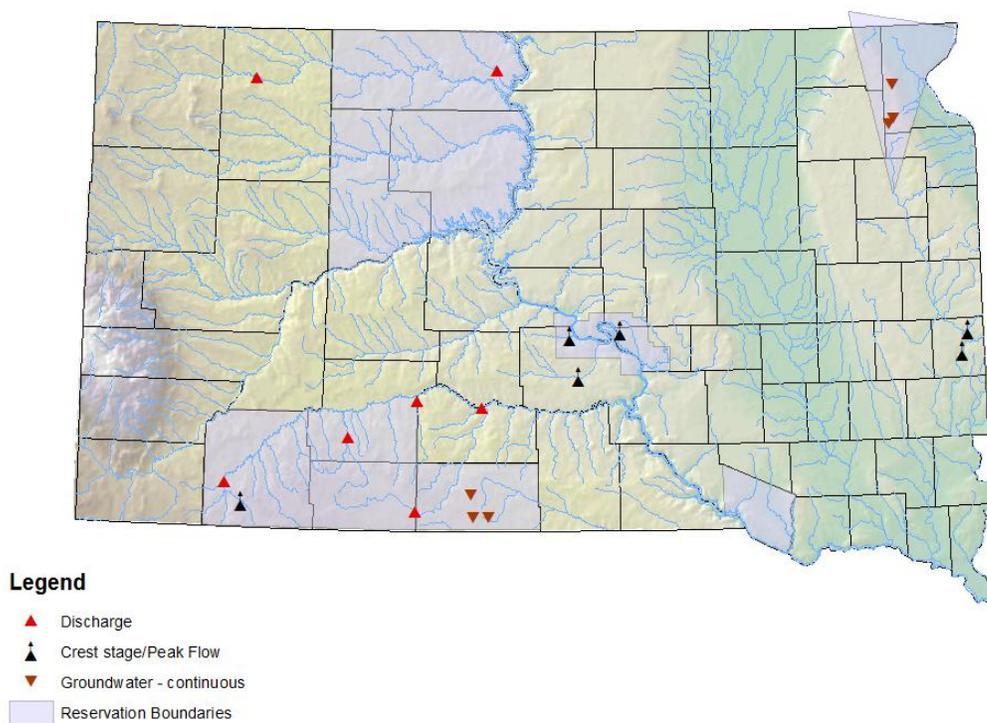
Another [USGS study](#), also done in cooperation with the Standing Rock Sioux Tribe, was completed in 2009 on the occurrence of emerging contaminants in water and bed material in the Missouri River upstream and downstream from the cities of Bismarck and Mandan, North Dakota, and upstream from the city of Fort Yates, North Dakota. The findings showed that concentrations generally were low; only sulfamethoxazole, an antibiotic, was present at a concentration higher than minimum detection limits. It was detected in a water sample collected downstream from the cities of Bismarck and Mandan, and in bed-sediment samples collected at the two sites downstream from the cities of Bismarck and Mandan and upstream from Fort Yates. Sulfamethoxazole is an antibiotic commonly used for treating bacterial infections in humans and animals.

Joint efforts with the Standing Rock Sioux Reservation may extend to assessments of groundwater sources. USGS has worked with the Turtle Mountain Band of Chippewa Indians since 2000, beginning with research efforts to assess lake water quality, and more recently to assess the quality of groundwater. Specifically, a recently completed [cooperative study](#) (2013) examined historical groundwater-level and groundwater-quality data for the Fox Hills, Hell Creek, Rolla, and Shell Valley aquifers. The Turtle Mountain Indian Reservation relies on groundwater supplies to meet the demands of community and economic needs.

USGS also partners with the Three Affiliated Tribes in analyzing water-quality data for groundwater, streams, and Lake Sakakawea on the Fort Berthold Reservation (USGS publication is expected in 2014). The study is addressing potential changes in water quality resulting from agricultural land use and energy development on the Reservation. Continued joint efforts are expected to include a reservation-wide ambient water-quality monitoring program of streams, groundwater, and springs in the western North Dakota intensive areas of energy development. (**Contacts:** Robert Lundgren, rflundgr@usgs.gov, (701) 250-7417; Tony Ranalli, tranalli@usgs.gov, (303) 236-6915); and Joel Galloway, jgallowa@usgs.gov, (701) 250-7402).

South Dakota

USGS actively works with 8 of the 9 federally recognized Tribes in South Dakota. (Contacts: Dan Driscoll, dgdrisco@usgs.gov, (605) 394-3211; Kathleen Neitzert, kmneitze@usgs.gov, (605) 352-4241, ext. 226; and Joyce Williamson, jewillia@usgs.gov, 605-394-3219).



USGS, in partnership with Tribes, monitors surface water at 13 sites and groundwater at six sites in South Dakota (additional groundwater and surface water sites are anticipated in 2014 for the Rosebud, Sisseton-Wahpeton, and Lower Brule Sioux Tribes; exact locations have not been determined).

Data-oriented programs focus on streamgaging, monitoring of ground-water levels, and training and assistance in water-quality sampling. Interpretive programs include surface-and ground-water characterization, ground-water flow modeling, characterization of sediment contamination, and monitoring and analysis of shoreline erosion along the Missouri River.

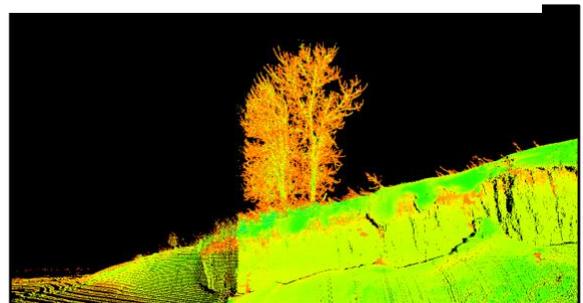
For example, the USGS partners with the Sisseton-Wahpeton Oyate on the Lake Traverse Reservation and the Rosebud Sioux Tribe on the Rosebud Reservation. Rosebud Reservation, which comprises nearly 2,000 square miles in Todd County in south-central South Dakota, lies along the Nebraska border. Extensive land and populations also are located in four adjacent counties, including parts of Gregory, Mellette, Lyman and Tripp counties. The Lake Traverse Reservation is located in northeastern South Dakota and southeastern North Dakota and comprises over 106,000 acres. Both Tribal and non-tribal entities and individuals associated with the reservations are interested in the effects of irrigation (in large part, center pivot systems) on water availability. The Rosebud Sioux Tribe (RST) and the Sisseton-Wahpeton Oyate need quantitative information on the effects of these irrigation systems on the availability of water for Tribal members, such as decreasing groundwater levels and streamflow depletion. Beginning in 2011, USGS implemented a real-time groundwater level network on the Reservations, which will help the Tribes in

decisions related to water-rights quantification for irrigation withdrawals. Further expansion and continued operation and analysis of the collected data are anticipated to provide a more complete understanding of the effects of irrigation and can be used toward future water-rights quantification.

USGS also has [ongoing studies with the Lower Brule Reservation](#) that belongs to the Lower Brule Lakota Tribe located on the west bank of the Missouri River in central South Dakota. One study uses various technologies to monitor the extent and rate of erosion on the Lower Brule Reservation, such as through real-time kinematic (RTK) satellite navigation, ground-based light detection and ranging (LiDAR) in cooperation with the Oglala Lakota College, and unmanned aerial systems. Erosion remains an issue for the Tribe, which estimates that the Reservation is losing shoreline in some locations at a rate of up to 8 feet per year. Erosion losses of up to 32 feet were measured by Tribal and USGS personnel from November 2011 to November 2012. The erosion is occurring, in large part, because of the loss of riparian and infrastructural areas on the Missouri River after the construction of main stem dams, which created reservoirs that flooded large areas and consumed forests, prairie, farms, and communities.



USGS and the Lower Brule Reservation monitor the extent and rate of erosion on the west bank of the Missouri River in central South Dakota (photo above) through real-time kinematic (RTK) satellite navigation, ground-based light detection and ranging (LiDAR) in cooperation with the Oglala Lakota College, and unmanned aerial systems (photos below)



Another study with the Lower Brule Reservation includes ground surveying (GPS) and water-quality sampling on six Lower Brule wetlands. The Tribe is interested in wetlands due to their importance for agriculture and wildlife. The USGS is compiling existing wetland graphical information system (GIS) data; delineating six Tribal-owned wetlands with real-time kinematic (RTK) satellite navigation to provide updated spatial data; and investigating the current water conditions.



USGS conducts ground surveying and water-quality sampling on the Lower Brule Reservation to help the Tribe manage and sustain their critical wetlands.

Wisconsin

USGS collaborates with nearly all eleven (11) federally recognized Tribes in Wisconsin on monitoring and studies related to streams, rivers, groundwater, and water quality. Some of the projects target specific hydrological issues, such as nutrient loads in wild rice wetlands, trace element contamination, and groundwater supplies and management. Training often is involved, such as to strengthen Tribal use of groundwater-flow models as a tool to manage Tribal water resources. For example, a training workshop was held in September 2013 for participants representing the:

- Menominee Indian Tribe of Wisconsin
- Bad River Band of Lake Superior Chippewa Tribe
- Lac du Flambeau Band of Lake Superior Chippewa Tribe
- Oneida Tribe of Indians of Wisconsin
- Red Cliff Band of Lake Superior Chippewa
- Sokaogon Chippewa Community of Mole Lake
- Indian Health Service
- Bureau of Indian Affairs



USGS and Tribes jointly support real-time monitoring of streamflow at six sites across Wisconsin (shown above is the Tyler Forks River streamgage ([Site Number 04026561](#)) near Mellen, Wisconsin).

A groundwater modeling cooperative study is ongoing with the Bad River Band of Lake Superior Chippewa Tribe, with specific focus on a proposed taconite mine in the Gogebic Range in the headwaters of the Bad River watershed. (**Contact:** Mike Fienen, mnfienen@usgs.gov, (608) 821-3894)

Groundwater-flow studies were completed in 2013 (reports are in review or in DRAFT form) for the Menominee Indian Tribe, Lac du Flambeau Indian Reservation, and Red Cliff Band of Lake Superior Chippewa. These studies present findings on the regional groundwater-flow systems and interaction of groundwater with surface water on the reservations.

USGS also conducts surface water and water quality studies in cooperation with Tribes. For example, monitoring and assessments are conducted with the Bad River Band of the Lake Superior Chippewa at Tyler Forks and Bad River that focus on streamflow, suspended sediment, temperature, and trace elements. Bad River is a long-term site with data since 1914. Real-time water-quality data have been added through support from the Great Lakes Restoration Initiative. The Tyler Forks gage was established in 2011 in partnership with the Great Lakes Indian Fish and Wildlife Commission specifically for monitoring water quality and streamflow downstream from a proposed mine location. The joint efforts also include streambed sediment analyses for trace elements at about 15 sites in the region's iron formation bedrock, and measurements of base flow across the watershed for integration with groundwater modeling. Finally, coordinated efforts are ongoing to better understand sediment and nutrient loads into wild rice wetlands at the mouth of the Bad River and Kakagon River.

Additionally, Wisconsin participates in cooperative studies across the region in partnership with the Great Lakes Indian Fish and Wildlife Commission (GLFWC) (see Minnesota activities). The GLFWC represents eleven (11) Ojibway Tribes in Wisconsin, Michigan, and Minnesota. The monitoring and assessments provide base-line water-quality information in anticipation of proposed mining that could potentially impact Tribal water resources. (**Contact:** Chuck Dunning, cdunning@usgs.gov, (608) 821-3897).

Maine

The Maine Water Science Center cooperatively operates three streamgages with Tribes in Maine. Proposed work with the Houlton Band Maliseet Indians involves addition of real-time water-quality monitoring at one of the USGS streamgages, as well as provision of USGS training, Geographic Information Services, data management services, and quality control oversight. In addition, new work is proposed with the Houlton Band Maliseet Indians and possibly other Tribes (two in Maine and one in Massachusetts) that focuses on regional evaluation of the impact of climate and hydrology on medicinal and traditional plants. The cooperative project would involve cataloging plants important to Tribes, assessment of hydrologic needs for plants, and watershed modeling to examine possible impacts with changing hydrologic conditions. (**Contact:** Bob Lent, rmilent@usgs.gov, (207) 622-8202, ext. 102)



USGS works with the Houlton Band Maliseet Indians on the Meduxnekeag River in eastern Maine. Activities may extend regionally to assess impacts of climate and hydrology on plants.

Mississippi

The Mississippi Water Science Center has been working with the Mississippi Band of Choctaw Indians (MBCI) since 2012. Cooperative efforts have focused largely on building capacities in water quality monitoring and assessment, including development and implementation of a biological framework and strategy for monitoring and assessment of Tribal lands; a quality assurance project plan (QAPP); and field and laboratory training. Current efforts focus on a data management plan, baseline monitoring, and development of a comprehensive water-quality monitoring strategy to include water quality, habitat and physical indicators of stream health. (Contact: Matthew Hicks, mhicks@usgs.gov (601) 933-2932)



USGS works with the Mississippi Band of Choctaw Indians on biological and water-quality monitoring.

New England and New York

A multi-disciplinary USGS team of scientists is working with four Native American Tribes in New England and New York—including the Wampanoag Tribe of Gay Head-Aquinnah on Martha's Vineyard, MA; the Mashpee Wampanoag Tribe on Cape Cod, MA; the Narragansett Indian Tribe near Charlestown, RI, and the Shinnecock Indian Nation on Long Island, NY—to assess impacts from Hurricane Sandy and to identify research needs related to hazards from future storms and climate change. The team is currently evaluating approaches for supplying the Tribes with data sets, GIS training, instrumentation, site evaluations, and science on vulnerability and resiliency to help the Tribes meet their immediate storm recovery and longer term planning needs. (Contact: John Young, jyoung@usgs.gov, (304) 724-4469).



Shavonne Smith, Director of the Shinnecock Indian Nation Environmental Department, points out erosion impacts from Hurricane Sandy