1st National Stream Morphology Database Workshop

April 27-28, 2011

Organized and led by Matt Collins (NOAA), and Faith Fitzpatrick, Marie Peppler, and John R. Gray (USGS)

Summary Report to the Subcommittee on Sedimentation

INTRODUCTION

The subject workshop, sponsored by Subcommittee on Sedimentation (SOS), Advisory Council on Water Information and hosted by the U.S. Geological Survey Wisconsin Water Science Center in Middleton, Wisconsin, took place on April 27-28, 2011. A total of 33 invitees participated (28 in person, 5 by WebEx; see appendix 1) representing eight Federal agencies, five universities, three State agencies, and one private-sector firm.

The workshop had three goals:

1. Explore the scope, scale and costs of developing a National Stream Morphology Database (NSMD).

2. Bring people together from a range of organizations and backgrounds that are collecting stream-geomorphic data, designing and populating related databases, and using geomorphic data to evaluate the need and tractability of developing a national stream morphology database.

3. Develop a set of recommendations to the SOS on the conceptualization and development of a stream morphology database.

Presentations germane to these goals provided context to the discussion. The multi-sector mix of attendees who represent the fields of stream geomorphology and database design imparted various compelling perspectives on stream morphology data-acquisition, -storage, and -dissemination. The workshop included an April 27 afternoon field trip to two sites of geomorphic interest where the in-person participants were able to interact individually and collectively on subjects germane to the suite of presentations that morning (see appendix 2 for the workshop agenda).

On April 28, three breakout groups convened entitled,

1. Scale and Data Model Issues (led by Matt Collins),
2. Scope Issues (led by Faith Fitzpatrick), and
3. Ways and Means (led by John R. Gray),

The groups produced verbal and draft written summaries of their deliberations (see appendix 3, breakout sessions guidelines and three "skeleton" breakout session summaries).

This summary presents to the Subcommittee on Sedimentation the salient outcomes and recommendations from the workshop.

OVERARCHING RECOMMENDATIONS

The following overarching recommendations are presented for consideration by the Subcommittee on Sedimentation:

- Maintain the SOS National Stream Morphology Database (NSMD) Work Group; the SOS is a natural inter-agency and national lead organization for a NSMD.

- Organize a group of experts (field folks, database folks) to evaluate results of this workshop and provide a Big Picture recommendation on how to proceed, with perhaps a specific set of steps to address the Big Picture recommendations.

- Identify a desired NSMD scope: Agreement among workshop attendees was that it should be national, although the effort might be piloted on a regional basis.

- Identify a desired NSMD architecture: should this be a data-level or metadata level approach? A national metadata clearinghouse would store information about datasets and would support searches against this metadata but data access would be through contact with the individual dataset 'owner.' An explicit database design with individual data elements loaded into a standardized data framework would greatly simplify data access and would facilitate data synthesis and analysis but would require additional front-end time and effort for development and additional on-going effort for data loading. Workshop participants agreed that the base data elements should be x, y, z and time (t) coordinates, but there was a strong preference to also record the network address (i.e., the sample location, or address, along a stream network. Based on discussions, the National Hydrography Dataset was the preferred stream network). There was also a preference to avoid recording and storing derivative data (i.e., interpreted and calculated data such as bankfull width, depth, area, etc.)

- Encourage communications between managers of extant databases; database experts; geomorphologists; and data users to identify options – both technical and financial.

- Consider the alternative approaches of building off of an extant database or develop a new, minimalist one.

DETAILED WORKSHOP OUTCOMES: OBSERVATIONS, DELIBERATIONS, AND CONCLUSIONS

Confirmation of Need for a National Stream Morphology Database (NSMD): Although a veritable explosion of stream morphology data production has taken place over the last quarter century, no common/central data archive exists. A plethora of data-collection protocols and instrument types, as well as a lack of consistent data reporting standards, render much of the data incomparable and incompatible.

During and following the workshop, the participants made it clear that compiling or otherwise organizing disparate sources of stream morphology data for the "common good" was a concept that has been due for a decade or more (although workshop participants agreed that the database should only collect new data that are created and older data sets should be represented only through metadata—i.e., no attempts would be made to retroactively collect the raw data for older data sets). Major cost savings (Federal, State, and other organizational levels) should result from SOS coordination of a NSMD by reducing duplication of effort and maximizing sharing of information. Development of (or piggy-backing on) a central data repository (or search-engine based repository) might be accomplished cost-effectively and result in unparalleled access to synthesis-ready data across the country.

Benefits of a NSMD include:

- Easily find available data for evaluation and synthesis: spatially-based with a time element
- Water-quality management: utility for TMDLs
- Engineering design and navigation
- Ecological restoration: Dam removal, channel design, fish passage design, watershed sediment management
- Transportation: culvert and bridge assessment/design
- Floodplain and land-use management: Flood forecasting/inundation mapping, rainfall-runoff modeling, hydraulic model calibrations
- Development of hydraulic geometry characteristics for use in digital hydrography databases (such as Arc Hydro) and regional/national hydrology and stream habitat models.
- Applied research/monitoring: short- and long-term effectiveness of habitat improvements and or/channel modifications (e.g., dam removal)
- Basic research: climate change, channel stability, sediment sources and sinks, improved understanding of channel formation and maintenance processes
- Facilitate multidisciplinary studies – link stream morphology data with streamflow, ecology, habitat, reservoir-sedimentation, sediment-transport, water-chemistry, and flow-statistic data sets
- Facilitate long-term trend studies (upgrade of Vigil Network)

One Measure of Value for a National Stream Morphology Database: The proposed NSMD is predicated on compilation and receipt of extant stream morphology data. The NSMD itself will not be in charge of collecting data, but data will be entered by those already collecting the data through ongoing programs and studies. The cost of a single site “record” for data collection and office compilation and analysis is on the order of $1,000s. In contrast, the cost of developing (or, adapting) and maintaining a NSMD would be a small fraction of the value of the ‘donated’ data if considered over the timeframe of years or more. In turn, the value of those readily accessible data and accompanying metadata to end users is substantial. One goal of an effort such as the NMSD is to increase the value of monies already spent or allocated for field sampling and thus to increase the return-on-investment of those past or present efforts.

Attributes of a National Stream Morphology Database: A NSMD should be:

1. Free and accessible on-line.
2. Platform independent.
3. Comparatively inexpensive to develop, implement, and maintain.
4. A database; *not* a metadatabase. However, with incorporated metadata provisions.
5. Flexible and understood to be ever-evolving.
6. Receptive to new data with flexibility for adding historical data in the future.
7. Built on data elements that include georeferenced (x, y, z) and temporal (t) coordinates
8. Independent of interpretation of process (i.e., not based on the bankfull or other interpretative concept).
9. Responsive to the needs of multiple end users and receptive to user updates.
10. Based on top-down and down-up boundary conditions
    a. The top is the real functions that we want the system to support – user stories (use cases are created from these)
    b. Prioritizing the use cases will be important to progress (prevent analysis paralysis) (governing body needed)
    c. Down is making sure that it is realistic for the users to actually use

11. Sufficiently simple and intuitive to avoid being a barrier to contributors/contributions.
12. Based on identifiable protocols, but not necessarily a small and rigid suite of protocols.
13. Based on a controlled vocabulary for variables and other data elements.
14. Based on reporting standards for the base data elements of x, y, z, and t
15. Georeferenced and ideally compatible with the National Hydrography Dataset, StreamStats, NAWQA, and other relevant national, multidisciplinary datasets.
16. Linked with existing streamflow and sediment databases at USGS streamgages.
17. Compatible, to the extent possible, with future remote sensing data and other sampling platforms and data types.
18. Able to accept and store metadata that describes important data quality information such as measurement uncertainties.
19. Capable of storing both raw and derived data as well as the capacity to identify both as such.

Data Types Suggested or Sought:

Mandatory: x, y, z, and t coordinates also recorded with a network address (e.g., reach code and reach measure within the NHD)

Recommended/Acceptable:

- Channel geometry (cross-sections, stream profiles, planform, benchmarks, control points)
- Longitudinal profiles of water surface, thalweg, and bank elevations
- Instantaneous stage and water discharge at the time of sampling
- Water-surface and/or channel slope in reach
- Water temperature
- Bed-material particle-size distributions and perhaps other characteristics (embeddedness, porosity, others)
- Suspended-sediment concentrations and particle-size distributions (x-section or at-a-point)
- Bedload transport rates and particle-size distributions
- Bank erosion (quantitative)
- Channel materials (inorganic, organic)

Other:

- Specific streamflow gage rating curves
- Stability assessments (stable, incising, aggrading)
- Location of grade controls, and of headcuts
- Stage in channel evolution model, if appropriate
- Biological data
- Photographs, ideally georeferenced
- Field maps and notes
- Rapid channel assessments/river walks
- Bank descriptions and data
- Valley/floodplain cross sections
- Channel and floodplain core descriptions and profiles
- Geochemistry and geochronology
- Stream classification

Data, Database, and Protocol Sources- Potential Linkages: A number of extant databases of potential relevance are “owned” by the USGS; Fish and Wildlife Service; Forest Service; Army Corps of Engineers; Dave Rosgen; Bill Emmett; and others. These should be identified in a matrix of attributes. Additionally:

Data Sources (in general order of priority to catalogue)

- Federal, State, and County agencies
- Universities
- Tribes
- Nongovernmental organizations and environmental consultants
- Data archives associated from grants

Data Categories:

- Project-level data
- Baseline data
- Monitoring data
- Basic data vs. interpreted data

Protocols:

- Goal is data compatibility.
- Cannot ‘mandate’ acceptance of a given data type based on a single protocol, but can mandate that any data stored meet specific reporting standards and be accompanied by metadata that describe important data collection and quality information.
- All data require georeferencing.

Potential NSMD linkages among existing databases or data models

- National Hydrography Dataset
- Streamflow -- NWIS
- USGS StreamStats
- Habitat/Ecology – USGS NAWQA
- Water quality – USGS NWIS
- Fluvial sediment – USGS NWIS (instantaneous and daily-value data)
- Reservoir sedimentation – SOS RESSED
- USGS Vigil Network
- CUAHSI Hydrologic Information System (HIS)

Toward Implementation of a NMSD:

- A phased approach is probably the most prudent.
- A “charter” with Objectives; Scope; Deliverables should be developed.
- Project would require the following elements:
    - i. Budget
    - ii. Advisory Team
    - iii. Project Manager
    - iv. Requirements statement
    - v. System architecture
    - vi. Standards and data design
    - vii. Implementation plan
    - viii. Operations

ix. Delivery
x. Maintenance
xi. Communication
xii. Improvements (cycles back to design)

Potential Impediments to Developing a NMSD:

- Demonstrable need and benefit: Although considerable interest has been expressed in the NSMD concept, it is difficult to quantify the cost-benefit ratio for its development and maintenance; i.e., we must be able to answer the "who cares?" question.
- Cost: Development of a NSMD would presumably require a manager and technical support to develop the application. Additionally, any useful database requires long-term maintenance. Entering data would require time not accounted for in existing projects and studies.
- Leadership: Identifying an agency or organization that can manage, maintain, and support the database
- Robbing Peter to pay Paul: No organization should be asked to support a NSMD effort "out of hide."
- Complexity: Concern that the varied data types will result in difficulty on parts of users to store their data in the NSMD.
- No existing database meets all of the aforementioned desired criteria for a NSMD without some degree of modification.