USGS National Hydrography Dataset Newsletter
Vol. 3, No. 3, January 2004
by Jeff Simley, USGS

Separate Databases

Part of the strategy to move the National Hydrography Dataset to Geodatabase had involved the combination of the medium and high-resolution databases into a single multi-resolution database. Under this plan, there would only be one database with the highest resolution data made available for each subbasin. That plan has now been abandoned as a result of input from some of our major clients. When the NHD in Geodatabase (NHDGeo) becomes available, there will actually be three separate resolutions of data: (1) the medium-resolution (1:100,000-scale) nation-wide except Alaska coverage, (2) the high-resolution (1:24,000-scale, 1:63,360-scale in Alaska) evolving coverage of the nation, and (3) the local-resolution (1:5,000-scale) covering parts of Vermont and later other parts of the country. An advantage of the original plan is that it would have included the linking of the medium-resolution and high-resolution hydrologic networks, giving users more options in applications where multi-resolution data must be used. The revised plan, however, will greatly help those who have made large investments in the medium-resolution NHD by preserving this data intact.

The Geodatabase Conversion

The conversion of the NHD to Geodatabase was started the last week of January and will take about a month to complete. Simultaneously, the web access capability is being programmed for completion at about the same time. Public availability is still being advertised as April 1 to assure time for testing.

Feature Classes

The NHDGeo datasets distributed to users will contain five feature classes: (1) NHDFlowline, (2) NHDWaterbody, (3) NHDPoint, (4) NHDLine, and (5) NHDArea feature classes. Additionally, a user will find a sixth feature class, the (6) Hydrography_net_Junctions, which is created to support the flow network each time a distribution dataset is created. The heart of the NHDGeo model is the NHDFlowline, which is the spatial and attribute framework for the network. The NHDWaterbody establishes the "reach" for the polygons, while the NHDPoint, NHDLine, and NHDArea provide hydrography related features such as a well, flume, or wash. The central repository for the NHDGeo will duplicate the five stored feature classes for each of the three resolutions: medium-resolution, high-resolution, and local-resolution.

Using the NHD at the USGS

Experts in water resources at the USGS recently got together to discuss the use of the NHD in science applications. Here is a synopsis of the first half of the discussion. Next month we'll review the second half of the discussion and look more deeply into some of the issues affecting producers and users.
The National Map – This is the "topographic map of the 21st Century" with a goal to greatly advance the Nation's state of geographic knowledge through a network of partnerships providing current and detailed geographic information. The NHD will serve as the hydrography theme for this "virtual" map. The water resource experts pointed out the need for *The National Map* as a delivery system, which will put data into the models used in scientific analysis, and not simply a map viewing system.
Geodatabase – A few of the highlights of NHDGeo were demonstrated. Of note is that NHDGeo will collapse the Reach and Drain features into the single NHD Flowline feature class, and the Waterbody Reach and Waterbody tables into the single NHD Waterbody feature class, simplifying the model to the relief of many. Scientists were concerned that the NHD is again restricted to a vendor specific format.

This will be resolved in the future with the XML distribution format, new FGDS standards, and hopefully, vendor input functions. This led to a discussion pointing out that the NHDGeo and ArcHydro models have gone through a coordinated development allowing the NHDGeo to be used as a source for ArcHydro. Also noted was that NHDGeo can be extracted through a variety of polygons, not just subbasins. There will be a limit on the number of Flowlines per Personal Geodatabase extract. A discussion also noted the critical need for vertical integration between the NHD and National Elevation Data (NED) for hydrologic modeling. Experience shows that the integration is very good for high-resolution NHD – 10m NED, but problems can develop in highly demanding applications. Another topic of note was the need for spatial thinning and generalization for more broad regional modeling applications.

Using the NHD – A briefing demonstrated the simplicity in obtaining the NHD, importing it to a GIS, importing and addressing hydrologic data, and using the NHD navigation to create a map of flow from streamgages. Such tasks can be conducted with only an intermediate knowledge of a GIS.

NHD Hydrology Applications – Hydrologists need the NHD for three fundamental reasons: (1) Basic mapping, (2) Flow network modeling, consisting of water quality mapping, time of travel, and access to other NHD-linked data, and (3) Demands of clients for the common NHD model. Some hydrology applications may have been slow to adopt the NHD due to model complexity and quality concerns, as well as limited demand for such a dataset in traditional surface water hydrology. This situation is rapidly changing with new models and quality improvements, along with new demands from hydrologists for spatially oriented modeling, which the NHD can address. Other issues important to hydrologists are (1) the need to integrate streamgages to the NHD, (2) problems of switching from 1:100,000-scale content to 1:24,000-scale content, (3) perennial and intermittent stream classifications, (4) the importance of Digital Raster Graphics as a GIS reference theme, (5) the need for a stable dataset without continuous new versions, (6) the need for ArcIMS map services, (7) consistent stream density across the landscape, (8) accurate names, (9) properly functioning flow, and (10) the need for high-resolution data. An interesting example of data problems was noted: when miles of steams with impaired waterways are calculated from the medium-resolution dataset, a result can be summed and presented to legislatures. But when the mileage of the same impaired waterways is again calculated using the high-resolution NHD, a much larger number results due to more detailed meandering, much to the dismay of legislatures who suddenly have a larger perceived problem on their hands.

Streamstats – This is an interactive web-based capability to compute basin characteristics for a user-defined basin on a state-by-state basis. It estimates streamflow at the user-defined location using statistically based techniques. It runs off of ArcHydro, taking advantage of raster and vector processing for building basin delineation and networks. Streamstats extends the ArcHydro utility by adding the web interface, using a regression equation solver and the basin characteristics computation. The use of Digital Elevation Models is necessary, which can be drainage-enforced to improve results. Although Streamstats can be run without the NHD, using the NHD creates more accurate flow paths in the model. NHD reach addressing can also be applied to add hydrologic addresses to the output tables. A goal of this development and ArcHydro is to forecast flooding when incorporating the appropriate data sources.

Karst Hydrography – Traditionally there has been a distinction between surface water and ground water, and because the NHD has been a surface water system, ground water has not been an issue. But in some parts of the country, such as the karst topography of Kentucky, the two interact rather blatantly. Lessons learned in surface water networks can be applied to flow networks underground, and can help create a more rigorous integrated network. An effort is now underway to model this by combining the NHD surface network, monitoring points, and underground flowlines using an ArcHydro model.

WATERS in Action – The Environmental Protection Agency has made the NHD the interconnecting hub of several of its programs. WATERS – Watershed Assessment, Tracking and Environmental ResultS – at EPA will make data from these programs accessible. They include (1) Impaired Waters, (2) Water Quality Standards, (3) Assessed Waters, (4) Beach Closures, (5) Sewage No Discharge Zones, (6) Nutrient Criteria, and Fish Consumption Advisories. In the future, additions will be made for (1) Water Quality Stations, (2) National Estuary, (3) Permitted Discharges, and others. WATERS will be used for

government performance measurements, reports to congress, and regulatory development. Applications will include (1) Ask WATERS Q&A; (2) EnviroMapper map display; (3) EnviroMapper 3.0 which can generate a report; (4) WebRIT for reach indexing; (5) web services such as upstream/downstream program data, water measurement statistics, mapping and water program identification; as well as (5) training and outreach.

Extending the Capability of the 100K NHD – The medium-resolution NHD is heavily used by customers who are placing new demands on the data. To extend its utility, a number of enhancements are being made in the form of value added attributes. These include (1) stream order, (2) waterbody identifier, (3) waterbody type, (4) upstream miles, (5) distance to sink, (6) drain stream level, (7) link-node transversal, (8) hydrologic sequence, (9) terminal ID's, (10) flow divergence flags, (11) level-path identifiers, (12) source and sink flags, and (13) generalization values. Other improvements are being made to (1) assure correct flow, (2) improve names, and (3) simplify the model by collapsing reaches onto drains. Another initiative is underway to build drain catchment polygons. This will be done using Thiessen polygons built around each reach. Although there are more rigorous methods using elevation data, Thiessen polygons are a cost effective way of meeting short-term needs. A Thiessen polygon is a synthetic polygon, calculated so the perimeter is equidistant from the adjacent reaches. Also in the works is a time-of-travel dataset by calculating the flow and volume for each reach/drain.

High Resolution Status Web Site

As part of the continuing evolution of the NHD, we have a new status site located on the NHD web page http://nhd.usgs.gov. Click on Data and then NHD Status Map, or just click on: http://webhosts.cr.usgs.gov/nhdstatus/viewer.htm. You can also still use http://statgraph.cr.usgs.gov.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Thanks to Paul Wiese, Bob Pierce, Mark Demulder, Keven Roth, Al Rea, Bill Kaiser, Pete Steeves, Tommy Dewald, and Cindy McKay.

Jeff Simley, USGS, assumes full responsibility for the content of this newsletter.