

# NHD Stewardship in Alaska: A Regionalized Approach

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## Summary

A regionalized approach is being established for the collaborative stewardship of the National Hydrography Dataset (NHD) by state, federal, and university partners in Alaska. NHD 'staging geodatabases,' built on a simplified hydrography data model and tailored to meet local business requirements, have been deployed for southeast and south-central Alaska. The geodatabases reside within an Enterprise ArcSDE instance housed on University of Alaska (UA) servers. Agency partners collaboratively edit and update fisheries information along with stream, shoreline, glacier, and other features by utilizing SDE replication to synchronize changes between agency-hosted child geodatabases and the parent at UA. A map service hosted by UA allows partner agencies to coordinate on areas checked-out by agency editors; thus limiting reconciliation issues. UA personnel, as a service to agency partners, updates the NHD from features contained within the staging geodatabases using a combination of Esri-developed models and USGS NHD tools.

## Introduction

The Alaska Hydrography Database project (AK Hydro) was initiated in southeast Alaska in 2010 to streamline hydrographic mapping efforts amongst agencies while simplifying the NHD update process for local resource and GIS specialists. Project partners utilize the AK Hydro editing process which make use of what can be thought of as NHD 'staging geodatabases' to collaboratively edit, manage, and maintain their hydrography information, which is ultimately uplifted into NHD. AK Hydro makes editing hydrography data accessible to GIS users in Alaska who may not have the resources to learn and/or maintain the skills that are necessary to be proficient in the use of NHD editing tools. AK Hydro improves the coordination between agencies on hydrography, hydrology, and natural resource management issues in addition to geospatial editing activities.

The Alaska Hydrography Technical Working Group<sup>3</sup> (AHTWG), which includes representatives from Alaska Department of Fish and Game (ADF&G), Alaska Department of Environmental Conservation (DEC), Alaska Department of Natural Resources (AK DNR), Kenai Watershed Forum (KWF), U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), Bureau of Land Management (BLM), National Oceanic and Atmospheric Administration (NOAA), National Park Service (NPS), U.S. Forest Service (USFS), and the University of Alaska, has recommended the statewide adoption of the AK Hydro system for the maintenance and stewardship of Alaska's hydrography information. The recommendation is

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<sup>3</sup> The Alaska Hydrography Technical Working Group (AHTWG) is chartered by the Alaska Climate Change Executive Roundtable (ACCER) and works under the direction of ACCER.

based on AK Hydro's ability to address long standing data management issues in Alaska where each agency had been independently mapping and maintaining its own set of hydrography data that were incompatible and, at times, inconsistent with one another.

The University of Alaska plays a key role in assisting state and federal agencies by managing the shared hydrography databases and incoming edit transactions. The University of Alaska also provides NHD editing and updating services to partner agencies. The partnership with the University of Alaska allows, for example, the Forest Service to meet agency goals, including using NHD in *Natural Resource Manager*<sup>4</sup> applications and in national map products such as *FSTopo*<sup>5</sup>, while meeting local business requirements such as modeling anadromous fish habitat and supplying intertidal stream information.

As updating the NHD requires a specific technical skill-set practiced on a regular basis (especially via the conflation process), AK Hydro streamlines the task by centralizing NHD maintenance services at the University of Alaska. In doing so, the partnering agencies no longer have to attempt running complex NHD conflation processes on an irregular basis, freeing up resources for other work activities.

AK Hydro consists of a series of collaboratively designed, shared, and maintained regional GIS databases containing hydrography data residing within the University of Alaska system. This regionalized approach allows for local flexibility as it allows for the design of workflow processes and database schemas that satisfy local business requirements. There are six AK Hydro regions based on ADF&G's Anadromous Waters Catalog zones (Figure 1). Two of these regions, which cover southeast and south-central Alaska, are in operation and provide a rich suite of bio-geographical information including:

- Aquatic organism and habitat data including fish observations collected during field sampling, locations of potential barriers to fish passage (i.e., bedrock waterfalls), locations of engineered fish passes, and locations of suitable anadromous fish habitat;
- Physical features such as rivers, streams, glaciers, lakes, dams, intertidal areas, estuaries, salt chucks, as well as minimum low-tide, maximum high-tide, and mean-high-water shorelines;
- Stream geomorphology information including fluvial process groups, stream channel gradient, stream pattern, stream bank incision, and stream containment;
- Regulatory fishing information integrated from the state's Anadromous Waters Catalog;
- Stream networks; which allow upstream or downstream tracing from dams, gauges, fish barriers, field observations and contaminants.

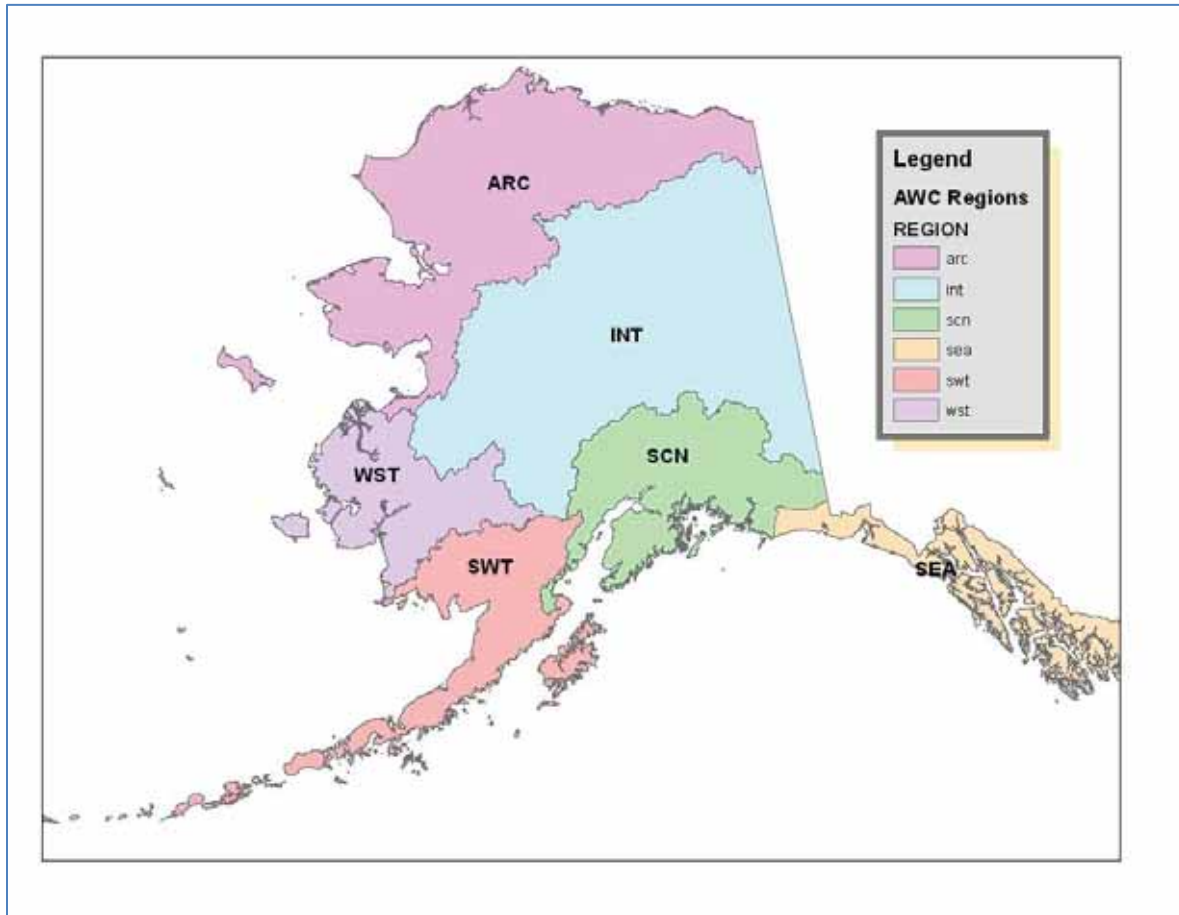
By working together and sharing knowledge, agencies in Alaska are better able to manage the public's resources and provide richer information for scientific investigation. The University of Alaska is providing leadership and the delivery of services to partnering agencies as well as availing educational opportunities to its students so they can work on real world issues.

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<sup>4</sup> Natural Resource Manager (NRM) has project management and development responsibility for many Forest Service national applications used to manage the agency's natural and physical resource data.

<sup>5</sup> FSTopo is a database-driven web application that enables the creation and downloading of large scale topographic maps.

Figure 1. ADF&G's Anadromous Waters Catalog regions. The spatial extents of the Southeast and South Central Alaska Collaborative Hydrography GIS databases are based on the SEA and SCN regions respectively.



## Methods

AK Hydro is built on Enterprise ArcGIS Server instances located across the University of Alaska Southeast (Juneau), the University of Alaska Anchorage, and the University of Alaska Fairbanks campuses. Two-way disconnected SDE Replication is utilized to distribute editing transactions via child replicas across agency firewalls (Figure 2). Agency editors use local check out/in replicas to edit specific spatial extents, such as a project area or a subwatershed. The coordination of edits between editors and/or agencies is accomplished by utilizing map services which depict areas that are currently checked out for editing, as well as those areas which have recently been edited and checked back in. The map service also provides users with information about who is editing or has recently edited an area, the timeframe for a particular check out transaction, and an indication of the types of edits undertaken in a particular area.

Incoming edits are synchronized across firewalls via disconnected SDE Replication to Quality Assurance (QA) versions of the authoritative SDE Default Version residing at UA. UA Technical Specialists, in turn, check for conflicts between agency transactions and post the changes to the Default Version. Once agencies have completed their edits in an area, the Technical Specialists at UA run the data through a QA/QC process using the Data Reviewer extension to ensure that AK Hydro geometries conform to NHD topologic criteria. The Technical Specialists then run a custom ETL (Extract, Transform & Load) model

built by Esri to convert AK Hydro data into a NHD-ready format that can be used with the NHD Toolset. The final part of the stewardship process is running the NHD Toolset, including the NHD GeoEdit and Conflation tools, which moves the edits into the NHD. The NHD Toolset, particularly the Conflation process which is required to densify Alaska's legacy course-scale stream networks using newer and finer scale hydrography data, involves a high learning curve and is most efficiently accomplished by individuals who are highly trained and perform the process regularly. Figure 3 depicts an example of the schema transformation from AK Hydro (SEA Region) to NHD.

AK Hydro data is made available through an Esri geoportals hosted by the [University of Alaska Southeast \(UAS\) GIS Library](#). The UAS GIS Library provides an array of data and data services to students, public, and agency partners in southeast Alaska and is funded and directed through a partnership consisting of eleven federal and state entities. The UAS GIS Library relies on Esri solutions and an Apache Tomcat web server to help fulfill its mission of promoting the use of regional geospatial data and applications to further research and improve management of public resources in Southeast Alaska.

Figure 2. Schematic depicting the AK Hydro and NHD update and data dissemination process.

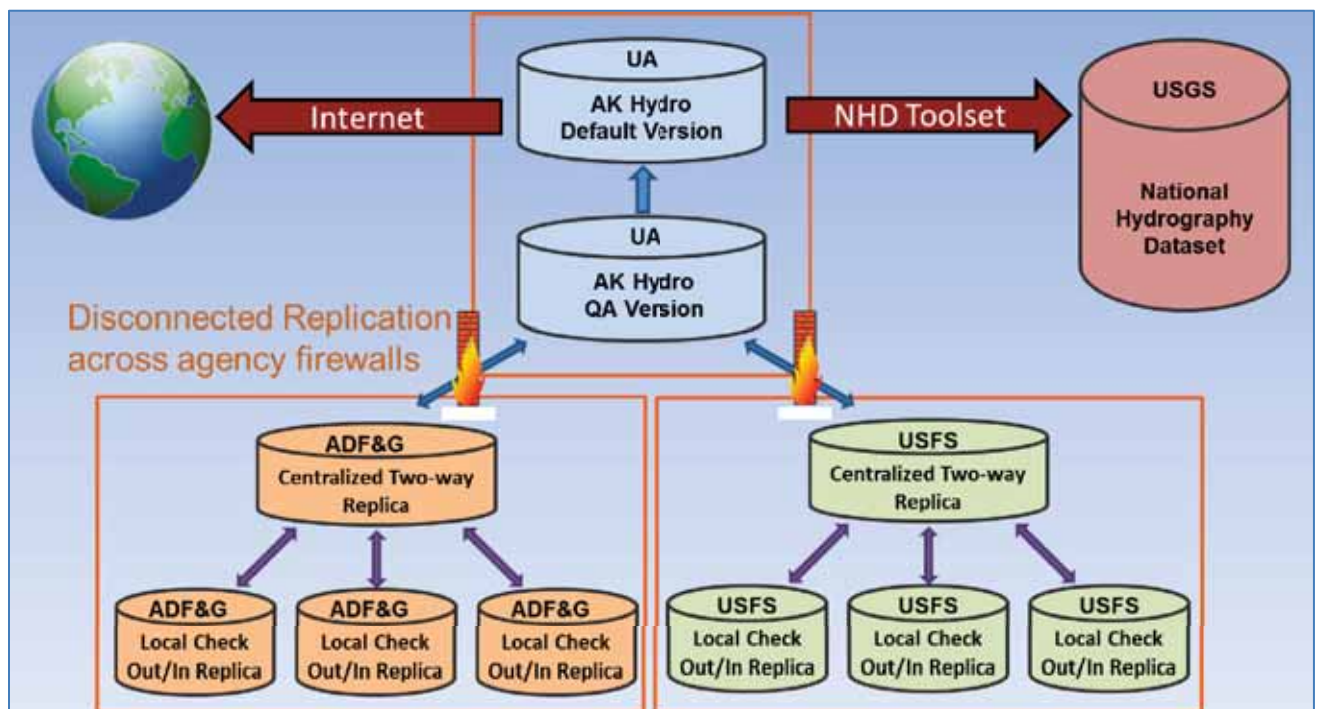
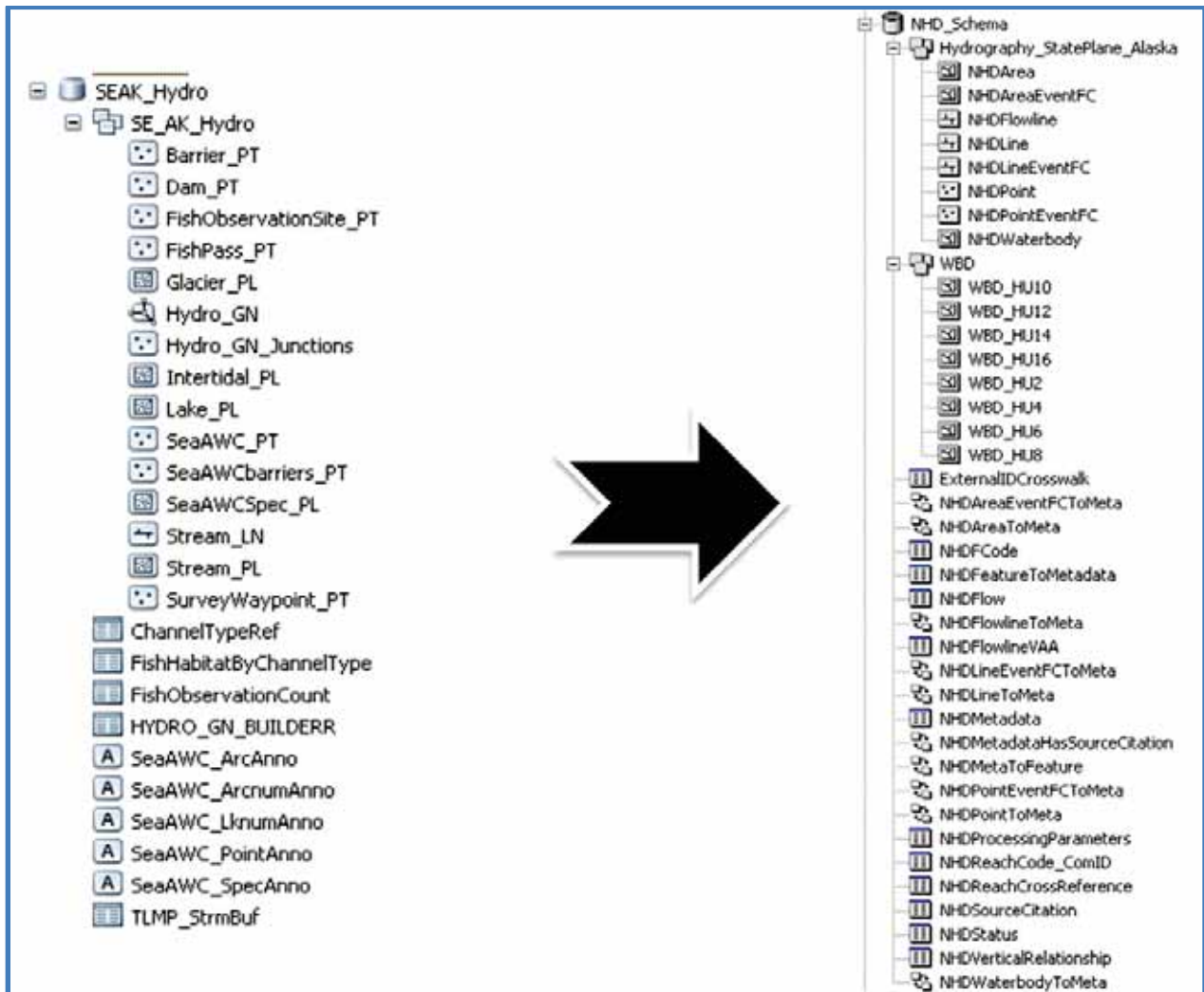


Figure 3. Schematic depicting the schema transformation from AK Hydro to NHD.



## Conclusion

At the time of this writing, the southeast and south-central regional geodatabases have been stood up on UA servers where AK Hydro and NHD stewardship processes are in full operation. Through the collaboration afforded by AK Hydro, fifteen years' of hydrography updates have been reconciled between the USFS and ADF&G and those changes are now finding their way into the NHD. In the past year, five sub basins have been run through the NHD conflation process and an additional two are in the queue. Active AK Hydro partners currently include the USFS, ADF&G, AK DEC, USFS and KWF; but more are coming on board including NPS, AK DNR, and USFWS. Since AK Hydro has been recommended by the AHTWG for adoption as the statewide process for NHD stewardship, plans are now underway to extend AK Hydro functionality to Alaska's four remaining regions.

AK Hydro is funded by the University of Alaska and its partners. Several positions and a network of servers are currently being funded in part or exclusively to support the project. It is anticipated that funding for an AK Hydro Coordinator position will soon be secured and the position will be advertised later in 2013. The coordinator will be expected to broadly engage stakeholders and end users, and pursue and develop multi partner, long-term funding strategies. The AHTWG will provide governance and oversight of AK Hydro and facilitate a NHD Stewardship Memorandum of Understanding agreement between USGS and the state of Alaska.

AK Hydro received a [Special Achievement in GIS award](#) at the 2011 Esri International User Conference. The award is given annually to recognize outstanding work with GIS technology and the AK Hydro project (then termed the *Southeast Alaska Hydrography Project*, or *SEAK Hydro*) stood out from more than 100,000 others. AK Hydro serves as an exemplar for collaborative data management which can be applied to other business areas including transportation, recreation, and terrestrial ecology. Sharing data is important, but real value occurs when organizations work together. AK Hydro has made this synergism possible in Alaska.

For more information on AK Hydro please visit the UAS Southeast Alaska GIS Library website <http://seakgis.alaska.edu/> or contact Erik Johnson at [ejohnson02@fs.fed.us](mailto:ejohnson02@fs.fed.us)