LESSONS LEARNED FROM THE SOURCE WATER STEWARDSHIP PROJECT

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March 2004

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This document summarizes "lessons learned" here at UMass-Amherst and at the pilot sites during the Source Water Stewardship Project. Our primary focus was on the Phase 1 watershed analyses and subsequent work with the Stewardship Exchange Teams, TPL, and project partners. In general and as expected, we became more efficient and effective as the project progressed. The contrasts and similarities between the four pilot sites provided a rigorous test of the process. A comprehensive overview of the project and a summary of key results can be found in Barten and others (2003) and Barten and Ernst (2004).

1. The evolution of our approach, presentation, revision process, and deliverables was substantial during the project.

As we progressed through the process on the four sites we learned to use the following sequence and to keep participants posted on progress towards goals. A general description of the watershed analysis process -- what it would and would not include -- had to be clearly stated. Otherwise, some participants tried to alter the study plan to meet narrow site-specific interests in ways that were inconsistent with the stated goals of the project. The first report and map should be presented and described as a discussion draft. We expected, and were pleased to receive and act upon comments, corrections, and suggestions for improvement. In some cases, local knowledge of watershed conditions helped to locate and correct errors in GIS data layers, dated information, and other inadvertent sources of confusion. Furthermore, although most of the audience at the Kick-Off Meeting appeared to understand and be satisfied with the generic description of the GIS-based overlay approach, they were much more engaged when data and information from *their* watershed was presented. In addition, some questions and discussion betrayed a lack of clarity about the goals of the project, the analytical methods, the limits of available data, and other issues and concerns that needed to be addressed before further progress could be made. The participants readily accepted the revisions and corrections in the discussion draft when it was presented in revised form.

We found that additional analyses were best presented in a "supplemental report" along with new maps and GIS output. For example, once we discovered the utility of US Census Bureau data, cross-tabulation of watershed and political boundaries, and designating land that was already protected on the priority lands maps, we completed these supplemental analyses for all the sites. In the future we would include them in the first round of watershed analyses. We also learned (and were not surprised) that many, if not most, participants performed a cursory review of reports before the meeting. This underscored the importance of a formal and comprehensive presentation and discussion. Attention quickly focused on the map set as the level of understanding and confidence of the participants grew. If anything, they became too enamored of the maps and needed to be reminded that field inspections and site-specific reviews were needed. Our colleagues at the Massachusetts Department of Conservation and Recreation (MA DCR) applied the GIS overlay process to the Springfield, MA water supply system (Cobble Mountain and Borden Brook watersheds). In the process they discovered strengths, weaknesses, and alternatives that can best be found through hands-on application by an interested third party. Specifically, MA DCR developed a very useful final map template that includes the base layers, land cover data, and a brief description of methods in addition to the final high priority conservation, restoration, and stormwater management priority (CPI, RPI, and SMPI) map. David Kimball, a MA DCR GIS analyst, automated much of the analytical process in ArcView (by writing menu-driven extensions). These ArcView extensions are appended to a comprehensive description of the GIS development and analysis process (de la Crétaz et al. 2004). The entire document can be disseminated as a *.pdf file with the ArcView extensions in a format that is ready to install.

Limitations on available data will, at least temporarily, limit the opportunity to expand the scope and predictive power of the watershed analysis. The next substantially more difficult step would be to calibrate and validate a spatially-distributed hydrologic model. However, the marginal benefit of more hydrologic modeling may not compare favorably to the investment of staff time and financial resources in water quality measurements and field assessments. This point is discussed below.

2. Intermediate to advanced GIS skills and software resources are needed for watershed analysis and mapping work.

Few of the participants had the GIS training and experience and/or the hardware and software needed to directly contribute to the watershed analysis. Many organizations have in-house GIS capability but it is limited to the straightforward manipulation of in-house, local, or state databases, display and printing, and other routine tasks. Usually, the "GIS person" at a water utility, local NGO, or local government agency has many other responsibilities and demands on their time. As a result, their ability to contribute to database development and compilation process, quality assurance/quality control (QA/QC), and other highly technical and time consuming tasks was limited. Limitations on experience and knowledge could, of course, be addressed with training and continuing education opportunities. But, for a variety of reasons discussed below we do not believe this a preferred solution. In addition, the variety of hardware (e.g., RW DVD drive, high-speed Ethernet connection, sheet-sized plotter, etc.) and software (ArcView, Spatial Analyst, ArcGIS, Arc/Info, etc.) needed to be self-sufficient would be an inefficient investment for many entities.

3. National (USGS, Census Bureau, etc.), regional (Chesapeake Bay Program), and state GIS databases are key resources; locally developed datasets are rarely useful.

National, regional, and state-level, web-based data sources were essential to the success of the project. The key attributes of the core spatial data sets include a standardized coordinate system (map projection), complete documentation (i.e., data sources, dates, references, description of classification systems and methods, error analyses of land cover classifications, etc.), and appropriate scale or spatial resolution (30 m). For the most part, local datasets were undocumented and inconsistent. In the worst cases they were little more than scanned images that looked like GIS layers but, in fact, were *.jpg or *.tif files. Simply put, most agencies or organizations have much less useable data than they think. Our experience with local organizations during the project argues for strict adherence to uniform and accepted national standards (e.g., the USGS land classification system), thorough documentation, and the professional development of web sites and spatial data libraries. Some themes, such as primary and secondary road networks, are particularly inconsistent and difficult to obtain. We are certain that state Departments of Transportation have extensive, up-to-date surveys and corresponding CAD files (which can be readily converted to GIS file formats). However, they are, for all practical purposes, functionally unavailable. When we tried to obtain roads and other data layers phone calls and email messages were bounced from person to person with few tangible results for weeks of effort. This example underscores the importance and economy of scale that is demonstrated by well-staffed state-level GIS programs.

Tax parcel maps, a key data layer for the implementation of forest conservation plans, are developed by local governments (typically for property tax assessment). Only the Little Tallapoosa watershed in Georgia had tax parcel maps for the majority of the project area. This map was developed by Carroll County for an earlier planning project. On the other three sites some towns had digital maps, most did not (2 of 14 in Nashua; 1 of 6 in New Jersey, none for the Prettyboy Reservoir watershed [MD]). As an intermediate step we developed a 1 km "chessboard" to compute total CPI, RPI, and SMPI scores and guide site-specific planning. However, the availability of tax parcel maps with appropriate attribute tables provides the opportunity to generate:

1. total CPI, RPI, and SMPI scores for each parcel,
2. a priority (numerically ranked) list of priority parcels, and
3. a contact list of landowners.

This database could substantially increase the efficiency and timeliness of land conservation programs for public agencies and NGOs. Most importantly, it provides an objective means of comparing the relative conservation value of parcels of different shapes, sizes, and locations. Based upon our experience during the project we strongly urge the EPA and other federal agencies to develop a cost-share or small grant program to encourage and assist local governments with the development of accurate tax parcel maps. This would have the added advantages of (1) standardizing the format and accuracy of these data layers and (2) minimizing or avoiding subsequent problems associated with joining adjacent towns into a seamless layer for the project area.

4. The development of NRCS digital soils maps lags behind other federal programs.

The Natural Resources Conservation Service (formerly SCS) is undertaking a major re-mapping and conversion process for county-level soil surveys across the U.S. This is a massive undertaking that includes field mapping, reconciling differences in soil classification and nomenclature, registering changes with the National Soils Database, correcting inconsistencies at county and state boundaries, and producing GIS layers and associated soil attribute tables (Access database or Excel spreadsheet files). Re-mapping and updates are conducted by state and district offices and are progressing at different rates as a reflection of field conditions, GIS and database capabilities, and overall staff resources. Data on soil permeability, erodibility, depth to seasonal high water table, drainage class, and other attributes are major assets for our GIS overlay process and other environmental and ecological analyses. In addition, other information presented in soil surveys is very helpful (e.g., local climate summaries, geologic history, land suitability classification, etc.). Therefore, we recommend that the EPA and other federal agencies work with the NRCS to accelerate the completion and standardization of this very important dataset.

5. Trans-boundary project areas present major challenges in joining and reconciling GIS data.

One of the major factors leading to the selection of the Nissitissit and Squannacook River watersheds (tributaries of the Nashua River on the Massachusetts-New Hampshire) was the self-imposed challenge of dealing with two states and many small towns (14 total, 7 in each state). It might be supposed that two states would prove to be about twice as difficult. In reality it was 3 or 4 times more challenging to complete the work. There are several reasons for this multiplier effect. First, states have developed GIS data clearinghouses (e.g., MassGIS and NHGRANIT) in relative isolation. Each uses their own state plane coordinate systems; land cover/land use layers are invariably developed at different times, with different source imagery, and different classification systems. Second, some layers are "clipped" exactly to state boundaries while others extend into adjacent areas. Finally, a wealth of data in one state corresponds to a dearth of data in the other. For example, New Hampshire has recent and extensive groundwater resources data (aquifer boundaries, specific yield, transmissivity, wellhead protection areas, well locations and pumping rates) while Massachusetts has a crude rendition of sand and gravel aquifers (a complete geologic re-mapping is underway). Obviously, undertakings like the Chesapeake Bay Program and the US Forest Service Highlands Project have tackled and solved these problems but not without substantial investments of time and money. Increased interaction and coordination between adjacent states and regional and federal programs should be productive of useful results and greater efficiency.

6. Water quality data collected by water utilities and state agencies for compliance purposes have limited utility for watershed assessment and model validation. Streamflow and groundwater data are rarely available.

We expected, based on prior experience, that water quality and streamflow monitoring data of sufficient record length, spatial coverage, and parameter type for meaningful analyses would be available for the study sites. However, across the four sites only the Metedeconk River watershed (Brick Township Municipal Utilities Authority, BTMUA) had enough data to support more than preliminary analyses. The reason for this information gap lies in the intended purpose of these datasets. Because water quality data are collected by utilities to ensure compliance with state and federal regulations they tend to be (1) collected at fixed frequencies (e.g., monthly or biweekly versus stormflow events), (2) in longitudinal transects along rivers, (3) inconsistent with respect to parameter sets and record lengths, and (4) detached from streamflow measurements. By contrast, a monitoring or measurement plan designed to calibrate and validate hydrologic models or to conduct statistical analyses would (1) sample tributary streams (subwatersheds) with relatively homogeneous characteristics, (2) deliberately couple water quality and streamflow measurements, (3) stratify sampling into baseflow and stormflow periods, and (4) compile and archive data in spreadsheet or database files as they are collected and processed.

7. Acquisition of data from participants is a time-consuming, low yield investment.

At every meeting members of the local committee and other attendees enthusiastically volunteered to send data for the GIS, water quality assessment, etc. In all but a few cases, it took weeks or months to complete the transfer of data. As noted earlier, deficiencies in the structure, format, and/or documentation of GIS data frequently limited the prospects for any productive use. This is disappointing and confusing to both parties. We think *"...I thought you said these data were available."* They think *"...we sent them our data and they never used them for the mapping and assessment work."* Again, this experience argues for standardization and coordination of mapping and monitoring programs.

8. Lack of access to the EPA Community Water System database in the aftermath of September 11, 2001 limits the scope, utility, and impact of watershed analyses.

Before it was removed from the EPA and associated state DEP or DNR web sites, the Community Water System database was an excellent resource for watershed and source water protection analyses. We understand the potential exists for the wrong people to access this information. However, there appears to be no way to access the data for any purpose. In the Little Tallapoosa watershed we were asked to show the location of municipal water supply reservoirs, intakes, and wells on the final map set for the implementation phase. The chairman of the Carroll County Commission, Robert Barr, needed to show upstream communities and decision makers that they were the first to benefit from land conservation and source water protection. We made repeated calls and sent numerous email messages to the Georgia office with responsibility for these data. They largely went unanswered, except for the GIS technicians with no authority to release the data. This is not surprising given the uncertainty and lack of formal procedures for a new, sensitive responsibility. The default bureaucratic reaction is simply to deny all requests. We strongly urge the EPA and state agencies to develop guidelines and application procedures. A request for information on university letterhead, notarized if necessary, and specific boundary conditions on publication and dissemination of these data could provide a common sense alternative to the *de facto* ban that is now in effect. The importance of this data and information to a small, disciplined group of managers and decision makers <u>with the strongest possible vested interest in protecting water supplies from all threats</u> argues for a less reactionary approach.

9. The Source Water Stewardship GIS analyses could [should] be done by state GIS programs and made available for viewing and use.

We conclude that the best approach to organizing, implementing, and disseminating the Conservation, Restoration, and Stormwater Management Priority Index maps developed during this pilot study would be to underwrite their development by state-level GIS organizations (e.g., MassGIS, NH GRANIT, etc.). They have the technical expertise, QA/QC procedures, and computing infrastructure to complete the task. Furthermore, on-line links to other resources such as digital orthophotographs, habitat maps, and protected areas would be very helpful for field assessments and operational planning (e.g., land purchases, water quality monitoring, BMP design, public and landowner outreach, etc.).

10. The GIS analyses and overall approach of the Source Water Protection Project could serve as an organizing mechanism for the Watershed Forestry Assistance Program (2002 Farm Bill).

The Water Resources Committees of the Northeastern Area Association of State Foresters (NAASF, 20 states) and the National Association of State Foresters (NASF, U.S. and territories) have expressed interest in the watershed analyses, GIS-based mapping, and the active approach to forest conservation and nonpoint source pollution management developed and tested during the Source Water Stewardship Project. In many ways, this marks a return to time-tested principles such as the multiple barrier approach for source protection extending from the forest to the faucet. Forests are the critical and irreplaceable first barrier to water pollution in addition to providing a wide range of other benefits and values. Active collaboration between state and federal agencies charged with in implementation of the Watershed Forestry Assistance Program could build directly upon TPL-UMass-US Forest Service project.

References

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