

2003 Project Abstract

For the Period Ending June 30, 2006

FINAL REPORT

TITLE: TAPwaters: Technical Assistance Program for Watersheds

PROJECT MANAGER: Dr. James E. Almendinger

ORGANIZATION: Science Museum of Minnesota -- SCWRS

ADDRESS: 16910 - 152nd St. N, Marine on St. Croix, MN 55047

WEB SITE ADDRESS: www.smm.org/scwrs/

FUND: Minnesota Environment and Natural Resources Trust Fund

LEGAL CITATION: ML 2003, Ch. 128, Art. 1, Sec. 9, Subd. 7(d)

AUG 17 2006

APPROPRIATION AMOUNT: \$160,000

Overall Project Outcome and Results

The St. Croix River is highly valued resource with nearly a million visitors each year, mostly from Minnesota. It is impacted by agricultural and urban nonpoint-source pollution; consequently Minnesota and Wisconsin have agreed to reduce nutrient pollution to the St. Croix River by 20%. To achieve this goal most economically, resource managers need computer models of watersheds to test effectiveness of proposed remedial actions. The main objective was to model a sub-basin of the St. Croix to identify the most effective ways to reduce nutrient-rich runoff from agricultural land. This project established the Science Museum's TAPwaters office, which is applying the Soil and Water Assessment Tool (SWAT) to the Willow River, a tributary that contributes nutrient pollution disproportionately to the St. Croix. The SWAT model is well accepted and used world-wide; however, we discovered critical errors in the model code. Correcting these errors greatly improved model accuracy. The significance to Minnesota is large, because SWAT will be used widely in coming decades to develop pollution reduction strategies. Whether changes in land management can achieve the targeted 20% reduction in phosphorus loads from the Willow is unclear from preliminary model runs. Completion of the Willow River model is scheduled for mid-November 2006. With funding from the National Park Service, work on a whole-basin model of the St. Croix will continue, thereby providing a nutrient-reduction tool for 3,500 square miles of Minnesota.

Project Results Use and Dissemination

St. Croix Basin Water Resources Planning Team of federal, state, and local officials is counting on SWAT modeling by the TAPwaters office to be an integral tool in reducing pollution to the St. Croix. Current results are critical to resource managers in the Willow River watershed for implementing remedial actions based on model runs. Results have been presented to over 500 attendees of annual conferences on pollution to the St. Croix and will be published on the web at www.smm.org/scwrs/.

June 2006

FINAL REPORT

LCMR Final Work Program Report

Date of Report: 30 June 2006
Date of Work Program Approval: 26 June 2003
Project Completion Date: 30 June 2006

AUG 17 2006

I. PROJECT TITLE: TAPwaters: Technical Assistance Program for Watersheds

Project Manager: Dr. James E. Almendinger
Affiliation: Science Museum of Minnesota -- SCWRS
Mailing Address: 16910 - 152nd St. N
City / State / Zip : Marine on St. Croix, MN 55047
Telephone Number: 651-433-5953, ext. 19
E-mail Address: dinger@smm.org
FAX Number: 651-433-5924
Web Page Address: www.smm.org/scwrs/

Total Biennial LCMR Project Budget: **LCMR Appropriation:** \$160,000
Minus Amount Spent: \$160,000
Equal Balance: \$0

Legal Citation: ML 2003, Chp. 128, Art. 1, Sec. 9, Subd. 7(d) *TAPwaters: Technical Assistance Program for Watersheds*

Appropriation Language:

7 (d) TAPwaters: Technical Assistance Program for Watersheds
\$80,000 the first year and \$80,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with the Science Museum of Minnesota to assess the St. Croix River and its tributaries to identify solutions to pollution threats. This appropriation is available until June 30, 2006, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROGRESS SUMMARY:

Overall Project Outcome and Results

The St. Croix River is highly valued resource with nearly a million visitors each year, mostly from Minnesota. It is impacted by agricultural and urban nonpoint-source pollution; consequently Minnesota and Wisconsin have agreed to reduce nutrient pollution to the St. Croix River by 20%. To achieve this goal most economically, resource managers need computer models of watersheds to test effectiveness of proposed remedial actions. The main objective was to model a sub-basin of the St. Croix to identify the most effective ways to reduce nutrient-rich runoff from agricultural land. This project established the Science Museum's TAPwaters office, which is applying the Soil and Water Assessment Tool (SWAT) to the Willow River,

a tributary that contributes nutrient pollution disproportionately to the St. Croix. The SWAT model is well accepted and used world-wide; however, we discovered critical errors in the model code. Correcting these errors greatly improved model accuracy. The significance to Minnesota is large, because SWAT will be used widely in coming decades to develop pollution reduction strategies. Completion of the Willow River model is scheduled for mid-November 2006. Whether changes in land management can achieve the targeted 20% reduction in phosphorus loads from the Willow is unclear from preliminary model runs. With funding from the National Park Service, work on a whole-basin model of the St. Croix will continue, thereby providing a nutrient-reduction tool for 3,500 square miles of Minnesota.

Project Results Use and Dissemination

St. Croix Basin Water Resources Planning Team of federal, state, and local officials is counting on SWAT modeling by the TAPwaters office to be an integral tool in reducing pollution to the St. Croix. Current results are critical to resource managers in the Willow River watershed for implementing remedial actions based on model runs. Results have been presented to over 500 attendees of annual conferences on pollution to the St. Croix and will be published on the web at www.smm.org/scwrs/.

IV. OUTLINE OF PROJECT RESULTS:

Result 1: Watershed model development and application

Description:

This project has established the use of watershed modeling to support resource management in the St. Croix basin. It has laid the foundation to continue such work in the St. Croix for years to come, and to expand to other watersheds and applications. Watershed models by themselves will not protect our receiving waters, but their results can help make us aware of the consequences of our actions, while there is still time to respond.

The specific outcomes and products of this result include the following:

- (1) Establishment of the TAPwaters modeling center at the St. Croix Watershed Research Station

This outcome was achieved through the acquisition of the necessary hardware, software, and training to construct and apply computer models of watersheds. LCMR-recommended funds were used to purchase a high-end desktop computer and a notebook computer; a portable large hard drive for backups; off-the-shelf software for standard office functions, statistics, and scientific graphing; computer supplies such as CD-R disks and printer ink; and a few computer repairs. Funding from other sources was used to complete the TAPwaters office establishment. The St. Croix Watershed Research Station supplied renovated office space and furniture, as well as two further high-end desktop computers and a wide-format plotter. The National Park Service has provided the annually-licensed GIS software necessary for processing the spatial data required for watershed modeling. The modeling software, the Soil and Water Assessment Tool (SWAT) developed by the U.S. Department of Agriculture Agricultural Research Service (USDA-ARS), is public-domain software downloadable from the web.

Training was achieved through attending two separate modeling workshops, an introductory workshop on SWAT followed the next year by a workshop for advanced modeling techniques. The second workshop was extremely important, as it provided enough details for us to learn how to more fully manipulate (and sometimes fix) the inner workings of the model. However important training is to get started, it cannot substitute for experience, both our own and that of others. To that end, we have helped organize a users group of about 20 (variously) experienced modelers from the Metropolitan Council Environmental Services, Minnesota Pollution Control Agency, University of Wisconsin (UW)-Green Bay, UW-Stevens Point, and Wisconsin Department of Natural Resources, as well as from our own TAPwaters office. This group has been meeting twice each year for the past two years and keeps in near-constant communication via email. Participation in this group has proven critically important, as UW-Green Bay provided a modified version of SWAT, unavailable to the general public, that fixed several serious bugs in the model code that had been blocking our own modeling progress. We did not obtain this version of the model until early in 2006, and progress has accelerated since that point. We feel that this users group will be instrumental in guiding future SWAT modeling in Minnesota and Wisconsin, as well as in providing the feedback to the USDA-ARS for continued improvement in model code.

(2) Development of management recommendations for a sub-basin of the St. Croix

The sub-basin where the SWAT model should first be applied was chosen by the Implementation Subcommittee of the St. Croix Basin Water Resources Planning Team (Basin Team). The Basin Team is an interagency partnership begun in 1993 and includes the National Park Service, Minnesota PCA, Minnesota DNR, Wisconsin DNR, Metropolitan Council Environmental Services, U.S. Geological Survey, University of Minnesota, Minnesota Dept. of Agriculture, St. Croix Chippewa of Wisconsin, and University of Wisconsin-Extension, as well as the St. Croix Watershed Research Station of the Science Museum of Minnesota. The Implementation Subcommittee is composed of managers with technical backgrounds from many of these agencies and serves as the technical advisory committee for the TAPwaters office. The subcommittee is in the process of identifying "hotspots" of nonpoint-source pollution in the St. Croix basin and will help prioritize the future modeling efforts of the TAPwaters office.

The Willow River, which enters the St. Croix near Hudson, WI, was chosen by the Basin Team's subcommittee as the first modeling project for the TAPwaters team. This watershed has been identified by previous studies as one of the larger contributors of nonpoint-source pollution to the St. Croix River, and it is facing rapid land-use change that could increase this pollution. GIS data sets on topography, hydrography, soils, and land cover were assembled from public sources, as were time-series data sets on climate and stream flow. The land-cover data set was originally from 1992-93 satellite imagery, yet our calibration flow and nutrient loading data were from 1999. Hence a detailed effort was undertaken to assess land-use change from 1992 to 1999 and to determine the primary agricultural practices in the watershed. With help from the St. Croix County Land and Water Conservation Department, about 900 questionnaires were mailed to the largest agricultural land owners in the watershed to assess current agricultural practices; a large percentage (40%) of the questionnaires were returned with the information requested. From this information, representative crop rotations were constructed for model input, which included

the multiyear sequence of crops grown (corn, soybeans, and alfalfa) and the annual schedule of tillage, fertilizer application, planting, and harvesting for each crop. Data from the U.S. Census Bureau, St. Croix County Planning Department, and the National Agricultural Statistics Service were also used to complete the assessment. Findings have been summarized in a report titled “Land-use change and agricultural practices in the Willow River Watershed, western Wisconsin, 1992-2004,” available on the web at www.smm.org/scwrs/. Our results were not surprising – about 10% of the cropland in the watershed was converted to mostly rural residential development from 1992 to 1999. The land-cover data set was then adjusted to account for these changes.

The SWAT model was then constructed from these corrected data sets and underwent calibration. To “calibrate a model” means to find the best combination of adjustments to model parameters such that the model output (e.g., daily flows, nutrient loads, and crop yields) matches the monitoring data as closely as possible. A “parameter” is a number in the model that typically describes some physical quantity, e.g., available soil water capacity. The model usually has default values for these parameters, but they should be modified to fit the actual watershed being modeled. While we could generally alter enough parameters to make the model output match the monitoring data relatively well – i.e., the model *appeared* to be calibrated – close investigation of model output revealed oddities that made us skeptical that the model was functioning properly. For example, in the model an excessive loss of nitrogen fertilizer by mineralization reduced crop yields below acceptable levels. Alfalfa, once planted in the model, was never allowed to be replaced fully by another crop. Water that infiltrated from depressions in the landscape was trapped in the shallow aquifer and never allowed to reach the stream. And, the landscape delivered large amounts of algae to the adjacent stream channel, such that excessive amounts of phosphorus suddenly appeared in the channel when the model decomposed this algae.

Despite months of effort, these problems precluded proper calibration of the model. Fortunately, we were made aware of a modified SWAT model code developed by Paul Baumgart out of UW-Green Bay, and this model code was generously given to us in early 2006. This version of the model solved the first two problems listed above. In the meantime we developed procedures to minimize the other two problems, and finally fruitful model calibration is underway at an accelerated pace. We expect to have the model fully calibrated for daily flows, monthly sediment loads, and monthly phosphorus loads before the end of August 2006. A number of agricultural best management scenarios have been selected for testing, especially the effect of no-till agriculture, altered fertilizer applications, reduction of phosphorus in cattle feed, and the use of buffer strips along selected channels. Preliminary model runs support the notion that changes in land-management practices will indeed reduce sediment and nutrient loads, but it is unclear whether these changes will amount to the target level of a 20% reduction.

We are focusing all of our current efforts to complete the Willow River model, as there is an urgent need to get a working product in the hands of resource managers, in this case, the St. Croix County Land and Water Conservation Department. Not only do they need to understand the effects of changing agricultural practices, they must soon face the probability of much-increased residential development with the construction of the new bridge at Stillwater. We plan to complete the Willow River model by mid-November 2006. While this extends beyond this LCMR project, we have secured funding from the National Park Service (NPS) for another 1.5 years of modeling work in the St. Croix, which will allow

completion of the Willow River model and extend our work to the Sunrise River as the next targeted sub-basin.

(3) Construction of a whole-basin model of the St. Croix Watershed

We knew that a whole-basin model would be (and will continue to be) a work in progress, as we learn more about the SWAT program and fill in details by systematically modeling selected sub-basins within the overall St. Croix Basin. However, we had hoped to construct a preliminary model as a start. This hope proved overly optimistic as we discovered problems with the model code and gave priority to finishing the Willow River model, for reasons noted above.

Nonetheless, the St. Croix Basin Team and the TAPwaters office remain committed to constructing a whole-basin model. It will be a fundamental tool for helping to evaluate (and hopefully achieve) the goal of reducing the input of sediment and nutrients to the St. Croix by 20%. This goal was recently formalized with an agreement signed by the Commissioner of the Minnesota Pollution Control Agency and the Deputy Secretary of the Wisconsin Department of Natural Resources. Whole-basin data sets have been assembled, and with the continued funding from the NPS, we plan to incrementally construct this model as we work on the Sunrise River watershed. We will still give priority to completion of the sub-basin (Sunrise) model, since that will produce a working tool for resource managers there and give us more experience in manipulating and interpreting the model. But a whole-basin model remains an objective of the St. Croix Basin Team and will be constructed at some point. We note here that the Army Corps of Engineers has recently begun their own reconnaissance study of the St. Croix Basin and has expressed interest in partnering on the whole-basin model, though details about funding and partitioning responsibilities remain to be determined.

Summary Budget Information for Result 1:	LCMR Budget	\$160,000
	Amount Spent	\$160,000
	Balance	\$0

Completion Date: 30 June 2006

V. TOTAL LCMR PROJECT BUDGET:

All Results: Personnel:	\$145,287
All Results: Equipment:	\$6,000
All Results: Development:	\$0
All Results: Acquisition:	\$0
All Results: Other:	\$8,713

Other includes Supplies and Travel

TOTAL LCMR PROJECT BUDGET: \$160,000

See Attachment A: Budget Detail

Explanation of Capital Expenditures Greater Than \$3,500:

A large, fast PC-style computer with an additional high-capacity external storage device was necessary to run the modeling program and store the required massive geographic and climatic data sets. While each component (CPU, monitor, hard disks, interfaces) cost less than \$3,500, the total system exceeded \$3,500 in aggregate. This system will remain in use for the stated purpose throughout its lifetime, as we plan to keep the TAPwaters office running beyond this initial biennium.

VI. PAST, PRESENT AND FUTURE SPENDING:

(Agency abbreviations: MDNR, Minnesota Department of Natural Resources; MPCA, Minnesota Pollution Control Agency; NPS, National Park Service; SCWRS, St. Croix Watershed Research Station; USGS, U.S. Geological Survey; WDNR, Wisconsin Department of Natural Resources)

A. Past Spending:

<u>Fiscal years</u>	<u>Amount</u>	<u>Source and description</u>
• 2001-03	\$150,000+	WDNR, MPCA, USGS, and MDNR Various studies to determine nutrient inputs from tributaries to the St. Croix and lake-modeling studies of Lake St. Croix. Total does not include in-kind services. Data will be used to prioritize sub-basins for SWAT modeling, as well as being critical for whole-basin model calibration.
• 2001-03	\$50,000	NPS, to SCWRS (St. Croix Watershed Research Station) Study of point-source inputs to the St. Croix; data will be useful for model calibration
• 2000-03	\$171,000	Met Council and MPCA, to SCWRS Study of historical loads of phosphorus and sediment to the St. Croix, reconstructed from lake sediment record. Data will be useful in testing the model's ability to "hindcast" past conditions (should time allow)
• 2001-03	\$11,000	SCWRS To renovate office space (about \$10,000), where TAPwaters would likely be housed. Also, purchased used 52" plotter internally from the Science Museum of Minnesota (our cost was only \$1,000; street value is probably about \$2,500; but it saved the project the cost of buying a new plotter, about \$8,000 to \$10,000)

B. Current Spending:

<u>Fiscal years</u>	<u>Amount</u>	<u>Source and description</u>
• 2004-06	\$40,000	WDNR, cash to SCWRS Non-required matching cash for this TAPwaters project with major funding recommended by LCMR
• 2004-06	\$7,500	NPS, in-kind, approximate Technical assistance with geographic information system (GIS) software and data-handling; annual licensing of GIS software
• 2004-06	\$15,000	WDNR and counties, in-kind, approximate Assistance from counties in gathering data on agricultural practices; assistance from SWAT modelers in WDNR Madison office.
• 2005-06	\$7,000	SCWRS Purchased another high-end PC for modeling use and a 42" wide-format plotter, to replace the previous plotter which failed beyond repair.
• 2006-08	\$100,000	NPS Will fund another graduate student and/or Project Manager (partially) to model the Sunrise River sub-basin within the St. Croix Basin, as well as to continue work on a whole-basin model of the St. Croix.

C. Required Match (if applicable):

(The appropriation language for this project does not specify that a match is *required*; see the above \$40,000 grant from WDNR for non-required matching funds directly relevant to this project.)

D. Future Spending:

• We intend to keep the TAPwaters center operational indefinitely. Fully funding the Project Manager and a graduate student, plus supplies, would require about \$100,000 per year; we expect some years would attract only partial funding at \$25,000 to \$50,000. We will seek grant funding for these future projects from federal, state, and local (e.g., watershed district) agencies. Training workshops held at the TAPwaters center would likely be run nearly at cost to the participants, and would not be a significant source of revenue.

VII. Project Partners:

A. Partners Receiving LCMR Funds:

<u>Fiscal years</u>	<u>Amount</u>	<u>Who</u>	<u>Affiliation</u>	<u>Percent Time</u>
• 2005-06	\$60,000	Grad student	U of Minn.	50%, nominally

The graduate student (an M.S. student) was selected from a pool of available students in the water resource science, geology, engineering, fisheries, or forestry departments. The Project Manager has adjunct professor status in several departments and serves as co-advisor for the student. A "50%" research appointment is considered full funding for a graduate students, and they are expected to work full time on the project during the period of funding. The student was brought onto the project for years 2 and 3, after the initial start-up phase, to make most efficient use of time and effort.

B. Project Cooperators:

The Nutrient Subcommittee of the St. Croix Water Resource Planning Team will served as the technical advisory committee for this project. Team members (excluding Project Manager) are as follows:

Affeldt, Craig	MPCA
Bartilson, Kathy	WDNR
Davis, Pam	Basin Team
Edlund, Mark	SCWRS/SMM
Engstrom, Dan	SCWRS/SMM
Ferrin, Randy	NPS
Haack, John	Univ. of Wisconsin-Extension
Hensel, John	MPCA
Johnson, Kent	Met Council Environmental Services
Lafrancois, Brenda	NPS
Lenz, Bernard	USGS
Prusak, Peter	WDNR
Shodeen, Molly	MDNR
Sorge, Patrick	WDNR
Spetzman, Jerry	MDA (Minn. Dept. of Agriculture)
Tomasek, Mark	MPCA

(Note that this subcommittee of the Basin Team has been renamed the Implementation Subcommittee as of 2006, and it will remain the technical advisory committee for the TAPwaters office.)

VIII. DISSEMINATION:

TAPwaters will disseminate project results in the following ways:

Presentations

- To Nutrient Subcommittee (members listed above -- these are key agency personnel representing their respective agencies regarding issues in the St. Croix basin). This committee meets about monthly to bi-monthly. We will update our project status to them at each meeting informally, and give a formal presentation about once each year.

- To local managers (county or watershed district managers) responsible for the sub-basin selected for detailed modeling of remediation scenarios.

Models and associated reports

- The sub-basin model and attendant data sets will be made available on CD-ROM to local watershed managers (with the invitation to visit the SCWRS/TAPwaters office for guidance in how to use the model)
- The model will be supported by (a) a documentation report, and (b) an interpretive report, as either (or both) hard copies or .pdf documents on CD-ROM.

Academic publications

- M.S. thesis
- Peer-reviewed journal articles

Web-based information

- To the extent possible, we will post reports as .pdf documents on the web, and possibly also model data sets. However, we were dependent on SMM personnel for help with this, and these positions have been retrenched as a result of budget cutbacks.

IX. LOCATION:

- The St. Croix basin covers about 20,000 km² and spans the border between Minnesota and Wisconsin. Minnesota counties wholly or partially in the watershed include the following: Aitkin, Anoka, Carlton, Chisago, Isanti, Kanabec, Mille Lacs, Pine, and Washington. Wisconsin counties wholly or partially in the watershed include the following: Barron, Bayfield, Burnett, Douglas, Pierce, Polk, St. Croix, Sawyer, and Washburn.
- Please see the attached map.

X. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than the following:

- 31 December 2003
- 30 June 2004
- 31 December 2004
- 30 June 2005
- 31 December 2005

A final work program report and associated products will be submitted by August 15, 2006.

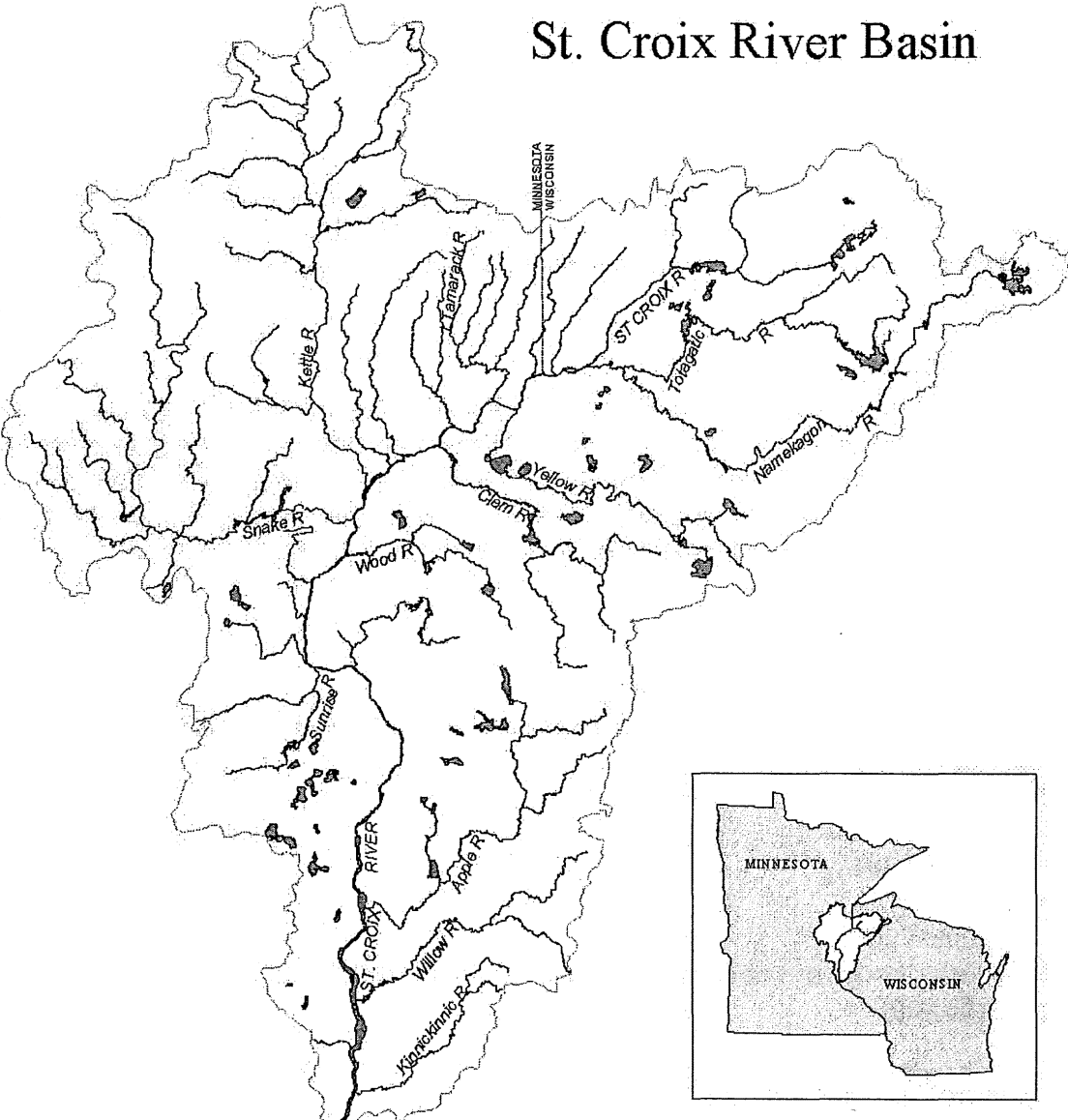
XI. RESEARCH PROJECTS:

Attachment B is not required for this project.

Map addendum to LCMR 2003 Work Program:

Title: TAPwaters: Technical Assistance Program for Watersheds

St. Croix River Basin



Confluence with
the Mississippi River

0 10 20 30 Miles

Map produced by GIS Staff,
St. Croix Watershed Research Station
and National Park Service, 3/26/02

Attachment A: Budget Detail for 2003 Projects - Summary and a Budget page for each partner

Proposal Title: 7(d) TAPwaters: Technical Assistance Program for Watersheds

Project Manager Name: James E. Almendinger

LCMR Requested Dollars: \$160,000

Values for LCMR funds have been checked against data from SMM's accounting department for consistency. Values for matching funds were estimated from Project Manager's spreadsheet. Matching funds were not specifically required for this project and are given here for informational purposes only.

2003 LCMR Proposal Budget	LCMR Funds				Matching Funds			
	Result 1 Budget: LCMR funds	Amount Spent as of 30 Jun 2006	Balance as of 30 Jun 2006	TOTAL FOR BUDGET ITEM	Result 1 Budget: Matching funds	Amount Spent as of 30 Jun 2006	Balance as of 30 Jun 2006	TOTAL FOR BUDGET ITEM
BUDGET ITEM	Result 1: Watershed model development and application				Result 1: Watershed model development and application			
Personnel: Salary and benefits Subtotal -->	\$145,287	\$145,287	\$0	\$145,287	\$40,000	\$40,000	\$0	\$40,000
<i>Project manager -- 80% time -- To oversee project and construct whole-basin model for the St. Croix</i>	\$64,287	\$64,752	(\$465)		\$30,800	\$32,411	(\$1,611)	
<i>Grad Student -- 50% time, nominally -- To focus on sub-watershed applications of model</i>	\$66,100	\$66,100	\$0					
<i>Benefits (FTE's only) -- Approx. 30% FTE salaries</i>	\$14,900	\$14,435	\$465		\$9,200	\$7,589	\$1,611	
<i>Medical: Single \$200/mon; Family \$720/mon</i>								
<i>Dental: Single, \$25/mon; Family \$55/mon</i>								
<i>Life Insurance: 0.16*2*annual salary/1000</i>								
<i>Retirement: 4% annual salary/year</i>								
Equipment: Subtotal -->	\$6,000	\$6,000	\$0	\$6,000				
<i>Computer (1 desktop, storage unit, peripherals)</i>	\$6,000	\$6,000	\$0					
<i>If funds allow: partial funding for laptop computer and projector for mobile presentations</i>								
Supplies: Subtotal -->	\$6,737	\$6,737	\$0	\$6,737				
<i>Software (by far the largest expense -- modeling, GIS, and visualization software, plus standard office software</i>								
<i>Computer supplies (disks, ink cartridge, plotter paper, cables, etc.)</i>								
<i>Report duplication, mailing</i>								
<i>Office supplies -- small amounts</i>								
Travel Subtotal -->	\$1,976	\$1,976	\$0	\$1,976				
<i>In Minnesota (and adjacent western Wisconsin)</i>								
<i>Local in-basin travel to consult with agencies, counties, and watershed districts</i>	\$114	\$114	\$0					
<i>Outside Minnesota</i>								
<i>To College Station, TX -- 1 trip for two people to consult with model developers at Ag. Res. Service</i>	\$1,862	\$1,862	\$0					
<i>To Madison, WI -- 3 to 6 trips to consult with WDNR modelers, support staff</i>	\$0	\$0	\$0					
Development (none this project)								
Acquisition (none this project)								
Contracts								
<i>A contract will be written with the Univ. of Minn. to cover the grad student salary -- the only budget item in this contract will be for personnel, and this expense is included above in the Personnel category</i>								
COLUMN TOTAL	\$160,000	\$160,000	\$0	\$160,000	\$40,000	\$40,000	\$0	\$40,000