Appendix G
National Assessment of Hydrography Data
Frequently Asked Questions

Hydrography and Related Data Types

What is the National Agricultural Statistics Service (NASS)?

The U.S. Department of Agriculture's (USDA's) National Agricultural Statistics Service (NASS) conducts hundreds of surveys every year and prepares reports covering virtually every aspect of U.S. agriculture. Production and supplies of food and fiber, prices paid and received by farmers, farm labor and wages, farm finances, chemical use, and changes in the demographics of U.S. producers are only a few examples.

NASS is committed to providing timely, accurate, and useful statistics in service to U.S. agriculture. To uphold its continuing commitment, NASS does the following:

- Reports the facts on American agriculture, facts needed by people working in and depending upon U.S. agriculture.
- Provides objective and unbiased statistics on a preannounced schedule that is fair and impartial to all market participants.
- Conducts the Census of Agriculture every five years, providing the only source of consistent, comparable, and detailed agricultural data for every county in America.
- Serves the needs of data users and customers at a local level through a network of State field offices and a cooperative relationship with universities and State Departments of Agriculture.
- Safeguards the privacy of farmers, ranchers, and other data providers, with a guarantee that confidentiality and data security continue to be top priorities.

Through the NASS website, users have access to agriculture statistics presented in databases, graphically in charts, and on maps. Figure G-1 shows an image from the NASS website of vegetation conditions in the Pacific Northwest for the same two-week period in 2011 and 2012.

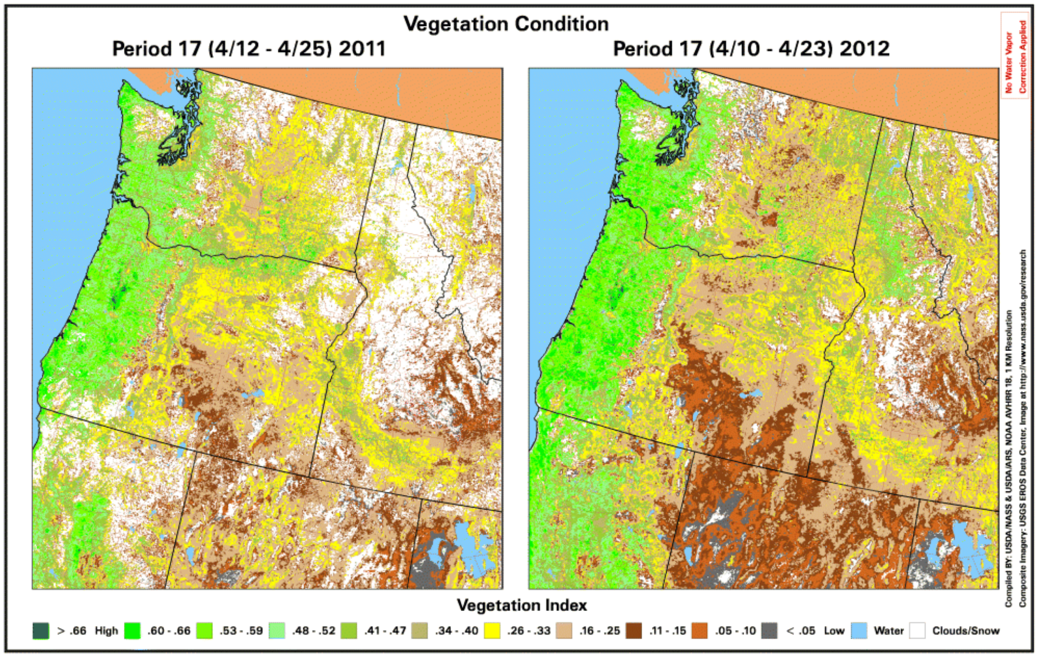

Figure G-1 - Maps of Vegetation Conditions in the Pacific Northwest from NASS

This information was derived from information found on the U.S. Department of Agriculture NASS page at http://www.nass.usda.gov/About_NASS/index.asp.

What is the National Hydrography Dataset (NHD)?

The NHD is a dataset maintained by USGS and other Federal, state, local, and tribal partners that contains comprehensive hydrographic data and spatial features for the Nation. These features represent the surface water drainage network of the U.S., including rivers, streams, canals, lakes, ponds, coastline, dams, and stream gages.

The NHD is a digital vector dataset used by Geographic Information Systems (GIS). The NHD contains features such as lakes, ponds, streams, rivers, canals, dams and stream gages. These data are designed to be used in general mapping and in the analysis of surface water systems. In mapping, the NHD is used with other data themes such as elevation, boundaries, and transportation to produce general reference maps. The NHD is often used by scientists using GIS technology. GIS takes advantage of a rich set of attributes that can be processed to generate specialized information. These analyses are possible because the NHD contains a flow direction network that traces the water downstream or upstream. The NHD also uses an addressing system to link specific information about the water such as discharge rates, water quality, and fish population. Using the basic NHD attributes, flow network, linked information, and other characteristics, it is possible to study cause and effect relationships such as how a source of poor water quality upstream might affect a fish population downstream. The features in the NHD are organized into polygons, lines, and points. The polygons most commonly portray waterbodies such as lakes while lines commonly portray streams. The stream lines are broken into shorter segments stretching from confluence-to-confluence. The segments are then linked together to trace the flow of water across the landscape. Flowlines attributed as artificial paths are added inside water bodies to maintain the flow network.

Figure G-2 shows an example of the NHD on-line viewer, accessed through The National Map, showing point features along flowlines.

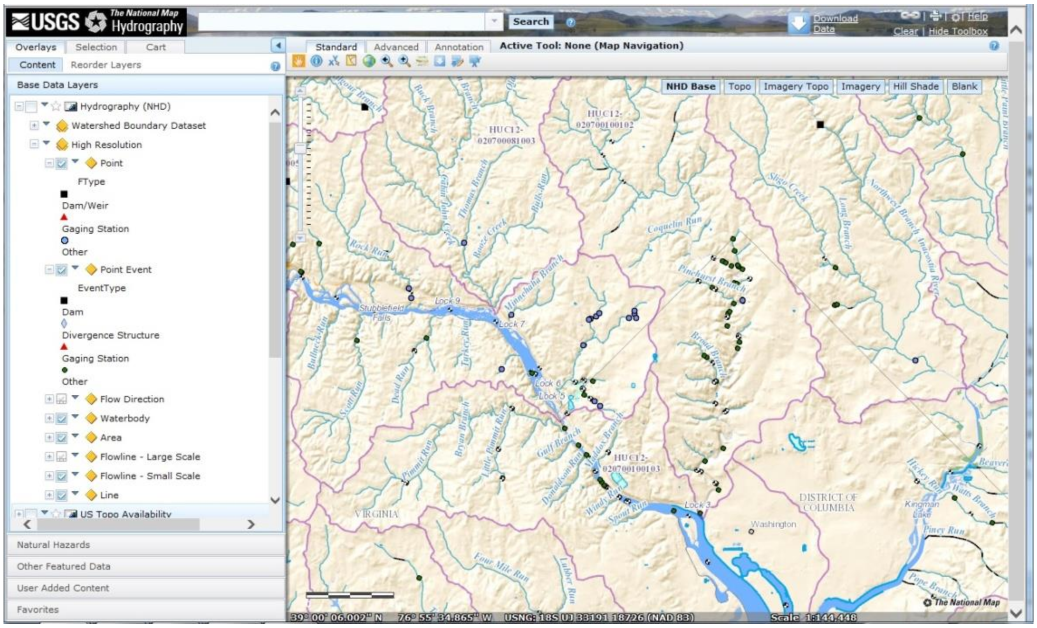

Figure G-2 - NHD On-line Viewer

The primary features making up the nation's surface water are labeled with nationally unique and permanent identifiers known as reach codes. These unique identifiers give features an identity for inventory and analysis. Water chemistry, for example, can be linked to a stream or a lake using reach codes. Many features also are labeled with the name of the feature, such as the Ohio River. The feature names must be approved by the Board of Geographic Names (BGN) in order to qualify for inclusion in the NHD.

The network of lines contains linear measurements, making it possible to locate the position of a stream gage, dam, or other event attached to a flow line. Measures, known as M-Values in the NHD, are used for linear referencing and are similar to the address of a house on a street. By recording the measurements upstream on a reach code it is possible to uniquely identify any position along a waterway. Linear referencing makes it easier to perform calculations in a GIS such as identifying dams upstream from a stream gage, and then determining the distance to those stream gages. The system of linear referencing also makes it easy for any agency to link data to the NHD without having to customize the NHD.

This information was derived from information found on the NHD Frequently Asked Questions page at http://nhd.usgs.gov/nhd_faq.html#q101.

What is the National Hydrography Dataset Plus (NHD Plus)?

NHDPlus is a geospatial, hydrologic framework dataset envisioned by the U.S. Environmental Protection Agency (EPA). The EPA Office of Water, assisted by the U.S. Geological Survey, has supported the development of the National Hydrography Dataset (NHD) Plus to enhance the EPA Watershed Assessment, Tracking & Environmental Results (WATERS) activities and the USGS National Water Quality Assessment (NAWQA) Program's SPARROW modeling. Since its first release in 2006, NHD Plus has been made available by EPA to the wider water resources community and has been used for many diverse applications inside and outside of EPA and USGS.

NHD Plus is an integrated suite of application-ready geospatial data sets that incorporate many of the best features of the NHD, the National Elevation Dataset (NED), and the Watershed Boundary Dataset (WBD).

This information was derived from information found on the NHDPlus Home page at http://www.horizon-systems.com/nhdplus/.

What is the National Inventory of Dams (NID)?

Congress first authorized the US Army Corps of Engineers to inventory dams in the United States with the National Dam Inspection Act (Public Law 92-367) of 1972. The NID was first published in 1975, with a few updates as resources permitted over the next ten years. The Water Resources Development Act of 1986 (P.L. 99-662) authorized the Corps to maintain and periodically publish an updated NID, with re-authorization and a dedicated funding source provided under the Water Resources Development Act of 1996 (P.L. 104-3). The Corps also began close collaboration with the Federal Emergency Management Agency (FEMA) and state regulatory offices to obtain more accurate and complete information. The National Dam Safety and Security Act of 2002 (P.L. 107-310) reauthorized the National Dam Safety Program and included the maintenance and update of the NID by the Corps of Engineers. The most recent Dam Safety Act of 2006 reauthorized the maintenance and update of the NID.

The NID consists of dams meeting at least one of the following criteria;

1) High hazard classification - loss of one human life is likely if the dam fails,
2) Significant hazard classification - possible loss of human life and likely significant property or environmental destruction,
3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage,
4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

The goal of the NID is to include all dams in the U.S. that meet these criteria, yet in reality, is limited to information that can be gathered and properly interpreted with the given funding. The Inventory initially consisted of approximately 45,000 dams, which were gathered from extensive record searches and some feature extraction from aerial imagery. Since continued and methodical updates have been conducted, data collection has been focused on the most reliable data sources, which are the many Federal and state government dam construction and regulation offices. In most cases, dams within the NID criteria are regulated (construction permit, inspection, and/or enforcement) by Federal or state agencies, who have basic information on the dams within their jurisdiction. Therein lies the biggest challenge, and most of the effort to maintain the NID; periodic collection of dam characteristics from 49 states (Alabama currently has no dam safety legislation or formal dam safety program), Puerto Rico, and 18 federal offices. The Corps resolves duplicative and conflicting data from the 68 data sources, which helps obtain the more complete, accurate, and updated NID.

The NID includes information about each dam to include its name, owner, date of construction, type, dimensions, storage capacity, foundation, inspection status, and downstream hazard potential. Figure G-3 shows an example of the NID data for Maryland.

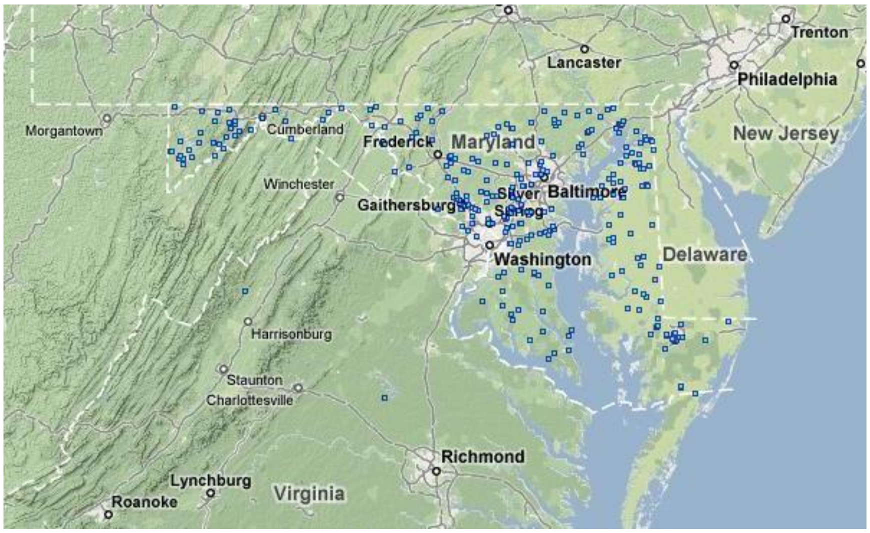

Figure G-3 - National Inventory of Dams for Maryland

This information was derived from information found on the U.S. Army Corps of Engineers National Inventory of Dams page at http://geo.usace.army.mil/pgis/f?p=397:1:0.

What is the National Pollutant Discharge Elimination System (NPDES) permit program?

Water pollution degrades surface waters making them unsafe for drinking, fishing, swimming, and other activities. As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality.

Figure G-4 shows an on-line map from the NPDES website of an area in Maryland showing polluted streams in red, streams with Total Maximum Daily Load (TMDL) cleanup plans in place in orange, and streams with runoff control in pink. Permitted discharge points are also shown on the map.

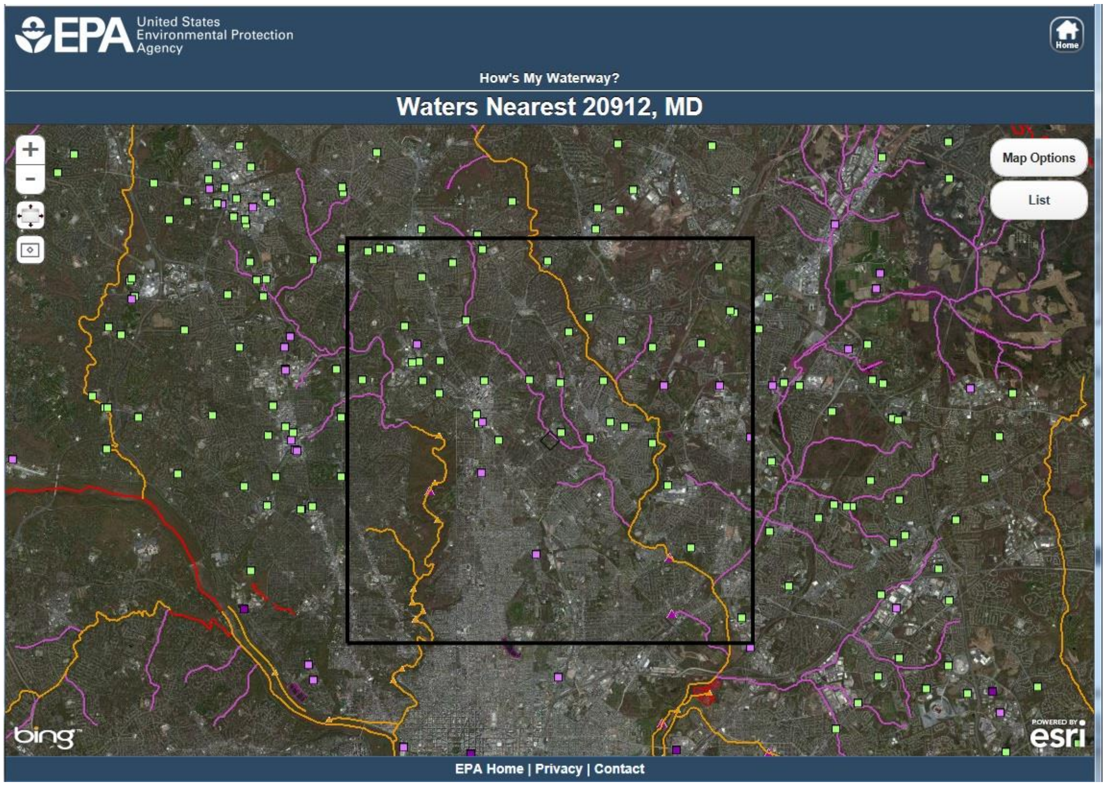

Figure G-4 - NPDES Data for Streams in Maryland and D.C.

This information was derived from information found on the U.S. Environmental Protection Agency NPDES home page at http://water.epa.gov/polwaste/npdes/.

What is the National Water Information System (NWIS)?

The U.S. Geological Survey's (USGS) National Water Information System (NWIS) is a comprehensive and distributed application that supports the acquisition, processing, and long-term storage of water data. Water Data for the Nation serves as the publicly available portal to a geographically seamless set of much of the water data maintained within NWIS.

These water data are collected at over 1.5 million sites around the country and at some border and territorial sites. Many types of data are stored in NWIS, including comprehensive information for site characteristics, well-construction details, time-series data for gage height, streamflow, groundwater level, precipitation, physical and chemical properties of water and water use data. Additionally, peak flows, chemical analyses for discrete samples of water, sediment, and biological media are accessible within NWIS. Several output options are provided including: graphs of current conditions, water levels, and water quality; tabular output in HTML and ASCII tab-delimited files; and summary lists for selected sites that can be used as a basis for reselection to acquire refined details.

The Water Data for the Nation discrete sample database is a compilation of over 4.4 million historical water quality analyses in the USGS district databases through September 2005. The discrete sample database is a large and complex set of data that have been collected by a variety of projects ranging from national programs to studies in small watersheds.

At selected surface-water and groundwater sites, the USGS maintains instruments that continuously record physical and chemical characteristics of the water including pH, specific conductance, temperature, dissolved oxygen, and percent dissolved-oxygen saturation. Supporting data such as air temperature and barometric pressure are also available at some sites. At sites where this information is transmitted automatically, data are available from the current data system. Once a complete day of readings are received from a site, daily summary data are generated and made available online. Annually, the USGS finalizes and publishes the daily data in a series of water-data reports.

Data from collection sites can be queried by users and displayed either in tabular format as shown in Figure G-5, or on a map.

PROVISIONAL DATA SUBJECT TO REVISION

--- Predefined displays --- USA Water-Quality Table | Group table by State | Select sites by number or name | go | show sites on a map

Customize table to display other current-condition parameters

Station Number	Station name	Specific conductance, wat unf uS/cm @ 25 degC	Temperature, water, deg C	Dissolved oxygen, mg/L	pH, water, unfltrd field, std units	Date/Time
Alabama						
023432415	CHATTAHOOCHEE R .36 MI DS WFG DAM NR FT GAINES, GA	97	28.7	4.9	--	09/22 14:30 EDT
02397530	COOSA RIVER AT STATE LINE, AL/GA	175	25.9	7.7	7.5	09/22 15:00 EDT
02405500	KELLY CREEK NEAR VINCENT AL	--	23.8	--	--	09/22 13:00 CDT
02407514	YELLOWLEAF CREEK NEAR WESTOVER, ALA.	--	24.4	--	--	09/22 14:00 CDT
02419890	TALLAPOOSA RIVER NEAR MONT.-MONT. WATER WORKS	49	24.4	--	--	09/22 13:00 CDT
02423130	CAHABA RIVER AT TRUSSVILLE, AL.	209	23.0	5.9	--	09/22 14:00 CDT
02423160	CAHABA RIVER NEAR WHITES CHAPEL AL	248	24.1	4.7	--	09/22 13:00 CDT
02423397	LITTLE CAHABA RIVER BELOW LEEDS, AL.	383	22.2	6.2	--	09/22 13:00 CDT
02423496	CAHABA RIVER NEAR HOOVER, AL	247	25.0	4.6	--	09/22 13:00 CDT
02450250	SIPSEY FORK NEAR GRAYSON AL	--	23.0	--	--	09/22 14:00 CDT
02453500	MULBERRY FORK AT CORDOVA AL	--	19.8	--	--	09/22 14:15 CDT
02455980	TURKEY CREEK AT SEWAGE PLANT NEAR PINSON AL	302	21.0	9.0	--	09/22 13:00 CDT
02457595	FIVEMILE CREEK NEAR REPUBLIC, AL	524	24.9	9.6	--	09/22 14:00 CDT
02458148	VILLAGE CREEK AT 86TH ST NORTH AT ROEBUCK, AL.	343	22.1	--	--	09/22 13:00 CDT
02458450	VILLAGE CREEK AT AVENUE W AT ENSLEY, AL	455	23.9	11.4	--	09/22 14:00 CDT
02458502	VILLAGE CREEK NEAR PRATT CITY, ALABAMA	385	26.2	--	--	09/22 13:00 CDT
02469100	TOMBIGBEE RIVER AT PENNINGTON AL	--	29.7	7.3	--	09/22 14:00 CDT

Figure G-5 - NWIS Current Conditions Data

This information was derived from information found on the USGS NWIS page at http://waterdata.usgs.gov/nwis/qw.

What is the National Water Quality Assessment (NAWQA) program data warehouse?

The U.S. Geological Survey (USGS) began its National Water Quality Assessment (NAWQA program in 1991, systematically collecting chemical, biological, and physical water quality data from 51 study units (basins) across the nation. The data warehouse currently contains and links the following data:

- Chemical concentrations in water, bed sediment, and aquatic organism tissues for about 3,000 chemical constituents
- Site, basin, well and network characteristics with many descriptive variables
- Daily stream flow information for fixed sampling sites
- Groundwater levels for sampled wells
- 4,700 surface water sites and 9,500 wells

- 68,000 nutrient samples and 45,000 pesticide samples as well as 13,000 Volatile Organic Compound (VOC) samples
- 2,700 samples of bed sediment and aquatic organism tissues
- Biological community data for fish, aquatic macroinvertebrate, and algae community samples

Figure G-6 shows an example of one of the many available NAWQA national maps made using NAWQA tools.

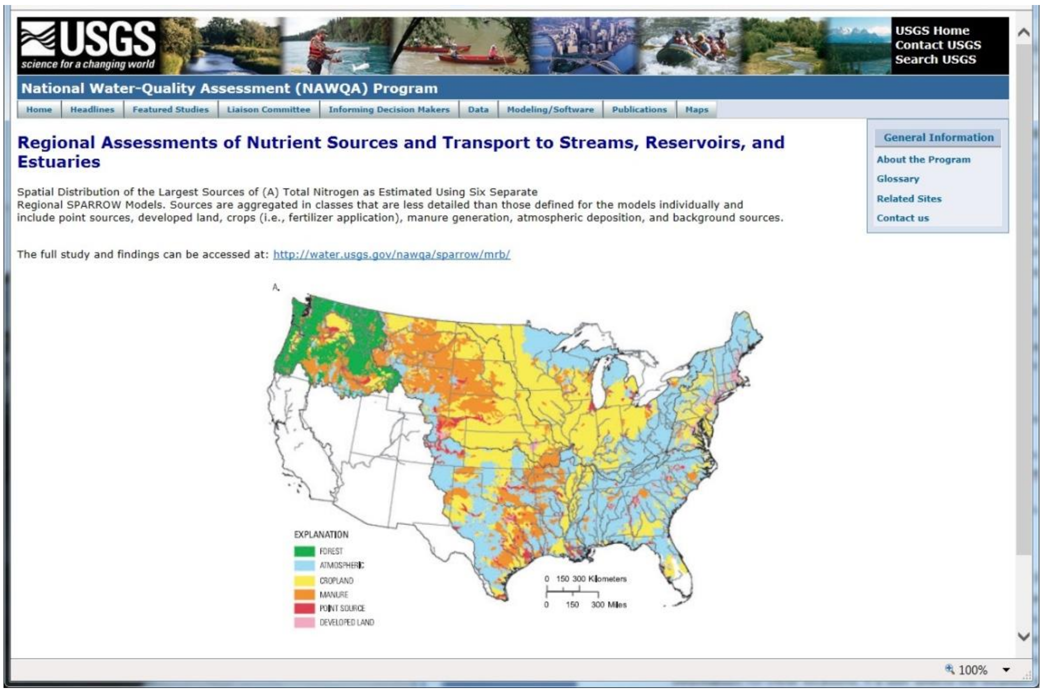

Figure G-6 - NAWQA Map of Nutrient Sources and Transport to Streams, Reservoirs, and Estuaries

This information was derived from information found on the USGS NAWQA Data Warehouse home page at http://cida.usgs.gov/nawqa_public/apex/f?p=136:1:0.

What is STORET?

The STORET (shorthand for STOrage and RETrieval) Data Warehouse is a repository for water quality, biological, and physical data and is used by state environmental agencies, U.S. Environmental Protection Agency (EPA) and other Federal agencies, universities, private citizens, and many others. STORET data available on the Internet is divided into two separate databases, according to when it was originally supplied to EPA, and to which of two STORET databases it was originally archived. The more current database is called the **STORET Data Warehouse** and the older of these two databases is called the **STORET Legacy Data Center** (LDC for short).

Figure G-7 shows an example of the STORET data warehouse and Figure G-8 shows the STORET web services.

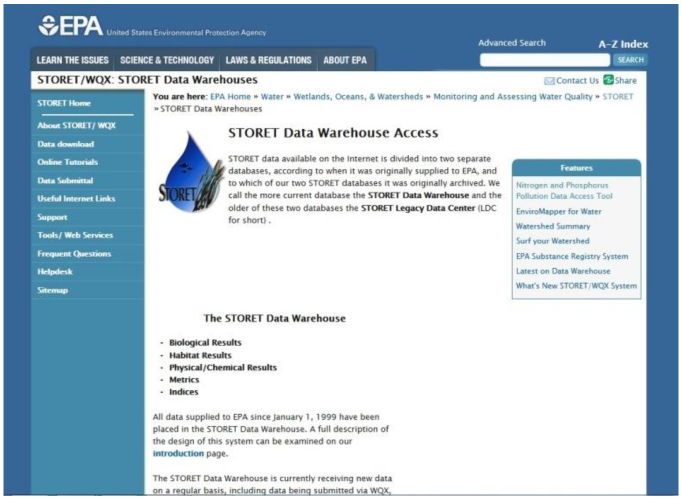

Figure G-7 - STORET Data Warehouse

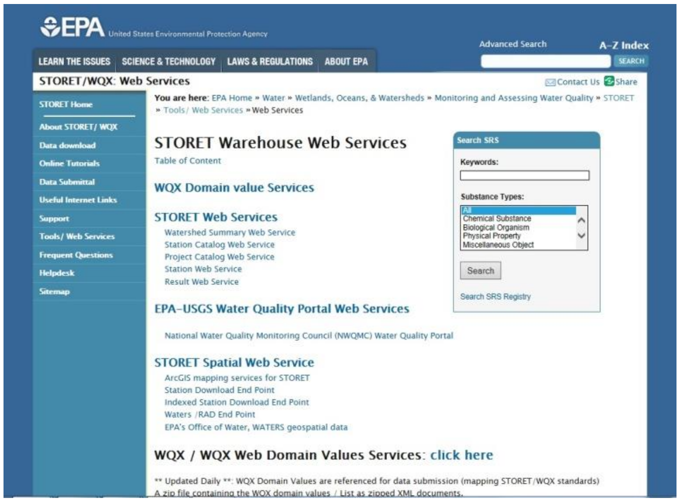

Figure G-8 - STORET Web Services

This information was derived from information found on the EPA STORET page at http://www.epa.gov/storet/.

What is StreamStats?

StreamStats is a Web-based Geographic Information System (GIS) that provides users with access to an assortment of analytical tools that are useful for water-resources planning and management, and for engineering design applications, such as the design of bridges. StreamStats allows users to easily obtain streamflow statistics, drainage-basin characteristics, and other information for user-selected sites on streams. StreamStats users can choose locations of interest from an interactive map and obtain information for these locations. If a user selects the location of a U.S. Geological Survey (USGS) data-collection station, the user will be provided with a list of previously published information for the station. If a user selects a location where no data are available (an ungaged site), StreamStats will delineate the drainage-basin boundary, measure basin characteristics and estimate streamflow statistics for the site. These estimates assume natural flow conditions at the site. StreamStats also allows users to identify stream reaches that are upstream or downstream from user-selected sites, and to identify and obtain information for locations along the streams where activities that may affect streamflow conditions are occurring. Figure G-9 below shows an example of the StreamStats gage data viewer.

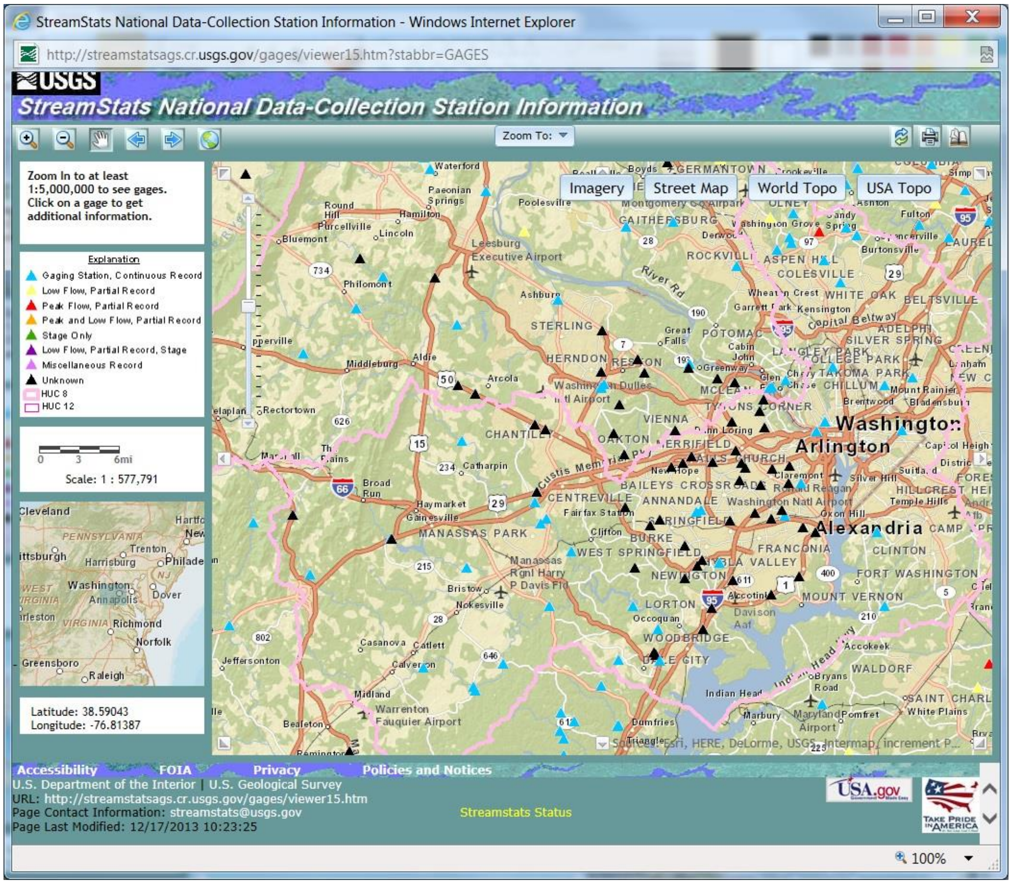

Figure G-9 - StreamStats Gage Data Viewer

This information was derived from information found on the USGS StreamStats page at http://water.usgs.gov/osw/streamstats/.

What is the Watershed Boundary Dataset (WBD)?

The WBD is a companion dataset to the NHD. It is a nationally consistent, seamless, and hierarchical dataset that delineates hydrographic units at 1:24,000 National Map Accuracy Standards in the conterminous United States, 1:25,000-scale in the Caribbean, and 1:63,360-scale in Alaska. A hydrologic unit has a single flow outlet except in coastal or lakefront areas. The WBD is complete for the lower 48 states, Alaska, Hawaii, Puerto Rico and the Virgin Islands. The WBD was developed through partnerships of 10 Federal agencies, 8 different state agencies, local organizations, universities, and Tribes in all 50 states and U.S. territories.

The WBD defines the aerial extent of surface water drainage to a point, accounting for all land and surface areas, determined solely upon science-based hydrologic principles, not favoring any administrative boundaries or special projects nor particular program or agency. The intent of defining Hydrologic Units (HU) for the WBD is to establish a base-line drainage boundary framework, accounting for all land and surface areas. Hydrologic units are given a Hydrologic Unit Code (HUC). For example, a hydrologic region has a 2-digit HUC. A HUC describes where the unit is in the country and the level of the unit.

Figure G-10 shows the largest hydrologic units for the nation in the WBD.

Figure G-10 - 2-Digit Hydrologic Units in the WBD

This information was derived from information found on the NHD Frequently Asked Questions page at http://nhd.usgs.gov/nhd_faq.html#q102.

GIS Concepts and Functions

What is area analysis?

The use of GIS tools in connection with the Watershed Boundary Dataset (WBD) to determine areas of specific inquiry or use areas already defined to perform additional analyses.

What is a mash-up?

A mash-up is a GIS map or web application that uses content from more than one source to create a single new service displayed in a single graphical interface. The main characteristics of a mash-up are combination, visualization, and aggregation. Mash-ups are generally client applications or hosted on-line. Mash-ups are made possible through the use of open Application Programming Interfaces (APIs) that let developers retrieve data easily from a site using a standard set of programming rules.

What is network analysis?

Network analysis is a method of solving network problems such as routing, rate of flow, or capacity, using network connectivity across an interconnected set of points and lines that represent possible routes from one location to another. For network datasets such as NHD, this consists of edge, junction, and turn elements and the connectivity between them. In the context of hydrography data, network analysis allows GIS users to measure distances along stream networks, identify the location along a stream network of an intersecting feature such as a dam, and determine the pathway a raindrop would take from where it falls on the ground to where it enters a lake or ocean.

What is time of travel?

Time of travel is the time required for a particle of water (or a contaminant) to move from one point to another on the network. An example might be the amount of time it takes a contaminant to move from a spill site to a water intake.

Hydrographic Data Concepts

What is bathymetry?

Bathymetry is the study of the "beds" or "floors" of water bodies, including the ocean, rivers, streams, and lakes. The term “bathymetry” originally referred to the ocean’s depth relative to sea level, although it has come to mean “submarine topography,” or the depths and shapes of underwater terrain.

In the same way that topographic maps represent the three-dimensional features (or relief) of overland terrain, bathymetric maps illustrate the land that lies underwater. Variations in sea-floor relief may be depicted by color and contour lines called depth contours or isobaths.

Figure G-11 shows an image of a bathymetric map of Kachemak Bay in Alaska.

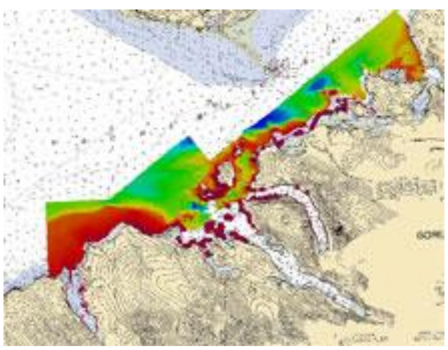

Figure G-11 - Bathymetric Map of Kachemak Bay, AK

This information was derived from information found on the National Oceanic and Atmospheric Administration (NOAA) National Ocean Service page at http://oceanservice.noaa.gov/facts/bathymetry.html.

What is a catchment?

A catchment is “an area having a common outlet for its surface runoff.” This term often used interchangeably with the terms “watershed” and “basin.” An example of a catchment is shown in Figure G-12.

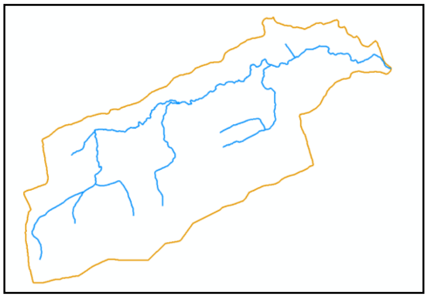

Figure G-12 - Catchment or Watershed

This information was derived from information found on the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Glossary page at http://w1.weather.gov/glossary/.

What is a conveyance?

A conveyance is any structure used to carry water from one place to another. Diversion lines are examples of conveyances. Figure G-13 shows an image of a canal conveyance.

Figure G-13 - Canal Conveyance

What is discharge?

A discharge is the rate at which water passes a given point. Discharge is expressed in a volume per time with units of L^3/T (e.g., cubic feet per second). Discharge is often used interchangeably with streamflow.

Discharge is often represented in equations as "Q." A commonly applied methodology for measuring, and estimating, the discharge of a river is based on the product of the stream's cross-sectional area and its mean velocity.

A river's discharge at a given location depends on the rainfall on the surface area of all land which drains toward the river from above that point and the inflow or outflow of groundwater to or from the area, stream modifications such as dams and irrigation diversions, as well as evaporation and evapotranspiration from the area's land and plant surfaces.

In storm hydrology, an important consideration is the stream's discharge hydrograph, a record of how the discharge varies over time after a precipitation event. The stream rises to a peak flow after each precipitation event, then falls in a slow recession. Because the peak flow also corresponds to the maximum water level reached during the event, it is of interest in flood studies. Analysis of the relationship between precipitation intensity and duration, and the response of the stream discharge is aided by the concept of the unit hydrograph which represents the response of stream discharge over time to the application of a hypothetical "unit" amount and duration of rain, for example 1 cm over the entire catchment for a period of one hour. This represents a certain volume of water (depending on the area of the catchment) which must subsequently flow out of the river. Using this method either actual historical rainfalls or hypothetical "design storms" can be modeled mathematically to confirm characteristics of historical floods, or to predict a stream's reaction to a predicted storm.

The relationship between the discharge in the stream at a given cross-section and the level of the stream is described by a rating curve. Average velocities and the cross-sectional area of the stream are measured for a given stream level. The velocity and the area give the discharge for that level. After measurements are made for several different levels, a rating table or rating curve may be developed. Once rated, the discharge in the stream may be determined by measuring the level, and determining the corresponding discharge from the rating curve. If a continuous level-recording device is located at a rated cross-section, the stream's discharge may be continuously determined.

What are diversion lines or points?

A diversion is a redirection of water from its natural course or location in a river, lake, etc. A diversion line indicates that the redirection is accomplished using a canal, pipe, or other conduit, thereby controlling the diversion and directing it to a specific location. A diversion point indicates that the redirection is not controlled in the same manner, but rather allows water to pass from one side of a barrier to another at a particular point (usually by way of a gate). Figure G-14 shows an image of a gate-controlled diversion structure.

Figure G-14 - Gate Controlled Diversion Structure

What is an elevation-profile?

An elevation-profile is a set of data representing the elevations of points along a streamline or along a cross-section associated with a stream. These are often displayed in graphical form, as shown below in Figure G-15.

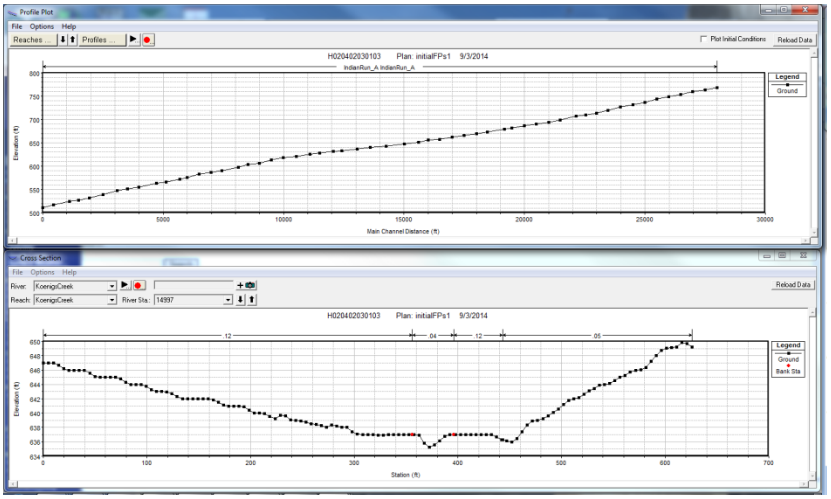

Figure G-15 - Stream Profile (top) and Cross Section Profile (bottom)

What is flood stage?

The flood stage is an established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce. The issuance of flood (or in some cases flash flood) warnings is linked to flood stage.

This information was derived from information found on the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Glossary page at http://w1.weather.gov/glossary/.

What are Hydrologic Units or HUCs?

A hydrologic unit is an area that is hydrologically connected and drains to a single location (except in coastal areas). The United States is divided and sub-divided into successively smaller hydrologic units which are classified at each level: region, subregion, basin, subbasin, watershed, and subwatershed. These hydrologic units are typically identified by their codes, or Hydrologic Unit Codes (HUCs). The classifications correspond to their shorthand equivalents of HUC2, HUC4, HUC6, HUC8, HUC10, and HUC12, signifying HUCs of 2, 4, 6, 8, 10, and 12 digits. The more digits are in the code, the more specific the location and the smaller the hydrologic unit. The codes are used to quickly identify not only the location, but also the scale of the hydrologic unit referenced. For example, HUC2-14 only has two digits, signifying that the largest division, or a region, is being referenced. The actual number (14) identifies which of the 21 hydrologic regions of the U.S. is being referenced. HUC12-020402030206 has 12 digits, therefore, it represents a subwatershed, the smallest hydrologic unit delineated in the WBD.

What is a reach code?

A reach code uniquely identifies each stream reach in the NHD. Each reach code occurs only once throughout the Nation. Once assigned, a reach code is associated with its reach permanently. If a reach is deleted, its reach code is retired.

Reach codes facilitate geocoding or linking of observations, such as a water quality sampling sites, to reaches. Reach codes form the basis of a national linear referencing system which supports linking such observations to a point along a reach, an entire reach, or groups of reaches.

This information was derived from information found on the NHD Frequently Asked Questions page at http://nhd.usgs.gov/nhd_faq.html#q119.

What is seepage?

Seepage is the slow movement of water through small cracks, pores, interstices, etc., of a material into or out of a body of surface or subsurface water. This is a common concern with levees and levee systems, which require regular inspections to maintain certification. Figure G-16 shows a graphic of seepage in and under a levee.

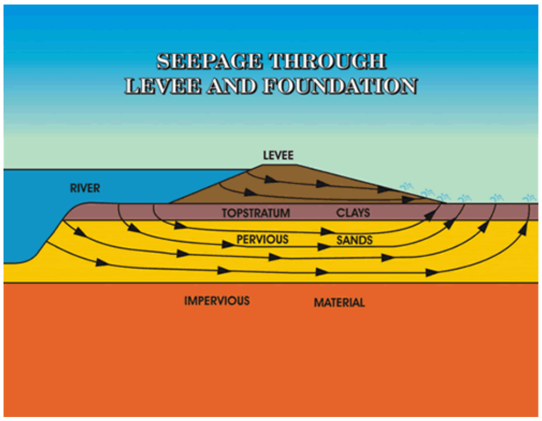

Figure G-16 - Seepage around a Levee

This information was derived from information found on the USGS Water Science Glossary of Terms page at http://water.usgs.gov/edu/dictionary.html#main.

What is a watershed?

A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place. Figure G-17 shows a graphic of a watershed.

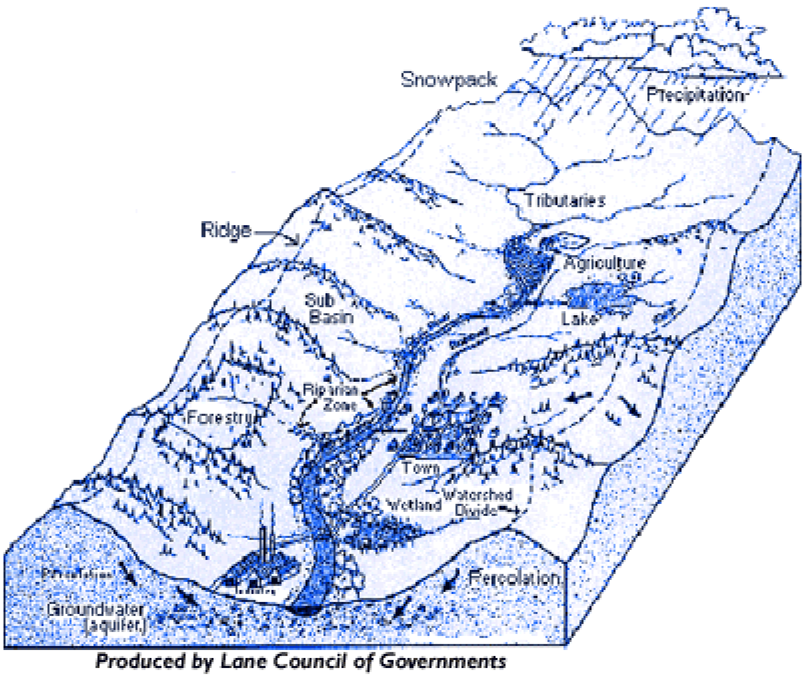

Figure G-17 - Graphic of a Watershed (provided by EPA)

Other terms that are used to describe a watershed are drainage basin, catchment, catchment area, catchment basin, drainage area, river basin, and water basin.

Watersheds are similar but not identical to hydrologic units, which are drainage areas delineated so as to nest into a multi-level hierarchical drainage system. Hydrologic units are designed to allow multiple inlets, outlets, or sinks. In a strict sense, all watersheds are hydrologic units but not all hydrologic units are watersheds.

File Formats

What is GeoJSON?

GeoJSON is a geospatial data interchange format based on JavaScript Object Notation (JSON). GeoJSON can be used for encoding a variety of geographic data structures. A GeoJSON object may represent a geometry, a feature, or a collection of features. GeoJSON supports the following geometry types: Point, LineString, Polygon, MultiPoint, MultiLineString, MultiPolygon, and GeometryCollection. Features in GeoJSON contain a geometry object and additional properties, and a feature collection represents a list of features.

This information was derived from information found on the GeoJSON page at http://geojson.org/geojson-spec.html.

What is a GeoTIFF?

A GeoTIFF is a georeferenced Tagged Image File Format (TIFF) file. The georeferencing of the image is accomplished through the use of tags within the TIFF file that embed the geographic (or cartographic) data. The geographic data are then used to position the image in the correct location and geometry on the screen of a geographic information display.

This information was derived from information found on the GeoTIFF FAQ page at http://www.remotesensing.org/geotiff/faq.html.

What is NetCDF?

NetCDF (network Common Data Form) is a set of interfaces for array-oriented data access and a freely distributed collection of data access libraries for C, Fortran, C++, Java, and other languages. The netCDF libraries support a machine-independent format for representing scientific data. Together, the interfaces, libraries, and format support the creation, access, and sharing of scientific data.

NetCDF data are:

- *Self-Describing*. A netCDF file includes information about the data it contains.
- *Portable*. A netCDF file can be accessed by computers with different ways of storing integers, characters, and floating-point numbers.
- *Scalable*. A small subset of a large dataset may be accessed efficiently.
- *Appendable*. Data may be appended to a properly structured netCDF file without copying the dataset or redefining its structure.
- *Sharable*. One writer and multiple readers may simultaneously access the same netCDF file.
- *Archivable*. Access to all earlier forms of netCDF data will be supported by current and future versions of the software.

This information was derived from information found on the UniData NetCDF page at http://www.unidata.ucar.edu/software/netcdf/.

What is NITFS?

The National Imagery Transmission Format Standard (NITFS) is the standard for formatting digital imagery and imagery-related products and exchanging them among members of the Intelligence Community (IC), the Department of Defense (DOD), and other departments and agencies of the United States Government as governed by Memoranda of Agreement (MOA) with those departments and agencies.

The initial NITFS purpose was to standardize the imagery format and associated data being transmitted from/to secondary imagery dissemination systems (SIDS). Due to the growing NITFS acceptance, it is now being applied to imagery dissemination systems in general, not SIDS alone. The purpose of NITFS is to transmit a file composed of an image accompanied by subimages, symbols, labels, text, and other information that relate to the image. One of the main features of the NITFS is that it allows several items of each data type to be included in one file, yet any data types may be omitted. The NITF file incorporates the Computer Graphics Metafile (CGM) standard for graphics and accommodates user-selectable compression for images. The file is submitted to the Message Transfer Facility (MXF), which allows it to be transferred using any of a set of user-selectable protocols and media. The output is a message which, by conforming to the standards and their use, is compliant with the NITFS.

The evolution of computer microprocessor technology in the early 1980s made it feasible to build numbers of systems that could interchange annotated digital imagery. By 1984, the need for a common data format became apparent, and a project to develop such a format was initiated. The original goal was to develop a co-standard that could be added to all of the existing systems and incorporated into new systems during the acquisition process.

This information was derived from information found on the Global Security page at http://www.globalsecurity.org/intell/systems/nitfs.htm.

What is a TIN?

A *Triangulated Irregular Network (TIN)* is a set of adjacent, non-overlapping triangles computed from mass points and/or breaklines. Figure G-19 shows how the TIN was generated from the mass points and breaklines in Figure G-18. The TIN's vector data structure is based on irregularly-spaced point, line and polygon data interpreted as mass points and breaklines and stores the topological relationship between triangles and their adjacent neighbors.

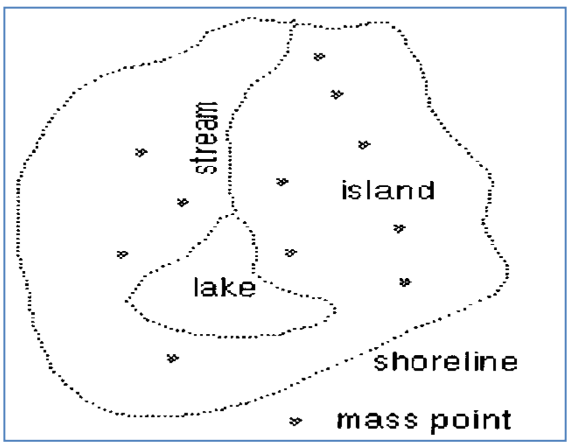

Figure G-18 - Mass Points and Breaklines

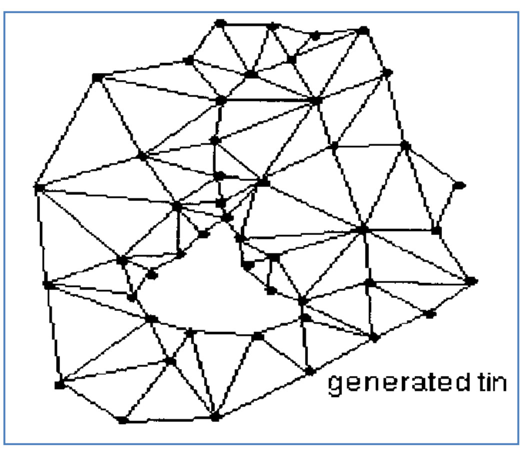

Figure G-19 - TIN Produced from these Mass Points and Breaklines

What is WaterML?

Water Markup Language (WaterML) is an XML schema defining the elements that are designed in support of the transfer of water data between a server and a client.

Beginning in 2005, the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI), as part of its Hydrologic Information System (HIS) project, implemented a variety of web services providing access to large repositories of hydrologic observation data, including the USGS National Water Information System (NWIS), and the US Environmental Protection Agency's STORET (Storage and Retrieval) database of water quality information. The services provide access to station and variable metadata, and observations data stored at these sites. As these services were without any formal coordination, their inputs and outputs were different across data sources. Linking together services developed separately in an ad hoc manner does not scale well. As the number and heterogeneity of data streams to be integrated in CUAHSI's hydrologic data access system increased, it would become more and more difficult to develop and maintain a growing set of client applications programmed against the different signatures and keep track of data and metadata semantics of different sources. As a result, WaterML was developed to provide a systematic way to access water information from point observation sites.

This information was derived from information found on the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) Hydrologic Information System page at http://his.cuahsi.org/wofws.html#waterml.