

# Status of the High-Resolution National Hydrography Dataset

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**Abstract** - The National Hydrography Dataset (NHD) provides the Nation with a GIS-ready coverage of networked surface water. A large consortium of Federal, State, and local agencies is producing the high-resolution NHD in several dozen separate projects. The U.S. Geological Survey ensures the effectiveness of partnerships and provides the synchronization of projects. A brief program review highlights the objectives of the partners and the status of the major projects, grouped by past, current, and future work. Such a review makes it possible to reduce a complex production program into an organized and systematic plan for national coverage.

**Introduction** - The National Hydrography Dataset (NHD) began as a cooperative effort between the U.S. Geological Survey (USGS) and the Environmental Protection Agency (EPA) to develop a complete, networked hydrography dataset for the United States at 1:100,000-scale content. Having completed this milestone in 2001, and with over 3 million EPA water quality events now linked to the NHD, efforts are now underway by the USGS to develop a 1:24,000-scale database for the entire United States, an effort currently focused on covering U.S. Forest Service lands in addition to several specific States. The NHD is designed to allow continuous navigation paths throughout the entire hydrologic network and to provide an addressing scheme to link attributes to hydrography. The NHD also provides an easy-to-use toolkit of hydrography-specific GIS functions and is designed for continuous maintenance by local data stewards. The NHD has become the standard for hydrography coverage in most Federal agencies and in over 40 States. The data are easily accessible from the Web and are ready to use in the ArcView environment. The NHD is now being converted to Geodatabase for use in ArcGIS.

**The High-Resolution NHD** – Many users are interested in more detail and accuracy than is provided by the medium resolution 1:100,000-scale product. To meet these needs, a program is underway to increase the content of the NHD to the features found on 1:24,000-scale USGS topographic maps. The digital hydrography information on these maps is most commonly provided by the USGS digital line graph – hydrography files, or the similar, but less expensive, minimally attributed, tagged vector – hydrography files. In many cases these data are revised from digital orthoimagery before the NHD is produced, such as for Alaska, Utah, Nebraska, and Kentucky. Where the U.S. Forest Service is a partner, its cartographic feature files are used as the data source. These data are then conflated with the medium-resolution NHD, assigning the reach structure already established in the 1:100,000-scale data to the 1:24,000-scale NHD. This allows users such as the EPA to transfer their investment in creating reach addresses for their events to the high-resolution NHD.

Partnerships – Just as the production of the medium-resolution NHD was too large for a single agency and required a partnership such as that between the USGS and the EPA, the high-resolution NHD also requires production partnerships in order to be practical. The program also needed a catalyst to turn the production of the high-resolution NHD from a scattered and isolated set of local initiatives into a nationwide program. This catalyst became the U.S. Forest Service, which holds land in more than 800 of 2,200 subbasins distributed throughout the country. Because the Forest Service effort provided a large amount of seed money to the program, which was then matched by the USGS, a fledgling idea was immediately transformed into the largest mapping program at the USGS. This development in turn provided local interests with the incentive to accelerate their programs and fill in the gaps in the coverage to create large contiguous blocks that, with time, will cover the Nation.

The USGS provided the coordination, leadership, and partnership funding to create a solid and well-managed program among a consortium of agencies now banded together into a national effort. The Forest Service also cultivated local initiatives and has been essential in providing sound management to ensure that its partnership successes have been linked to the overall program.

The Role of the States – The decision by many States to produce and use the NHD as their standardized hydrography coverage provided a second initiative to boost the program. State programs, such as those in Kentucky, Georgia, Utah, Missouri, Texas, and Delaware, provided regional anchors around the country to help firmly establish the NHD. These State programs used state funding that was then matched by USGS and Forest Service funds. Several States have recently joined this initial list, including Connecticut, Rhode Island, and Florida. Other States launched longer-term programs with statewide coverage as a goal but funded under short-term initiatives. These include Maine, New Hampshire, Vermont, New York, North Carolina, West Virginia, Ohio, Indiana, Michigan, Minnesota, Nebraska, and Kansas.

Federal Initiatives – Many States will benefit from the Forest Service program even without significant State programs of their own for high-resolution data. These include Alabama, Mississippi, Louisiana, Arkansas, Montana, Idaho, New Mexico, Wyoming, and Colorado. California greatly benefits from the Forest Service but also has a number of in-State efforts. Wisconsin also benefits from the Forest Service program but is unique in that the State has not yet joined the NHD program; instead it uses a local hydrography model. A USGS program to support other Department of the Interior agencies has also been a big help to several States. These include Pennsylvania, Virginia, Maryland, Tennessee, New Mexico, and Hawaii. Additional initiatives are helping provide coverage for Illinois and Oklahoma. Coverage of Alaska is being produced entirely from USGS funds, most of which came from a special initiative to support the Federal Geographic Data Committee. Another effort sponsored by the Forest Service is the conversion of data hosted by Washington and Oregon that will lead to the

completion of these States.

**Gaps in Coverage** – States without clear NHD plans in place but that will soon benefit from Federal programs include Nevada and Arizona. States without future plans include North Dakota, South Dakota, Iowa, Massachusetts, and South Carolina. States with significant coverage from Federal programs but with no completion plan include Nevada, Arizona, Colorado, Montana, Oklahoma, Wisconsin, Illinois, Arkansas, Louisiana, Mississippi, and Alabama.

**Completing the Coverage** – Several approaches may be used where plans are not in place to complete coverage. One is to simply wait for the USGS to have funding available in the outyears when its initial priorities have been met. This approach runs the risk of the always-uncertain budget process, in which nothing can be guaranteed in the years to come. Another approach is to hope that the momentum of NHD production and applications will entice other agencies to fund work in the future. This is the case with the Bureau of Land Management, which has significant land holdings but has not yet made the NHD a priority for funding. Yet another prospect is the possibility that the scattering of void areas will annoy the user community to the point where a special funding initiative will be demanded to complete coverage of the Nation. Other possibilities may include the role of private industry to create the remaining NHD for a variety of motives, making it proprietary and available on a fee basis. Many State plans for NHD production are moving slowly and will create some gaps in coverage in the next few years. Filling those gaps could be accelerated if additional funding were provided as a result of the success of the initial data. This is particularly true in Maine, Ohio, North Carolina, Michigan, Nebraska, and Kansas.

**Future U.S. Forest Service Plans** - Following completion of the initial Forest Service program, a large number of subbasins remain to be produced. It is hoped that the Forest Service will provide a second major initiative and that will then be matched by USGS support. This remains under study. However, in the meantime, individual Regions of the Forest Service are providing funds to extend the initial agreement, covering significant parts of the north coast of California and much of Mississippi.

**The National Park Service** - The National Park Service and the USGS have signed an agreement to produce the NHD for Park Service lands. Approximately 20 subbasins worth of work will likely be performed in the August 2003 to June 2004 timeframe. This recent development will reshape the national picture and will probably serve as an incentive for other agencies to partner on new work. Coverage that is now out of reach for some agencies may become more realistic when specific Park Service plans are known. This is expected to influence Forest Service and Bureau of Land Management plans.

The Final Subbasin – A Gantt chart of NHD production weighted evenly over time and based on the volume of production up to now would indicate that national coverage could be achieved by the mid-part of fiscal year 2006. Some slowdown at the end of the program as funding becomes more of a challenge might extend the program to early fiscal year 2007.

Stewardship – The stewardship of the NHD has long been a design of the program. The stewardship includes (1) correcting errors, (2) coding intentional data gaps, such as canal flow, (3) improving positional accuracy, (4) doing revision that is based on hydrographic change, (5) adding density, and (6) adding value to the basic NHD, such as stream order. Stewardship will most likely be driven by the States, with specific agencies identified as the lead. This first tier of stewardship will then be supplemented by Federal agencies, regional agencies, and local municipalities. The USGS will serve as a third tier steward to fill the balance. Kentucky and Utah appear to be the first groups to launch stewardship programs. It is likely that Maine, New Hampshire, New York, Georgia, Ohio, Michigan, Minnesota, Missouri, Texas, and Alaska are likely to soon follow. The USGS is establishing a national network of Mapping Partnership Offices in the States that will help facilitate the stewardship of the NHD and other data layers.

Conclusion – The NHD is perhaps the first product designed specifically for GIS analysis (on a nationwide bases) as opposed to human map interpretation. Such analysis was initiated by the EPA, but with the availability of the high-resolution NHD, has spread throughout the GIS community. The USGS is working hard to manage and guide a national strategy to achieve nation-wide coverage to benefit all users. This is being done in partnership with an unprecedented number of agencies and has created the first true national mapping partnership since the production of the 7.5-minute series topographic map.

Acknowledgments – Thanks to Keven Roth, Mark Gewinner, Gladys Conaway, Ed Kelty, Ellen Finelli, Paul Kimsey, Barry Henrikson, and Bill Kaiser.

Reference – <http://rockys9.cr.usgs.gov/nhdstatus/viewer.htm>

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