III. Completed Research Projects

"a summary of any research project completed in the preceding biennium;"

This section includes summaries of all projects completed, including research projects.

- The following documents are summaries of accomplishments for each appropriation year and short abstracts for all projects completed since the previous biennial report of January 15, 2015.
- The abstracts describe the general accomplishments of each project for completed projects. See http://www.lccmr.leg.mn.
- Research projects have been marked as such in the description.
- Full final reports are available at the LCCMR, Room 65 - State Office Building. The abstracts are current as of 12/31/2016.
- 76 Projects were completed for a total of $44,487,343.
- Legal Citations
  1. M.L. 2015, Chapter 76, Section 2
  2. M.L. 2014, Chapter 226, Section 2
  3. M.L. 2013, Chapter 52, Section 2
  4. M.L. 2011, First Special Session, Chapter 2, Article 3, Section 2
  5. M.L. 2010, Chapter 362, Section 2
  6. M.L. 2005, First Special Session, Chapter 1, Article 2, Section 11

- Spreadsheet of all research projects completed between January 1, 2015 and December 31, 2016.

1. **M.L. 2015 Projects Completed**
   January 15, 2015 – January 15, 2017

   MN Laws 2015, Chapter 76, Section 2

M.L. 2015 Projects

MN Laws 2015, Chapter 76, Section 2 (beginning July 1, 2015)

For the FY 2016 and FY 2017 biennium (July 1, 2015 - June 30, 2017), approximately $46.3 million is available each year (total = $92,674,000) for funding from the Environment and Natural Resources Trust Fund. In response to the 2015 Request for Proposal (RFP) 152 proposals requesting a total of approximately $126.3 million were received. Through a competitive, multi-step process, 76 of these proposals, requesting a total of $74.9 million, were chosen to present to the LCCMR and 65 of those proposals were selected to receive a recommendation for funding to the 2015 MN Legislature.The Legislature adopted 63 of these project recommendations and replaced two of them with two new project appropriations on 05/18/15. The project appropriations adopted by the Legislature were signed into law by the Governor on 05/22/15.

LINKS TO:

- Print-ready PDF list of the M.L. 2015 projects adopted by the Legislature and signed by the Governor.
- Summary of appropriations and expected outcomes
- Additional information on LCCMR's M.L. 2015 proposal and funding process

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

When available, we have provided links to web sites related to the project. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

MN Laws 2015, Chapter 76, Section 2

Subd. 03 Foundational Natural Resource Data and Information

Assessing Ecological Impact of St. Anthony Falls Lock Closure
Subd. 03p $125,000 TF

Kathleen Boe
Minneapolis Riverfront Partnership
2522 Marshall St NE
Minneapolis, MN 55418

Phone: (612) 465-8780 x212
Email: kathleen.boe@minneapolisriverfrontpartnership.org
Web: http://www.minneapolisriverfrontpartnership.org

Appropriation Language
$125,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the Minneapolis Riverfront Partnership to study the impact of altered river flow due to closure of the Upper Lock on the Mississippi River at St. Anthony Falls on the physical and biological characteristics of the river between the Coon Rapids Dam and Lock and Dam No. 1 in order to inform future river restoration efforts.

OVERALL PROJECT OUTCOME AND RESULTS
On June 10, 2015, the Upper St. Anthony Falls Lock and Dam was closed to navigation. This closure, and the resulting changes to navigation and dredging, is expected to alter the sediment dynamics of the Mississippi River between Coon Rapids Dam and Ford Dam. This project was undertaken to develop a baseline condition of the Mississippi River using physical, chemical, and biological indicators that can be tracked over time as the river's ecosystem responds to adjustments in management. Lessons learned from this project are expected to help develop a better understanding of the relationships between river management, hydrology, sediment dynamics and river ecology that can be applied to other river management scenarios.

The project team collected bathymetry, water chemistry, sediment, invertebrate, and mussel data to establish the physical, chemical, and biological condition of the river at the time of lock closure. They also sourced existing data from state and local agencies, such as the Department of Natural Resources (DNR), into a common database. The project team then critically evaluated the available physical, chemical, and biological data to identify key indicators of changes in river health.

No single indicator can provide a complete measurement of changes in the river. We suggest that monitoring within each category of data (physical, chemical, and biological) would allow for the most complete assessment of future river changes. In the physical category, bathymetry data would be an effective indicator to assess the impacts of stopping dredging on river habitat. In the chemical category, water quality data are relatively simple to monitor and are part of ongoing programs. In the biological category, mussels are publicly relatable and also integrate physical (habitat) and chemical (total suspended solids) parameters in their responses to the riverine environment.

A final report summarizing the findings entitled Assessing the Ecological Impact of Lock Closure will be submitted to the LCCMR.

PROJECT RESULTS USE AND DISSEMINATION
Dozens, if not hundreds, of people and organizations are committed to the future of the Minneapolis riverfront. The results of a scientific study conducted at the time of the lock closure, a historic event by nearly any measure, is important for many of the planning and program efforts going forward. Accordingly, the study team took a multifaceted approach to dissemination of project results; these efforts will continue beyond the end of the actual grant period itself.

In-person presentations
Project staff took part in two events dedicated to disseminating the results of the study. Lead scientist Jane Mazack presented preliminary findings at the "Sip of Science" program at the Aster Cafe in Minneapolis. Mazack and DNR scientist Mike Davis were part of a Riverfront Vitality Forum, presented by the Minneapolis Riverfront Partnership at the Mill City Museum.

Both presentations began from a foundational understanding that treated the lock closure as the latest in a long series of river manipulations that have taken place on the Minneapolis stretch of the river. The presentations then detailed the study's methodology, key components of what was being sought, and the preliminary results.

Digital/social media
The dissemination of project results through digital social media has been awaiting final development of project results. Project team members from the River Life program manage a blog "River Talk", as well as a digital map, the River Atlas and Twitter and Facebook feeds. We expect the map of project results to be posted to the River Atlas once the Atlas staff member returns from summer leave.

Social media feeds through Twitter and Facebook will likewise be activated through at least December 2016.

The report, as well as significant supplemental material and links to project data, will be posted on the River Life web site as well as the sites of the Minneapolis Riverfront Partnership and the Mississippi Watershed Management Organization.

River Life publishes a quarterly digital publication, Open Rivers: Rethinking the Mississippi River Planning is under way to have Issue 4, published in October 2016, focusing on the results and studies of the project.

Project completed: 6/30/2017

FINAL REPORT (PDF)

Subd. 09 Land Acquisition for Habitat and Recreation

Metro Conservation Corridors Phase VIII - Wildlife Management Area Acquisition
Subd. 09h $400,000 TF

Patrick Rivers
MN DNR
500 Lafayette Rd
St. Paul, MN 55155

Phone: (651) 259-5209
Email: pat.rivers@state.mn.us
Web: http://www.dnr.state.mn.us/index.html

Appropriation Language
$400,000 the first year is from the trust fund to the commissioner of natural resources for Phase VIII of the Metro Conservation Corridors partnership to acquire in fee at least 82 acres along the lower reaches of the Vermillion River in Dakota County within the Gores Pool Wildlife Management Area. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards. This appropriation may not be used to purchase habitable residential structures, unless

expressly approved in the work plan. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS

The DNR, in partnership with Dakota County, acquired 169.59 acres of high quality habitat along the lower reaches of the Vermillion River on April 27, 2016. The acquisition consists of several disjoint parcels that are inholdings within the Gores Pool Wildlife Management Area (WMA) and the Vermillion River Complex. This was a high-priority acquisition for the Department of Natural Resources as the area is classified as an Outstanding Regionally Significant Ecological Area for documented colonial waterbird nesting and red shouldered hawks. The property includes more than one mile of river shoreline, high value wetlands and floodplain forest (red oak- sugar maple- basswood forest; silver maple floodplain forest) important for waterfowl, beaver and mink, whitetail deer and numerous other species including non-game species of special concern. Bald eagles and common snapping turtles are present; lake sturgeon and blue sucker occur in Mississippi River Pool 3 nearby. The acquisition reduced the WMA boundary by approximately one mile and resolves potential for boundary dispute.

PROJECT RESULTS USE AND DISSEMINATION

This parcel will soon be designated as part of the statewide WMA system (anticipated in August, 2016). This process involves publishing a designation order in the State Registrar, and a news release announcing this and other recently acquired WMA lands. The news release will mention the use of Environment and Natural Resource Trust Fund for the acquisition.

Project dcompleted: 6/30/2017

FINAL REPORT (PDF)

2. M.L. 2014 Projects Completed
January 15, 2015 – January 15, 2017

MN Laws 2014, Chapter 226, Section 2

M.L. 2014 Projects Completed in 2015-2016

MN Laws 2014, Chapter 226, Section 2 (beginning July 1, 2014)

MN Laws 2014, Chapter 312, Article 12, Section 8 (beginning July 1, 2014)

For the Minnesota's FY 2014-15 biennium (July 1, 2013 - June 30, 2015), approximately $33.8 million was available each fiscal year (Total = $67,620,000) for funding from the Environment and Natural Resources Trust Fund. In response to the 2014 Request for Proposal, 192 proposals requesting a total of approximately $111 million were received. Through a competitive, multi-step process 94 of these proposals, requesting a total of $58.7 million, were chosen to present to the LCCMR and 71 of those proposals, totaling $29 million, were chosen to receive a recommendation for funding to the 2013 MN Legislature. The Legislature adopted all 71 of these project recommendations and they were signed into law by the Governor on 05/09/14. The Legislature added one additional project and it was signed into law by the Governor on 05/20/14. For 2014 a total of 72 appropriations will be receiving $30,430,000.

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

When available, we have provided links to web sites related to the project. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

Subd. 04 Aquatic and Terrestrial Invasive Species

04c Northwest Minnesota Regional Aquatic Invasive Species Prevention Pilot

Subd. 05 Foundational Natural Resource Data and Information

05d Restoring Forest Inventory Data

05g Assessing Contaminants in Minnesota's Loons and Pelicans - Phase 2

05i Wild Bee Pollinator Surveys in Prairie-Grassland Habitats

Subd. 06 Methods to Protect, Restore, and Enhance Land, Water, and Habitat

06i Cattail Management for Wetland Wildlife and Bioenergy Potential

06k Expansion of Greenhouse Production

Subd. 07 Land Acquisition, Habitat, and Recreation

07d Shoreland Acquisition on St. Croix River

Subd. 08 Air Quality, Climate Change, and Renewable Energy

08h Solar Photovoltaic Installation at Residential Environmental Learning Centers

Subd. 09 Environmental Education

09b Youth-led Sustainability Initiatives in 40 Greater Minnesota Communities

09e Educating Minnesotans about Potential Impacts of Changing Climate

09f Pollinator Education Center at the Minnesota Landscape Arboretum

09h Raptor Lab Integrating Online and Outdoor Learning Environments

09i Wolf Management Education

Subd. 10 Administration and Contract Agreement Reimbursement

10a Contract Agreement Reimbursement

Subd. 04 Aquatic and Terrestrial Invasive Species

Northwest Minnesota Regional Aquatic Invasive Species Prevention Pilot
Subd. 04c $219,000 TF

Julie Goehring
Red River Basin Commission
1120 28th Ave N, Suite C
Fargo, ND 58102

Phone: (701) 356-3183
Email: Julie@redriverbasincommission.org
Web: http://www.redriverbasincommission.org

Appropriation Language
$219,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with the Red River Basin Commission to develop aquatic invasive species prevention strategies on a watershed scale and develop materials to sustain watershed scale decision-making and implementation. This initiative must be coordinated with the Department of Natural Resources and outdoor heritage fund activities for locally based invasive species control. Specific reporting and analysis of outcomes and findings of this alternative approach must be provided to enable duplication in other regions of the state.

Project Overview
Aquatic invasive species are a threat to the ecology and the recreational and economic viability of Minnesota's water resources. When an invasion is confined to a distinct lake or wetland, local government units will implement localized plans to address invasions. However, when a water body crosses jurisdictions, such as with river systems, to be effective a more coordinated, regional approach is necessary that is more attuned with the natural pathways for invasive species. The Red River Basin Commission is using this appropriation to pilot an effort to develop processes for addressing invasive species at a watershed scale using partnerships between local government units working collectively rather than individually. The pilot is intended to create a model for invasive species prevention that can be applied in other parts of the state.

OVERALL PROJECT OUTCOME AND RESULTS
Aquatic Invasive Species (AIS) spread has become one of the top concerns as it threatens the recreational and economic viability of the surface water resources of the Red River of the North watershed. According to the Minnesota Department of Natural Resources Infested Waters report

(2016), Zebra Mussels have invaded the Otter Tail, Pelican and Red River systems. The Local Governmental Units (LGU's) are implementing plans to address AIS issues at the county level, but introduction into our river systems necessitate a regional approach to education, outreach and management of AIS within the Red River of the North watershed. The goal of this pilot project was to expand AIS work from a largely county based process to a watershed scale through partnerships between LGU's. The project targeted three main watersheds, Buffalo, Otter Tail and Wild Rice, which make up the Red River drainage basins of Becker, Clay, Otter Tail and Wilkin Counties.

The project focused on three specific outcomes including 1) Coordination with LGU's to develop effective AIS communication and management. 2) Develop and distribute educational materials that support best management practices for AIS. 3) Expand and leverage opportunities to develop and deliver an AIS program based on best management practices that are replicable throughout the region.

The project made significant progress toward the coordination of the LGU's within the three watersheds and four counties. All endorsed the watershed approach and included this strategy in their local plans. The Red River Basin Commission staff met monthly for the duration of the project with AIS LGU's to integrate the watershed approach and worked directly with over 20 groups and 6,000 individuals including natural resource managers, lake property owners, students, teachers and researchers.

Educational materials and management resources including; AIS Risk Assessments for the targeted watersheds, an AIS mobile application, GIS based AIS maps, AIS identification cards, information brochures and promotional items and multiple surveys, presentations and ads were all developed and disseminated by the Red River Basin Commission for the watershed approach to AIS management as a result of the project.

PROJECT RESULTS USE AND DISSEMINATION

Educational materials and management resources developed by the Red River Basin Commission were disseminated to local groups, state agencies, national and international AIS related peer groups through the Red River Basin Commission website, public presentations and educational workshops.

Additionally, targeted media messages included regionally branded print media and radio AIS promotions that run along with other timely water conservation messages daily during prime listening time were adopted for reaching a regional listening audience of 71,500 weekly.

The resources developed including the Aqua.mn mobile application - https://aqua.mn/ and website- http://www.redriverbasincommission.org/ are designed so citizens can access educational materials and resources with links back to county based resources, watershed partner resources and Minnesota Department of Natural Resources AIS tools and information.

The AIS Risk Assessments that use science, fact and logic to identify and quantify vectors of risk assist in planning for zebra mussel management. These assessments were shared with and are used by watershed districts, local units of government, lake associations and others, to support the prioritization of funding and activities, including inspection and decontamination, to curtail and prevent the spread of zebra mussels and other AIS species to Minnesota's lakes and rivers. The AIS Risk Assessment GIS Tool allows users to interactively explore the infestation risks of lakes and rivers in the project area, and visualize where aquatic invasive species have been sighted. It serves as a digital companion to the static maps generated in the reports. The AIS Risk Assessment GIS Tool can be accessed on ArcGIS Online via the link:

http://www.arcgis.com/home/webmap/viewer.html?webmap=2a3a1ecbc1ca414b875c0b8feed7463a

The Red River Basin Commission lead efforts to collect, review and distribute current AIS survey data and watershed scale demographic data within the targeted project region. The survey initiatives were aimed to help determine the current knowledge, attitude and interest in AIS issues affecting Minnesota's lakes region. A final survey results report was shared with watershed districts, LGU's, lake associations and others and is attached to the LCCMR Final Report.

As a basin wide focused organization the Red River Basin Commission is continuing to take action in coordinating efforts between organizations focused on AIS. The Red River Basin Commission through the facilitation of the Red River AIS Technical and Science Team and multiple other working groups will continue to sustain and build upon the watershed scale AIS strategy for the Red River of the North International Watershed.
Project completed: 6/30/2016

FINAL REPORT (PDF)
Wild Rice River Watershed: AIS Prioritization (PDF)
Otter Tail River Watershed: AIS Prioritization (PDF)
Pelican River Watershed: AIS Prioritization (PDF)
Early Detection Zebra Mussel Monitoring Project (PDF)

Subd. 05 Foundational Natural Resource Data and Information

Restoring Forest Inventory Data
Subd. 05d $100,000 TF

Alan Ek
U of MN
2004 Folwell Ave
St Paul, MN 55108

Phone: (612) 624-3400
Email: aek@umn.edu
Web: http://www.forestry.umn.edu/People/Ek/index.htm

Appropriation Language
$100,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to obtain and restore statewide forest inventories of 1935, 1953, and 1966 to link with more recent data to improve understanding of historical forest trends and enhance long-term ecological monitoring.

Project Overview
Long-term forest plot datasets are helpful for understanding the changing conditions and ecology of forestland over time. The USDA Forest Service produced statewide forest inventories in 1935, 1953, 1962, 1977, 1990, 2003, 2008, and 2013. Unfortunately, only the data from 1977 to the present is currently easily accessible and available in full. Researchers at the University of Minnesota are using this appropriations to locate and restore important information from the 1935, 1953, and 1962 surveys and link it to the more recent data from 1977 and later to generate more detailed understandings of changes in Minnesota's forests over time. Compiling this data will be useful for examining forests in

terms of climate change implications for resilience and adaptability, carbon sequestration potential, habitat and biodiversity change, and overall forest health.

OVERALL PROJECT OUTCOME AND RESULTS

Motivation and objectives: Long-term datasets have proven invaluable for understanding changing forest conditions and implications for timber supply, wildlife habitat, insect, disease, wildfire, and climate change. This history is also important to charting future investments in forest based industry, forest management and the protection of forests resources for the role they play in water quality and retention of biodiversity. The primary objective of this project was to find and restore the first (1935), second (1953) and third (1962) statewide forest inventories of Minnesota plus other forest inventory datasets we might find. A secondary object was to develop comparisons of those inventories to present day forest conditions.

Methods: The project began with review of the published literature and available notes, letters, planning and other documents) plus direct contacts with present and former USDA Forest Service inventory staff who might recall aspects of these early inventories and especially where these data might be located. With success in locating these data, we have moved to digitize and restore them, check the accuracy of the restoration, and make comparisons with the present (the 2014) statewide forest inventory. Finally, we have sought to make these data (and metadata) publically available for other analysts and researchers.

Results: We have succeeded in restoring the 1935 statewide forest inventory in considerable detail, now described in a published project report. We have also located various summary data of the 1953 inventory. However, that effort was developed as an update of the 1935 inventory with inputs of data obtained from federal, state, county and private companies in various years. Thus it lacks the geographical and temporal specificity and completeness to be very detailed and thus useful in research. The 1962 inventory records were fully digital and are thought to be much more useful, but those records are yet to be located-thus our search is continuing.

Significance: The project publication (Flanary et al. 2016) included with this report describes the restoration of the 1935 inventory and comparisons to the present. Also, figures 8, 9 and 10 of this report describe major aspects of forest change. This report is viewed by the USDA Forest Service forestry inventory leadership as a very successful effort and a model for other states in restoration of inventories from the 1930s to the 1960s that have likewise been lost in terms of their detail. The agency is now moving to establish a nationwide effort to restore these older yet very valuable inventory datasets.

PROJECT RESULTS USE AND DISSEMINATION

The project data have been and are increasingly used to provide an understanding of the dramatic change in our forests since 1935. E.g., we have moved from a very young forest to an older forest with 3-4 times more standing biomass per acre than in the 1930s with important implications for forest health, wildfire, productivity and habitat. These results have been presented to the Minnesota Forest Resources Council and the Minnesota Forest Resource Partnership and been made available on the Interagency Information Cooperative website at: http://iic.umn.edu/project-areas/forest-inventory/historic-data/1936-usfs-survey. Additional presentations, publications and reports (and popular messages) are planned for the coming months.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Restoration of the 1936 Statewide Forest Survey of Minnesota (PDF)

Assessing Contaminants in Minnesota's Loons and Pelicans - Phase 2

Subd. 05g $260,000 TF

Carrol Henderson
MN DNR
500 Lafayette Rd, Box 25
St. Paul, MN 55155

Phone: (651) 259-5104
Email: carrol.henderson@state.mn.us
Web: http://www.dnr.state.mn.us

Appropriation Language

$260,000 the second year is from the trust fund to the commissioner of natural resources to continue to assess the potential impact of petroleum, dispersants, and heavy metal contaminants from the Deepwater Horizon oil spill in the Gulf of Mexico on the wintering habitat of Minnesota's common loons and white pelicans using radiotelemetry, geolocators, and contaminant analysis.

Project Overview

Over a three-month period in 2010, approximately five million barrels of oil was spilled into the Gulf of Mexico causing extensive damage to marine and wildlife habitats and resulting in significant losses in fish and wildlife populations. A number of Minnesota's migratory bird species spend parts of their lives in the areas impacted by the spill and impacts on their populations in the state could become evident over time. Impacts could be from immediate losses of birds that were present at the time of the spill or from cumulative negative effects resulting from contamination of the food chain by petroleum chemicals and the dispersants used on the oil. The two Minnesota species that are potentially most vulnerable are the common loon and the American white pelican; some of their young would have been present in the Gulf at the time of the spill and their behavior and feeding patterns put them at greater risk of exposure to chemicals from the spill persisting in the environment. The Minnesota Department of Natural Resources is using this appropriation to continue efforts aimed at determining whether or not common loon or American white pelican populations in Minnesota have been impacted by the Gulf oil spill. Phase one revealed that there were population losses following the spill and that a significant percentage of Minnesota loons and pelicans have been exposed to oil and dispersant contaminants, which may be having long-term effects by causing changes in behavior, migratory abilities, reproductive success, or longevity. Any impacts documented will be critical for receiving remediation funds from the Federal Natural Resource Damage Assessment (NRDA) process currently underway, and those funds could be used to help restore the populations of these two species.

OVERALL PROJECT OUTCOME AND RESULTS

The Deepwater Horizon oil spill in 2011 released about five million gallons of crude oil into the Gulf of Mexico and subsequent deposition of up to one million gallons of "dispersant". Both are carcinogenic and threaten the health of Common Loons and American White Pelicans that nest in Minnesota and

winter in the Gulf of Mexico.

Minnesota has the largest populations of Common Loons and American White Pelicans in the continental US. We have a stewardship responsibility to preserve healthy populations of those species.

This project documented the threat posed to loons and pelicans by the Deepwater Horizon oil spill. Loon research involved satellite telemetry and internal transmitters to monitor migration and wintering movements, geolocators on leg bands to study diving behavior, and sampling of blood, feathers, tissues, and eggs for contaminants. Pelican research involved analyses of eggs and shed bill knobs. Collection of pelican migration with cell tower transmitters was not successful.

Radiotelemetry revealed juvenile loons wintering in the Gulf where contaminants occurred. In summer they traveled along the Atlantic seaboard to Quebec and northern Manitoba their first two years. This information is new to science.

Sublethal petroleum contaminant levels were present in pelican eggs (46.3%), bill knobs (78.4%), loon eggs (17.9%) and blood (35.0%), loon feathers (14.3%) and fat (31.8%). Dispersant contamination was found in pelican bill knobs (37.0%) and eggs (43.5%). Those contaminants could affect survivability, behavior, reproduction, or chick survival. Loon population levels appear stable. Pelicans declined from 2012 to 2015 but the cause does not appear related to the oil spill.

The federal Oil Pollution Act of 1990 will allow the State of Minnesota to obtain remediation funds from BP to pay for recovery efforts for conservation of loons and pelicans. The DNR is awaiting guidelines to apply for remediation funds.

PROJECT RESULTS USE AND DISSEMINATION

This LCCMR project has generated an enormous amount of media and public attention, especially for the work related to loons and the potential impact of the Deepwater Horizon oil spill on loons. There have been numerous presentations to conservation groups, garden clubs, bird clubs, civic groups, and statewide media coverage.

Recent media coverage has included:

1. Loon research. A look at new loon research at a time when Minnesota stands to share in BP Oil Spill settlement money to benefit the state bird. Photo gallery by Aaron Lavinsky.Star Tribune. Sept. 3, 2016.
2. Minnesota on Cusp of a New Era of Loon Conservation. Star Tribune. Tony Kennedy. Sept. 4, 2016.
3. Gulf oil spill residue found in Minnesota loons. Greg Vandegrift, KARE-TV. Sept. 27, 2016.
4. Loon Study. Frequently asked questions. USGS. Upper Midwest Environmental Sciences Center. Website.
5. Loons and the gulf oil spill. MN DNR website. Nongame Wildlife Program.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Wild Bee Pollinator Surveys in Prairie-Grassland Habitats
Subd. 05i $370,000 TF

Gerda Nordquist
MN DNR
500 Lafayette Rd
St. Paul, MN 55155

Phone: (651) 259-5124
Email: gerda.nordquist@state.mn.us
Web: http://www.dnr.state.mn.us

Appropriation Language
$370,000 the second year is from the trust fund to the commissioner of natural resources to assess the current status and distribution of wild bee pollinators in prairie-grassland habitats of Minnesota.

Project Overview
Wild bees are important for their pollination services and for their contribution to species diversity; for example, many prairie-grassland plant species require pollinators for seed production. However, while the importance of plant-pollinator interactions is well recognized, there are large gaps in our knowledge of Minnesota's wild bees. The only statewide list of bee species was published in 1919 and it reported only 88 species, whereas it is currently estimated that there are approximately 350-400 native bee species in the state. The Minnesota Department of Natural Resources is using this appropriation to conduct field surveys throughout the prairie-grassland region of MN to document the diversity and distribution of wild bees and related vegetation diversity and quality in order to assess the current status of wild bees and provide a baseline for comparing to past and future data. This information will be used to refine conservation and management decisions to enhance bee pollinator populations and prairie-grassland habitat. Future efforts could further expand knowledge by extending surveys into forested and forest-transition regions of the state.

OVERALL PROJECT OUTCOME AND RESULTS
Wild bees are important for their pollination services and also for their contributions to species diversity in prairie-grasslands. Many prairie plant species require pollinators for seed production and bees are often cited as the most important pollinator group. Native prairies once covered a third of Minnesota, but less than two percent of this habitat remains today. The impact of this habitat loss to wild bees is unknown due to large gaps in our knowledge of Minnesota's wild bees. The primary objective of this project was to fill in these knowledge gaps. This was accomplished by compiling existing records of wild bees statewide and conducting surveys of wild bees in prairie-grassland habitats of western Minnesota. The association of wild bees with native plant species and the effects of prairie restoration efforts on bee species diversity are poorly understood. To address these information needs, both native prairie and restored grassland sites were surveyed for bees and associated flowering plants.

To build upon the 1919 publication, The Hymenoptera of Minnesota, by Frederic Washburn that listed only 66 bee species, 11 museum collections in the Upper Midwest were accessed for bee specimens from Minnesota. Numerous personal collections, reports and publications were reviewed. Distributional data was obtained for over 30,000 bee specimens, resulting in a preliminary Minnesota wild bee list that presently stands at 418 reported species with an additional 29 species requiring expert evaluation . In

addition, the statewide distribution of known species was greatly expanded. For example, a common sweat bee (Halictus ligatus) was known from only one county in 1919, but this project has compiled records from an additional 44 counties.

Surveys for wild bees were conducted at 75 locations in western Minnesota, May through October 2015 and May through June 2016 . Fifty-five native prairie sites distributed across western Minnesota and eight restored grassland sites were sampled every three weeks to obtain seasonal information on bees and flowering plants, and comparative information on bees found in native prairie versus restored grassland. The remaining twelve sites were sampled every three weeks to augment county records. Over 10,000 bee specimens were collected through this effort. Specimens have been prepared and data entered into databases that will be used to inform researchers and land managers.

Important bee and plant records were obtained. The rare and declining yellow banded bumble bee (Bombus terricola) was documented in Stevens County. This is a county record for the species and also the first time this bee has been recorded visiting snowberry plants, genus Symphoricarpos. Equally notable is the absence of another declining species, the rusty patched bumble bee (Bombus affinis). Twenty-eight county records for plants were collected during these surveys, as well as information on blooming phenology.

PROJECT RESULTS USE AND DISSEMINATION
Data collected from this project is stored in the MNDNR Natural Heritage Information System and bee specimens are being deposited in the Insect Collection at the University of Minnesota. These will be available to researchers, land managers, and the public.

Several MNDNR websites were developed that summarize the goals and accomplishments of this project and address wild bees and other pollinators:

- Native Bees of Minnesota's Grasslands presents the goals and accomplishments of this project http://www.dnr.state.mn.us/mbs/grasslandbees.html.
- Minnesota's Pollinators webpage http://www.dnr.state.mn.us/pollinators/index.html
- Minnesota Pollinator Resources webpage http://www.dnr.state.mn.us/pollinator_resources/index.html).
- Pollinator Resource Values for Upland & Wetland Prairies webpage and booklet http://files.dnr.state.mn.us/natural_resources/npc/pollinator_booklet.pdf.

The project coordinator/bee specialist (Crystal Boyd) has delivered information on this project through presentations, publications, interviews and educational events. She co-organized a Tallgrass Prairie Bee Identification Workshop and has highlighted Minnesota's wild bees at a wide variety of public venues.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Subd. 06 Methods to Protect, Restore, and Enhance Land, Water, and Habitat

---

Cattail Management for Wetland Wildlife and Bioenergy Potential
Subd. 06i $74,000 TF

Daniel Svedarsky
U of MN

Northwest Experiment Station
Crookston, MN 56716

Phone: (218) 281-8129
Email: dsvedars@mail.crk.umn.edu
Web: http://www3.crk.umn.edu/faculty/S/WDaniel_Svedarsky.htm

Appropriation Language
$74,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Northwest Research and Outreach Center in Crookston to evaluate different management techniques for cattail control and related wildlife impacts in northwest Minnesota and to assess the use of cattails as a biofuel feedstock.

Project Overview
On many public lands in northwest Minnesota, cattail growth has far exceeded the distribution recommended for optimum wetland wildlife habitat and a need for cattail control has become recognized. Cattails have also recently been demonstrated to have bioenergy potential. Researchers at the University of Minnesota in Crookston are using this appropriation to evaluate cattail management and harvesting techniques in various northwest Minnesota habitats as a means of reducing an increasing overabundance of exotic cattails in wetlands, which are degrading wildlife habitat, while providing a value-added feedstock for sustainable bioenergy in the region.

OVERALL PROJECT OUTCOME AND RESULTS
Cattails are a major problem in Minnesota wetlands because their growth is commonly in excess of the 50:50 ratio of cattail/bulrush vegetation to open water desired for optimum wetland wildlife habitat. How to control them is the most frequently asked question by wetland managers. This project evaluated traditional management techniques (mowing, burning, grazing, and chemical) and explored the logistics of partial harvest for biofuel. Since 2005, the International Institute for Sustainable Development in Winnipeg, Manitoba has been evaluating cattails to remove nutrients from runoff water to reduce eutrophication of Lake Winnipeg, and develop an economically viable system of harvesting cattails for biofuel. This project used the Canadian model to evaluate possible applications in Minnesota. Management effects on vegetation, birds, and amphibians were measured. The energy content of cattail pellets is similar to wood (~ 8,500 Btu/lb.) and, at least for northwest Minnesota, are an ideal sustainable bioenergy source; available in large quantities, no planting required, and no competition with agricultural lands. Challenges include guaranteeing a reliable fuel supply in spite of varying wetland and weather conditions, and refine logistics so the energy content of the product is in favorable relationship to the total amount of energy required to harvest, transport, and process. Cattails produce 8-10 tons of biomass per acre so the resource is large since about half could be harvested in a checkerboard pattern for wildlife management. Over 95,500 acres of cattails are in the 10 northwestern Minnesota counties. What is needed is an integrated management system of dependable harvest, processing into an acceptable fuel (usually pellets), storage systems, and identify users all within reasonable proximity to reduce transportation costs. Such would help offset the expensive cost of cattail control, and generate a renewable and Minnesota-grown fuel that would help mitigate greenhouse gases. The potential economic and environmental values are significant.

PROJECT RESULTS USE AND DISSEMINATION
Findings from this project and other case studies are being disseminated through presentations to a broad spectrum of interest groups (natural resource agencies, landowners, researchers, students,

private industry, and entrepreneurs), through the electronic media, and by an illustrated booklet. The booklet by 13 authors contains a review of a broad range of management techniques along with a discussion of the ingredients of a niche industry, called the "bioeconomy" in Manitoba. Presentations were made to the following: Cattail Summit in Crookston campus involving collaborators from the International Institute for Sustainable Development in Winnipeg, University of North Dakota, Red River Basin Commission, Agricultural Utilization Research Institute, and the Hudson Valley Grass Energy Cooperative of Kingston, NY; annual meeting of the North Dakota Chapter of The Wildlife Society; Wetland Biomass Workshop at Loyola University in Chicago: Heating the Midwest with Biomass Conference in Rochester, MN sponsored by Agriculture Utilization Research Institute; International Wildlife Management Congress in Sapporo, Japan; symposium on Renewable Energy and Wildlife at the national meeting of The Wildlife Society in Winnipeg, Manitoba; Cattail Management and the Bioeconomy Workshop, U of Winnipeg, Manitoba; workshop on using cattails for bioremediation and energy sponsored by Red River Basin Commission. More recently, Ray Norrgard, one of the booklet co-authors and Wetlands Program Leader for MN DNR spoke on cattail management at a statewide wetland management workshop for 150 wetland wildlife managers sponsored by the MN Chapter of The Wildlife Society. Booklets were distributed and discussed.

Cattail and other resources on biofuels and sustainability are posted on the U of MN Crookston Center for Sustainability web page under "Reports and Resources." https://www.crk.umn.edu/units/center-sustainability. Also at the U of MN's Northwest Research and Outreach Center web site under http://www.nwroc.umn.edu/research/wildlife-management-biofuels with the booklet at: http://www.nwroc.umn.edu/sites/nwroc.umn.edu/files/cattail_management.pdf A list serv of wetland and sustainability researchers and managers has been established and sets the stage for follow-up collaboration.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Expansion of Greenhouse Production
Subd. 06k $176,000 TF

Lana Fralich
City of Silver Bay
7 Davis Dr
Silver Bay, MN 55614

Phone: (218) 226-4408
Email: lanaf@silverbay.com
Web: http://www.d.umn.edu/cscd/victusfarm/

Appropriation Language
$176,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with the city of Silver Bay to expand and enhance a city-owned greenhouse facility to increase system production for locally grown food on a year-round basis and reduce water usage.

Project Overview

New and innovatively designed greenhouse facilities have the potential to provide sustainable food, fuel, and other products year round by utilizing ecological processes and other practices to integrate production of fish, plants, and algae in a low input, self-sustainable system. The City of Silver Bay and researchers at the University of Minnesota - Duluth are using this appropriation to expand and enhance a demonstration greenhouse facility. Refined techniques developed at the facility have the potential to be transferred and replicated at similar facilities throughout the state.

OVERALL PROJECT OUTCOME AND RESULTS

Minnesotans currently import over 90% of the food they consume each year. New developments in Controlled Environmental Agriculture (CEA) have the potential to allow year-round food production in cold climates like ours. These CEA approaches hold the promise of billions in new economic development along with increased environmental and human health producing environmentally sustainable and healthy food year-round in Minnesota. Victus Farms is a 9,000 ft2 controlled environmental agriculture facility (CEA) in Silver Bay, MN operated by researchers at the University of MN, Duluth. Victus Farms is aimed at developing/demonstrating an environmentally sustainable and economically viable approach to year-round food production in cold climates. It also conducts applied research to improve these CEA production methods, and education to communicate the benefits of CEA and train its future workforce.

LCCMR Funds were used at Victus Farms to explore the potential of a wide variety of crops and production methods. Specifically, we wanted to determine the revenues generated per square foot of greenhouse space for a variety of potential crops, and determine the best methods to grow these crops. We were able to determine that lettuce ($101.76/ft2), basil ($125.84/ft2) and hot peppers ($130.00/ft2) were the crops with the best economic potential. In addition, we concluded that given its large local market and ease of year-round growth, lettuce has the best overall potential. We were also able to determine the most consistent, environmentally sustainable and economically viable growth method was a hydroponic approach including both vertical thin films and deep water floating rafts. As the result of this project work and its dissemination, two new related businesses have been created in Northern Minnesota and several others are in the early stages of development. These CEA approaches have the potential to create a new multibillion-dollar sustainable food production industry in Minnesota.

PROJECT RESULTS USE AND DISSEMINATION

Since the LCCMR funded portion of our project began in June of 2014 we have conducted numerous dissemination activities. These include local, national and global presentations (13 total); Tours of the Victus Farms facility to a wide variety of groups/individuals (over 20 in total); Peer reviewed research publications (3); Technical Reports (10 total) and numerous media stories (8 total) in local newspapers, TV stations, Radio Stations and University of MN, communication outlets. Therefore, we have been fortunate to enjoy a great deal of interest in our work at Victus Farms over the past several years, and have had numerous opportunities to communicate our work to a broad audience from local hobbyists to community groups to private businesses to university researchers, to prominent, local, state and national policy makers. As the result of our project work and these widespread dissemination activities, two new CEA businesses (Mariner Farms and Wicked Fin Aquatic Farms) have begun operations in our region, and many others are in the early stages of development.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Subd. 07 Land Acquisition, Habitat, and Recreation

Shoreland Acquisition on St. Croix River
Subd. 07d $1,250,000 TF

June Mathiowetz
Washington County
14949 62nd Street N
Stillwater, MN 55082

Phone: (651) 430-6016
Email: june.mathiowetz@co.washington.mn.us
Web: http://www.co.washington.mn.us

Appropriation Language
$1,250,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with Washington County to purchase 15 acres, encompassing 3,500 feet of St. Croix shoreland paralleling Brown's Creek State Trail in the city of Stillwater. The county will transfer the parcel to the city of Stillwater. This appropriation is contingent on the expenditure of at least $2,500,000 of nonstate match.

Project Overview
The St. Croix River is one of the most pristine, large river ecosystems remaining in the upper Mississippi River System. Washington County, in partnership with the City of Stillwater, is using this appropriation to acquire 15 acres containing 3,500 feet of St. Croix River shoreline just north of downtown Stillwater and parallel to the Brown's Creek State Trail. The land will be turned into a local nature park for trail users, river users, tourists, and area residents with passive recreation including fishing, boat launching, walking, and picnicking.

OVERALL PROJECT OUTCOME AND RESULTS
This $4.3 million project resulted in acquisition of 15 acres of property along the St. Croix River for a new shoreline park in downtown Stillwater to enhance ecosystems, restore public access to the riverfront and contribute to an even more vibrant downtown economy.

This premier property was one of the longest stretches of St. Croix River frontage remaining in single private ownership in Washington County, with approximately 3,300 feet of largely wooded area sloping toward the river and containing a beach. The long rectangular piece of land running from just north of the old Zephyr line depot almost to the Wolf Marina in downtown Stillwater lies within the Lower St. Croix National Scenic Riverway District. The new Browns Creek Trail that opened in fall of 2014 runs parallel with the property and will connect downtown Stillwater to the Gateway Trail. State, regional and local residents and visitors will soon have a new gem of a park in which to connect, relax, recreate and take in the awe-inspiring St. Croix River.

The parcel was initially acquired by Washington County who is placing a conservation easement on it to assure its return to a more natural state in perpetuity and transferring it to the City of Stillwater in 2015. The City of Stillwater will launch a planning process to define the use of the property and develop a management plan for the restoration and long-term care of the property. This could include recreational

uses such as shore fishing, short-term docks, walk-in boat launches, walking paths, nature observation, and picnicking, in addition to its trail access.

Collaboration and taxpayer funding from three levels of government made this project possible: $1.25 million in State ENRTF dollars, $1.96 million in Washington County Land and Water Legacy Funds, and $1.125 million in City of Stillwater funds.

PROJECT RESULTS USE AND DISSEMINATION
Our dissemination efforts for this project focused on generating media coverage to make the public aware of the purchase agreement and closing on the property. We released two press releases about the project, one announcing the signing of the purchase agreement and approval of the project by the Washington County Board on September 17, 2014 and the other announcing the closing on November 25, 2014. The St. Paul Pioneer Press, KSTP, Stillwater Gazette and Stillwater Current ran news stories.

Project completed: 6/30/2015

FINAL REPORT

Subd. 08 Air Quality, Climate Change, and Renewable Energy

Solar Photovoltaic Installation at Residential Environmental Learning Centers
Subd. 08h $150,000 TF

Dale Yerger
The MN Coalition of RELCs
Deep Portage Learning Center
2197 Nature Center Drive NW
Hackensack, MN 56452

Phone: (218) 682-2325
Email: portage@uslink.net
Web: http://www.deep-portage.org

Appropriation Language
$150,000 the second year is from the trust fund to the commissioner of natural resources for agreements with Deep Portage Learning Center to coordinate with Audubon Center of the North Woods; Eagle Bluff Environmental Learning Center; Laurentian Environmental Learning Center; Long Lake Conservation Center; and Wolf Ridge Environmental Learning Center the installation of at least five kilowatt institutional solar arrays at each of the six residential environmental learning centers as a teaching tool. Prior to the installation, the proposed placement of the solar arrays must be submitted to the Legislative-Citizen Commission on Minnesota Resources office to ensure the demonstration of the maximum educational value.

Project Overview
Over the past several years six environmental learning centers located around the state - Audubon Center of the North Woods, Deep Portage Learning Center, Eagle Bluff Environmental Learning Center, Laurentian Environmental Learning Center, Long Lake Conservation Center and Wolf Ridge Environmental Learning Center - have been implementing demonstrations of energy conservation,

energy efficiency, and renewable energy on their campuses for use as educational tools for the thousands of students and visitors that come to the centers each year. The six environmental learning centers are using this appropriation to expand their energy demonstration offerings by installing 5-kilowatt solar photovoltaic systems at each of the centers.

OVERALL PROJECT OUTCOME AND RESULTS

Six Minnesota-made 6.15 kW tenKsolar arrays have been installed at six Minnesota Environmental Education centers. Each array has an internet-based reporting system that is hosted on the eGauge website. The device numbers are as follows:

- Deep Portage: 19732
- Wolf Ridge: 19723
- Eagle Bluff: 16737
- Laurentian: 19730
- Audubon: 19735
- Long Lake: 19742

You simply type in the device number, and various graphs and production numbers will pop up.

Teachers and students and members of the interested public will be able to monitor the production of whichever center they would like to follow; they can compare and contrast. All of the arrays are situated in public places where access to the general public is easily achieved.

We (the RELCs) believe that this project will be accessed by at least 25,000 people each year. We are the premier disseminators of Environmental Education in Minnesota, and this ability will greatly increase the knowledge and analysis of Solar Electric production in the State of Minnesota. Prior to this project, there were many arrays in Minnesota that did not have the public accessibility and analysis available to the general public. We believe that a new leaf is turning over at the RELCs in regard to Solar Electric education. These arrays should be solid producers for the next 25 years; therefore, the public will receive many years of value and top-quality dissemination.

As of August 11, 2015 the arrays have produced 12.53 megawatt hours of electricity, they have mitigated approximately 12 tons of atmospheric CO2, and are showcasing Minnesota technology and innovation. The unique reflectors of the tenKsolar arrays were formulated by Minnesota's own 3M Company.

PROJECT RESULTS USE AND DISSEMINATION

Vigorous dissemination has begun at Eagle Bluff, Wolf Ridge and Deep Portage.

Wolf Ridge has developed an alternative energy brochure that features the solar array and invites guests and interested members of the public to take a tour. They have also crystallized their new solar electric curriculum around the array and are excited that the Jack Piccotta Science Center has gone net zero in the summer months.

Deep Portage offered six solar energy tours this summer and also prominently featured the array in the Izaak Walton League Camp (June 28-July 3, 2015) curriculum. There were also several dozen impromptu solar energy tours, based on people walking by the array and asking, "What's this?"

Eagle Bluff has used the array during the 2014-15 school year, as their array was activated last Fall. This past summer numerous visitors and campers were also exposed to the wonders of solar energy.

Northwoods Audubon, Long Lake and Laurentian have toured interested members of the public and will be putting great effort into this coming school year and embedding the previously developed solar energy curriculum into their school offerings.

Project completed: 6/30/2015

FINAL REPORT

Subd. 09 Environmental Education

Youth-led Sustainability Initiatives in 40 Greater Minnesota Communities
Subd. 09b $350,000 TF

Dave Pederson
Prairie Woods Environmental Learning Ctr
12718 10th Street NE
Spicer, MN 56288

Phone: (320) 354-5894
Email: d.pederson@tds.net
Web: http://www.youthenergysummit.org/

Appropriation Language
$350,000 the second year is from the rust fund to the commissioner of natural resources for an agreement with Prairie Woods Environmental Learning Center and Laurentian Environmental Learning Center to complete over 100 youth-led sustainability action projects in 40 communities in southwest, southeast, central and northeastern Minnesota.

Project Overview
Adoption of renewable energy technologies and energy conservation practices can contribute in a variety of ways to the environmental and economic health of rural Minnesota communities through costs savings and emissions reductions. Engaging and coaching students as the leaders in the process of implementing such practices provides the added benefit of increasing knowledge, teaching about potential career paths, and developing leadership experience. Using this appropriation the Prairie Woods Environmental Learning Center and its partners are expanding an existing program called the Youth Energy Summit (YES!) to engage approximately 650 students in implementing 150 additional youth-led renewable energy and energy conservation projects in over 40 communities in central, northeastern, southwestern, and southeastern Minnesota. These projects will be driven by collaboration between students, community members, and local businesses and organizations.

OVERALL PROJECT OUTCOME AND RESULTS
The Youth Energy Summit (YES!) program is designed to mobilize teams of youth to address critical environmental issues and emerging opportunities in Minnesota.

The YES! program impacts for July 1, 2014 to June 30, 2016 include:

- 36 YES! Teams completed over 280 youth-led energy conservation projects in 52 communities
- Over 820 students in grades 6-12 participated in YES! and worked with local community leaders, businesses, schools, public utilities, waste haulers and other partners
- Over 26,000 additional students and 125,000 community members were directly impacted by these efforts to decrease waste and increase energy efficiency

Over the last 2 seasons (2014-2016), YES! teams leveraged over $ 550,000 in local support of projects and in the form of in-kind contributions, matching funds, and volunteer hours and another $ 110,000 in grants, fundraisers and corporate support. These collaborative, student-driven projects included: installing hydration stations, building and maintaining deep winter greenhouses, school gardens, hydroponic gardens, solar boats and vehicles, installing waste oil recycling stations, improving recycling systems, reducing school energy bills, promoting environmental stewardship through educational events and more!

During the past 2 seasons, YES! staff conducted 4 Fall Summits, 25 Winter Workshops tailored to meet the needs and interests of teams, and a Community Convening co-hosted with Climate Generation. Teams participated in spring judging events each season with award winners highlighted in the Team Accomplishments documents.

The YES! program demonstrates that young people in Minnesota are ready, willing and able to assume leadership roles and take action to address environmental issues and opportunities affecting our state and the world. Collaborating partners for this project include: Prairie Woods ELC, Laurentian Environmental Center, Ney Nature Center, Central Minnesota Sustainability Partnership, Southwest Initiative Foundation, and Saint John's University. Of special note, the Royalton YES! team won the state-wide 2014 "Red Wagon" award from the Minnesota Alliance with Youth.

PROJECT RESULTS USE AND DISSEMINATION

Information on YES! projects are regularly highlighted through the YES! website (www.youthenergysummit.org/), blog posts, Facebook updates and Twitter. The YES! website received well over 25,000 page views from July 1, 2014 to June 30, 2016 with 68 % of these viewers being new to the site. Local media frequently print stories on YES! team accomplishments, the Warbler, a PWELC newsletter reaching 1,400 people, goes out 3 times a year and commits a page of each publication to YES! furthermore the YES! e-newsletter goes out 4 times a year.

Several communications and outreach activities have been done in relation to this Youth-Led project including one Community Convening hosted by the YES! Albany team in collaboration with Climate Generation: A Will Steger Legacy. This event brought together community leaders, resource experts, parents and students to learn about climate mitigation strategies and to highlight local resources. A highlight of the evening was the telling of climate stories by 4 citizens, 2 of which were YES! students. Other outreach activities include tabling at local green fairs and events by student-led YES! steams.

The program's funding partners are regularly updated on projects and show their support through continued funding and volunteer time. Coordinators submit Press Releases to local and regional outlets for Spring Award winners and other important stories.

YES! staff and students presented at a 21st Century Skills workshop for the National Joint Powers Alliance in Staples, MN, (2015), Region 9 Economic Development events (2016) and the Smithsonian Water Ways exhibit at Prairie Woods ELC (2016) and plan to table at the Minnesota Community

Education and Minnesota Education Association events this fall (2016). During YES! events, techniques such as S.M.A.R.T. goals have been developed and shared with the students and students have taken that information back to their Team to successfully plan and implement projects.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Educating Minnesotans about Potential Impacts of Changing Climate
Subd. 09e $325,000 TF

Kristen Poppleton
Will Steger Foundation
2801 21st Avenue S, Ste 110
Minneapolis, MN 55407

Phone: (612) 278-7147
Email: kristen@willstegerfoundation.org
Web: http://www.willstegerfoundation.org

Appropriation Language
$325,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with the Will Steger Foundation to plan and conduct forums, workshops, and trainings on Minnesota's changing climate and the potential impacts on ecosystems and natural resources. An accompanying television program and information spots must be produced for broadcast and use at the forums.

Project Overview
Climate change has and will have profound effects on Minnesota's economy, agriculture, tourism, and natural resources. While climate change is often discussed in the broader contexts of its potential impacts at a national or international level, research has shown that climate change education and behavior change happens more effectively when the issue is made local and relevant. The Will Steger Foundation is using this appropriation to develop and implement efforts aimed at increasing understanding of the potential impacts of climate change for Minnesota and changing related behavioral norms of Minnesotans through the use of stories of individuals' experiences, facilitation of related discussions, and guidance toward additional available resources. Activities include holding public forums and educator workshops around the state, establishment of peer support networks, and the production and broadcast of information spots and a documentary on public television. Approximately 100,000 people are expected to be reached statewide.

OVERALL PROJECT OUTCOME AND RESULTS
In 2014 Climate Generation: A Will Steger Legacy was allocated $325,000 from the Minnesota ENRTF to implement Educating Minnesotans about Potential Impacts of a Changing Climate. The project was branded as Climate Minnesota: Local Stories, Community Solutions and developed in response to the urgent need to increase climate literacy and promote behavior change among Minnesotans. The knowledge of local experts and the stories of individuals engaged in the issue of climate change were a key focus.

The two major activities of this project include:
1) 12 Statewide Public Convenings: 12 public convenings engaged 1000 Minnesotans and 100 community organizations, across the state. Convenings included presentations on climate impacts and solutions, and were community specific. A climate expert, such as Mark Seeley, presented on climate impacts including flooding in Duluth and increased urban heat effects in Rochester. In addition, a panel of community members shared stories of how they were implementing climate solutions, such as stormwater management through raingardens, or public health education. The convenings closed with a range of workshops featuring tangible solutions such as energy efficiency projects, building rain gardens or crafting their own climate story to share.

Post convening survey results showed that:

- Participants show an increase in their confidence to talk about climate change impacts and solutions
- PThe majority of participants said they met at least 2 people at the convening that they could email, call or meet with if they needed advice about how to deal with climate change
- P88% of participants have taken some step toward mitigating and or adapting since the convening

2) Television production: In coordination with TPT, a 60 minute documentary, Minnesota Stories in a Changing Climate, was produced that shares the stories of six Minnesotans experiencing climate change. The documentary includes expert testimony and a discussion guide.

PROJECT RESULTS USE AND DISSEMINATION
The results of Climate Minnesota: Local Stories, Community Solutions have been used and disseminated through a variety of means depending on the project activity.

Climate Minnesota Convening's
The model of public engagement that was developed and tested through Climate Minnesota has been shared, including the survey results of our convening's at:

- CLEAN network (national climate literacy network) webinar presentation
- Poster presentation at the American Geophysical Union
- Minnesota Climate Adaptation Conference

All convening's have a recap page where we have included audio, presentations and sometimes video for individuals to revisit and use as a resource. They can be accessed at www.climategen.org/

Finally, we have also applied for funding to use the model both nationally and locally. We will be presenting on the project at the upcoming National Association for Environmental Education Conference in October

Webinars
Convening survey results and featured stories from the convening's were shared at two webinars held in March and April. 250 people attended or watched the archive of these webinars.

Minnesota's Changing Climate Screenings

We continue to offer screenings and discussion of Minnesota's Changing Climate around thes state. They screenings offer an opportunity to customize discussion based on location. For example, one screening was held at Frontenac State Park and the focus was climate change impacts on natural areas, while screenings in businesses offer the opportunity to discuss behavior change in the workplace. We have offered it so far in locations engaging 750 people.

Educator Workshop
100 educators viewed and received copies and discussion guides of Minnesota's Changing Climate at the last two summer's institutes for climate change education. The majority showed interested in using the film in their classroom.

Storytelling Collection
Our storytelling collection has grown to 30 over the last two years. We continue to develop and coach individuals to add to the collection. Governor Dayton chose to use one of the stories from our collection in his "state of the state" address.

Media Coverage and Participation Summary
Climate Minnesota Participants

- 1100 Convening Attendees
- 120 Community Organizations Reached
- 45 Convening Workshop Leaders
- 37 Storytellers
- 130 Webinar Attendees
- 12 Minnesota Stories in A Changing Climate Screenings
- 750 Minnesota Stories Screening Attendees

Climate Minnesota Convenings Media Highlights:

- 26 media stories about convenings (pre- and post-event coverage)
- 15 stories in local papers (Bemidji Pioneer, Owatonna People's Press, Duluth News Tribune, etc.)
- 3 blog posts (Minnesota Brown, MPR's Updraft blog, etc.)
- 3 TV interviews
- 5 radio interviews (WTIP North Shore, Mankato State campus station, etc.)
- Additional mentions of convenings on MPR in lead-up to events
- Climate Minnesota project highlighted by the White House in the announcement of their new Climate Education and Literacy Initiative (Dec. 2014)
- Media stories surrounding Climate Minnesota have consistently used our "frame" - talking about climate change as a local and personally relevant issue

Project completed: 6/30/2016

FINAL REPORT (PDF)

Pollinator Education Center at the Minnesota Landscape Arboretum
Subd. 09f $615,000 TF

Peter Moe

U of MN - MN Landscape Arboretum
3675 Arboretum Dr
Chaska, MN 55318

Phone: (952) 443-1408
Email: moexx004@umn.edu
Web: http://www.arboretum.umn.edu

Appropriation Language
$615,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to develop exhibits for an educational center that will offer hands-on learning experience about the role of pollinators and importance of pollinator habitat. Exhibits must utilize and integrate the best available science pertaining to all pollinator types, particularly native species. Approval of the work plan for this appropriation is contingent upon the organization addressing how it will increase access to the center by youth at no or limited cost.

Project Overview
Pollinators play a key role in ecosystem function and in agriculture, including thousands of native plants and more than one hundred U.S. crops that either need or benefit from pollinators. However, pollinators are in dramatic decline in Minnesota and throughout the country. The causes of the decline are not completely understood, but identified factors include loss of nesting sites, fewer flowers, increased disease, and increased pesticide use. Developing an aware, informed citizenry that understands this issue is one key to finding and implementing solutions to counteract these factors. The Minnesota Landscape Arboretum is using this appropriation to implement educational efforts designed to raise awareness about pollinators, their role in the environment and the economy, and the challenges they currently face due to recent unprecedented decline. Exhibits, programming, and demonstration sites will explore the role of pollinators in plant reproduction, maintaining biodiversity, and supporting agriculture and provide guidance on actions individuals can take, such as with their landscaping choices, to help pollinators.

OVERALL PROJECT OUTCOME AND RESULTS
It is well-known that pollinators are suffering due to loss of habitat, diminished diversity of native vegetation, and upticks in disease. The Minnesota Landscape Arboretum is in a unique position to introduce the public to the plight facing our pollinators what they can do to help. Last year the Arboretum hosted 462,000 visitors including 28,000 school children on field trips. Now all of these visitors will have an opportunity to learn the basics of pollinator science at the Pollination Education Center - through both formal and informal education. In collaboration with University of Minnesota researchers Dr. Marla Spivak and Dr. Karen Oberhauser, the Arboretum has created highly engaging exhibits that will encourage visitors to explore:

- The intricate relationships between flowers and their pollinators,
- The critical role of pollination in plant reproduction and in maintaining species diversity,
- How pollination is vitally important for many food crops,
- Creating pollinator-friendly landscapes in urban and rural settings, by helping to preserve and restore diversity and health of native habitats.

On the grounds surrounding the Pollination Education Center, the Garden for Pollinators introduces visitors to plants that are valuable for use in pollinator-friendly landscaping. Interpretive signage

provides tips on planting for pollinators, observing pollinators, and offers citizen science opportunities and plant labels provide visitors with specific information on the plant species that they can use in their gardens. Zones in the garden for pollinators include:

- Butterfly Zone - Demonstrates perennials, with sturdy clusters of flowers preferred by butterflies and caterpillars.
- Compare Zone - Allows for comparison of native species vs. cultivars and their benefit to pollinators.
- Bee Lawn - Planted with dutch clover, ground plum, and coreopsis as an example of a pollinator friendly lawn for low-traffic areas.
- Wild Bee Habitat - An example of nesting habitat for native bees.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Raptor Lab Integrating Online and Outdoor Learning Environments
Subd. 09h $186,000 TF

Julia Ponder
U of MN
1920 Fitch Ave
St. Paul, MN 55108

Phone: (612) 624-3431
Email: ponde003@umn.edu
Web: http://www.raptor.cvm.umn.edu/

Appropriation Language
$186,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Raptor Center to develop an environmental education program on raptors for middle schools that integrates outdoor experiences with technology and scientific investigation.

Project Overview
Increasingly many youth are disconnected from the outdoors and the natural world and many of these same youth, nearly 50% in Minnesota, are also not proficient in science. Yet such experiences and knowledge are necessary components for this next generation to understand and participate in solving the complex environmental challenges facing our world. The University of Minnesota's Raptor Center is using this appropriation to develop and implement an online learning environment for 7th and 8th grade students that links outdoor experiential learning with classroom curriculum by engaging students in the design and execution of student-based research projects that utilize real-world data from raptors admitted to the Raptor Center in conjunction with students' outdoor exploration of their local environment. Initially the program will be tested with a minimum of 900 students at five schools in different regions of the state with varying demographics and then made available to schools statewide.

OVERALL PROJECT OUTCOME AND RESULTS
The Raptor Lab is a resource for teaching students science-based research through wildlife issues and outdoor exploration of their local environment. The goal was to link outdoor experiential learning with a

STEM-focused classroom curriculum. The Raptor Lab curriculum addresses the urgent need to connect students with the natural world and inspire them to participate in solving challenging environmental problems.

Major goals for the project are to:

- Instill in students an action-based conservation ethic through outdoor exploration
- Expand access to an effective environmental education curriculum to middle school teachers and students throughout the state of Minnesota
- Engage students in solving environmental issues through experiential learning and scientific investigation
- Develop skills of critical thinking, collaboration and communication in middle school students

The Raptor Lab online environment has been designed, developed, built, and piloted. It consists of three parts: (1) Wildlife Veterinarian in Training; (2) Wildlife Researcher; and (3) Share Your Work. Part 1 has 6 videos and 5 activities to simulate training students to role play being a wildlife vet in training. Part 2 has eleven videos and two activities walking students through conducting a scientific research report on an environmental issue. Part 3 is an online environment where students can apply their learning by conducting their own outdoor field investigation. Students upload images, maps, sounds, data, and video to present their findings.

The Raptor Lab was piloted by 14 teachers in eight school districts (four metro and four outstate) reaching 1,010 students. Online assessment tools were created to assess student learning. The pre-assessment was taken by 911 students and the post by 652 (one pilot site dropped out mid-year and another did not administer final assessment due to schedule conflict. Pilot teachers took part in two workshops, receiving training and providing feedback and evaluation of the curriculum.

PROJECT RESULTS USE AND DISSEMINATION

The Raptor Lab has been presented at several conferences: the National Association of Environmental Educators, the Minnesota Naturalist Association, the Minnesota Science Teacher's Association, and the University of Minnesota's Grand Challenges Conference. In the fall of 2016, TRC staff will present at the Minnesota Education Association (MEA) Conference and the National Science Teacher's Association Regional Conference. The Raptor Lab was also promoted at the Minnesota Alliance of Geographic Education's workshops held at the LT Media Lab and the Minnesota Alliance of Geographic Education annual meeting. In addition, social media has been used to highlight the development of the Raptor Lab. Raptor Center Staff will also use their large database of schools currently engaged with their program to market the Raptor Lab to schools around the state.

The Raptor Lab is currently in use by last year's pilot teachers and has already begun to be expanded to other schools. Raptor Lab should reach between 1,000 - 1,500 students this school year. Teachers in Prior Lake middle schools are replacing sections of their curriculum with Raptor Lab to teach the scientific method and teachers at Rockford Middle School are integrating the Raptor Lab across subject fields to use in STEM, science, math, language arts, and social studies.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Wolf Management Education
Subd. 09i $120,000 TF

Darcy Berus
International Wolf Center
3410 Winnetka Ave N Ste 101
Minneapolis, MN 55427

Phone: (763) 560-7374
Email: dberus@wolf.org
Web: http://www.wolf.org

Appropriation Language
$120,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with the International Wolf Center for outreach to metro area kindergarten through grade 12 classrooms and nature centers to help children understand wolf management issues.

Project Overview
Wolves are a hot topic in Minnesota, with the public sharply divided on management issues such as wolf hunting. The complexity of the topic lends itself to a lot of misunderstanding and misinformation that is not always helpful to resolving the polarized debate. The International Wolf Center is using this appropriation to help bridge the gap with science-based information by delivering on-site programs to approximately 460 classrooms in the Twin Cities metro area to teach approximately 16,000 students about wolf biology and behavior, the social and political conflicts surrounding wolves, and the overall effects of wildlife habitat loss throughout the state.

OVERALL PROJECT OUTCOME AND RESULTS
This project was undertaken to provide engaging, unbiased 60-minute program about wolves to public school K-12 classrooms and nature centers in the 9 county twin cities metro area. An IWC outreach specialist presented these programs to help students understand the complicated issues surrounding wolves and wolf management.

A total of 546 school classroom programs were presented between Oct. 22, 2014 and June 30, 2016. Five nature center programs were presented as well, for a grand total of 551 programs, which surpassed the project goal of 460 programs, while coming in $18,535 under budget. These programs reached approximately 13,906 students as well as approximately 600 teachers. Programs were presented to 546 individual school classrooms at 77 schools in 27 districts and 8 counties. Programs covered basic wolf biology, predator/prey dynamics, role of wolves in healthy ecosystems, myths and opinions of wolves, wolf management, and importance of wildland habitat. The PowerPoint based programs included engaging video clips and photos. Students were also able to learn from handling artifacts such as wolf, deer and moose bones and pelts.

Students were surveyed pre and post program using clicker survey technology to collect data on knowledge of and attitudes toward knowledge of wolves and wolf issues. Survey data showed a range in increases from 9% to 48% from preprogram to post-program in knowledge of wolf facts and attitude and understanding of issues between wolves and humans. When the increase from pre-program to post-program was not as high, we found students had scored quite high on the pre-program question.

99% of the teachers who participated in a post-program survey would recommend the program to other teachers.

PROJECT RESULTS USE AND DISSEMINATION
This information will be available on the International Wolf Center Website at www.wolf.org, and will also be presented in the Winter 2017 issue of International Wolf Magazine.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Subd. 10 Administration and Contract Agreement Reimbursement

Contract Agreement Reimbursement
Subd. 10a $135,000 TF

Amanda Graeber
MN DNR
500 Lafayette Rd, Box 10
St. Paul, MN 55155

Phone: (651) 259-5533
Email: amanda.graeber@state.mn.us
Web: http://dnr.state.mn.us/grants/passthrough/index.html

Appropriation Language
$135,000 the second year is from the trust fund to the commissioner of natural resources at the direction of the Legislative-Citizen Commission on Minnesota Resources for expenses incurred for contract agreement reimbursement for the agreements specified in this section. The commissioner shall provide documentation to the Legislative-Citizen Commission on Minnesota Resources on the expenditure of these funds.

Project Overview
Appropriations to non-state entities must be made through a formal contract with a state entity that manages all of the funds for the project on a reimbursement basis. This appropriation to Minnesota's Department of Natural Resources (DNR) funds the expenses incurred by the DNR in contracting, contract management, and expense re-imbursement for most of the Environment and Natural Resources Trust Fund appropriations made to non-state entities, including both new projects funded during the biennium and existing projects funded in previous bienniums.

OVERALL PROJECT OUTCOME AND RESULTS
This appropriation was used to support the ENRTF contract management program, which ensured that ENRTF grantees expended grant funds in compliance with state law, session law, approved work plans, and Office of Grants Management grants policies.

The DNR Grants Unit managed 39 grants active in FY 2015, including monitoring 32 grants. In FY 2016, the Grants Unit managed 59 active grants.

Between 7/1/2014 when the services began and 12/31/2015 when they ended, the DNR Grants Unit:

- Made 199 reimbursements to grantees totaling $7,099,485.17
- Prepared and executed 23 ML 2015 grant agreements
- Published 6 editions of the quarterly newsletter for all grantees
- Billed 1,619 hours at the FY 2015 professional services rate of $56.94/hr
- Billed 720 hours at the FY 2016 professional services rate of $59.00/hr
- Participated in the Office of the Legislative Auditor's Internal Controls and Compliance Audit of the Environment and Natural Resources Trust Fund. This audit, published in February 2016, identified no findings relating to the DNR Grants Unit contract management. It identified one finding related to DNR allocation of administrative costs, which the Grants Unit worked with LCCMR staff to resolve.

PROJECT RESULTS USE AND DISSEMINATION
Project personnel were in frequent contact with appropriation recipients and LCCMR staff. Information was disseminated through manuals, training sessions, orientations, meetings, memos, letters, emails, newsletter, and phone.

Project due to be completed: 6/30/2016

FINAL REPORT (PDF)

3. M.L. 2013 Projects Completed
January 15, 2015 – January 15, 2017

MN Laws 2013, Chapter 52, Section 2

M.L. 2013 Projects Completed in 2015-2016

MN Laws 2013, Chapter 52, Section 2 (beginning July 1, 2013)

For the next biennium (July 1, 2013 - June 30, 2015), approximately $33.8 million is available each fiscal year (Total = $67,620,000) for funding from the Environment and Natural Resources Trust Fund. In response to the 2013 Request for Proposal, 169 proposals requesting a total of approximately $155 million were received. Through a competitive, multi-step process 66 of these proposals, requesting a total of $73 million, were chosen to present to the LCCMR and 46 of those proposals, totaling $38.2 million (all FY 2014 funds and part of the FY 2015 funds), were chosen to receive a recommendation for funding to the 2013 MN Legislature. The Legislature adopted all 46 of these project recommendations and added one additional project. All 47 appropriations were signed into law by the Governor on 05/09/13. $29.6 million remains availble for LCCMR funding recommendations to the ML 2014 Legislature.

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

When available, we have provided links to web sites related to the project. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

Subd. 03 Natural Resource Data and Information

03a Minnesota Biological Survey

03b County Geologic Atlases - Part A

03d Updating the National Wetland Inventory for Minnesota - Phase IV

03e Conservation Easement Stewardship Program - Phase III

03f Harnessing Soudan Mine Microbes: Bioremediation, Bioenergy and Biocontrol - **RESEARCH**

03g Improved Rapid Forest Ecosystem and Habitat Inventory

03h Finding Disease Resistant Elm Trees in Minnesota - **RESEARCH**

03i Enhancing Timber Sale Program Environmental and Economic Sustainability

03j Enhancing Environmental and Economic Benefits of Woodland Grazing - **RESEARCH**

Subd. 04 Land, Habitat, Restoration, and Recreation

04a State Parks and State Trails Land Acquisition

04b Scientific and Natural Areas Restoration, Enhancement and Citizen Engagement

04c Native Prairie Stewardship and Prairie Bank Easement Acquisition

04d Metropolitan Conservation Corridors (MeCC) - Phase VII

04e Landscape Arboretum Acquisition Lake Tamarack

04f Conservation Program Technical Assistance

04g Moose Habitat Restoration in Northeastern Minnesota - **RESEARCH**

04h Bee Pollinator Habitat Enhancement

04j Preserving the Avon Hills Landscape - Phase II

04k Frogtown Farm and Park Acquisition

04l Restorations Evaluations

Subd. 05 Water Resources

05a Sustaining Lakes in a Changing Environment - Phase II - **RESEARCH**

05c Heron Lake Sediment and Phosphorus Reduction Implementation Projects

05d Southern Minnesota Lakes Restoration

05g Membranes for Wastewater-Generated Hydrogen and Clean Water - **RESEARCH**

05h Antibiotics in Minnesota Waters - Phase II - Mississippi River - **RESEARCH**

Subd. 06 Aquatic and Terrestrial Invasive Species

06a An Aquatic Invasive Species Research Center - **RESEARCH**

06b Detection and Monitoring of Asian Carp Populations

06d Elimination of Target Invasive Plant Species

06e Biological Control of Garlic Mustard - **RESEARCH**

06f Zebra Mussel Control Research and Evaluation in Minnesota Waters - **RESEARCH**

Subd. 07 Environmental Education

07a Minnesota Conservation Apprentice Academy

07b Youth Outdoors: Mississippi River Education and Employment Opportunities

Subd. 08 Administration and Contract Management

08b Contract Agreement Reimbursement

Funding Source:
Environment and Natural Resources Trust Fund (TF)

MN Laws 2013, Chapter 52, Section 2

Subd. 03 Natural Resource Data and Information

Minnesota Biological Survey
Subd. 03a $2,650,000 TF

Bruce Carlson
MN DNR
500 Lafayette Rd
St Paul, MN 55155

Phone: (651) 259-5083
Email: bruce.carlson@state.mn.us
Web: http://www.dnr.state.mn.us/mbs/index.html

Appropriation Language
$2,650,000 the first year is from the trust fund to the commissioner of natural resources for continuation of the Minnesota biological survey to provide a foundation for conserving biological diversity by systematically collecting, interpreting, monitoring, and delivering data on plant and animal distribution and ecology, native plant communities, and functional landscapes.

Project Overview
The Minnesota Biological Survey (MBS) is an ongoing effort begun in 1987 by the Minnesota Department of Natural Resources (DNR) that is systematically surveying, county-by-county, the state's natural habitats. The effort identifies significant natural areas and collects and interprets data on the status, distribution, and ecology of plants, animals, and native plant communities throughout the state. To date, surveys have been completed in 81 of Minnesota's 87 counties and nearly 20,000 records of rare features have been recorded. MBS data is used by all levels of government in natural resource planning and use decisions, including prioritization of protection of park lands and scientific and natural areas. This appropriation will permit continuation of the survey in Lake, St. Louis, Clearwater, Beltrami, Lake of the Woods, and Koochiching counties. Additionally sites containing select native plant communities or select rare plant and animal populations will be monitored, conservation technical assistance will be provided, and interpretive products and publications will be developed to make the information useful to a variety of audiences.

OVERALL PROJECT OUTCOME AND RESULTS
The need to protect and manage functional ecological systems, including ecological processes and component organisms continues to accelerate with increased demands for land, water, and energy, continued habitat fragmentation, loss of species and genetic diversity, invasive species expansion, climate change, and other changing environmental conditions.

Since 1987 the Minnesota Biological Survey (MBS) has systematically collected, interpreted and delivered baseline data on the distribution and ecology of plants, animals, native plant communities, and functional landscapes. These data help prioritize actions to conserve and manage Minnesota's ecological systems and critical components of biological diversity.

Since July 2013, MBS contributed 1,326 new rare features records to the Rare Features Database, surveyed 72 lakes for rare plants and vegetation, and added 439 vegetation plots (releve) to the statewide database. Since 1987, MBS has added a total of 21,478 new rare feature records statewide; MBS botanists have documented 1,245 rare aquatic plants during targeted surveys of 1,983 lakes in 46 counties; MBS plant ecologists have contributed 5,392 of the 10,269 vegetation plot records in the DNR's releve database. Statewide 10,734 MBS sites of Biodiversity Significance and 83,913 polygons of native plant communities are now publically available on the Minnesota Geospatial Commons.

During this project period baseline surveys continued, focused in northern Minnesota (see map) within large functional landscapes of forests, peatlands, wetlands, and undeveloped lakes and streams. Highlights include helicopter-assisted field surveys of the most remote areas within northwest Minnesota's patterned peatlands, remote-access-only vegetation and botanical field surveys of the Border Lakes, and the discovery of a new state-record species of sedge, (Carex tincta), along with numerous other examples of new and expanded distribution data for native plant species.

MBS continued monitoring to measure the effectiveness of management and policy activities. For example, as part of DNR's forest certification high conservation value forest sites in southeastern

Minnesota have been targeted as monitoring sites with field survey efforts focused on detailed rare plant surveys. This work provided updates to existing data that is often more than 20 years old, set a foundation from which to more precisely track target species' populations through time, and improved the relevance of MBS data to monitoring needs.

PROJECT RESULTS USE AND DISSEMINATION

MBS data are stored primarily in the Division of Ecological and Water Resources information systems, which are increasingly linked to other databases in the MN DNR. For example, MBS, in collaboration with other DNR partners, developed and operationalized a DNR-wide native plant community GIS database that integrates native plant community mapping by all DNR Divisions. In addition, MBS procedures, updates, recent maps, and links to related data are presented on the DNR website. Many MBS GIS datasets are delivered to clients through the Minnesota Geospatial Commons. MBS regularly provides vegetation plot data from the releve database to researchers at academic institutions and other agencies and organizations. Non-public rare species data are available through agreements with the requesting agency and the DNR.

MBS publishes and distributes survey results in a variety of formats for various audiences. Many products are available on the DNR website, including GIS shape files of native plant communities and MBS sites, native plant community field guides, and guides to sampling techniques such as vegetation plot data collection using the releve method. MBS web pages are updated with new information and have links to associated resources: http://www.dnr.state.mn.us/eco/mcbs/index.html.

The DNR and Legislative libraries and other local information repositories (such as libraries within counties) have access to published products, including books, maps, reports, field guides and digital media. MBS has published several books and field guides and the publication of a natural history book based on MBS data collected in the northwestern prairie region and Red River Valley is underway. Based on local collaborator interest and the results of regional focus groups, this book will include a guide to selected natural areas of the region. A Minnesota publisher has agreed to publish this book.

Staff routinely make presentations that describe MBS methodologies and results to a wide range of audiences including county boards, local planning groups, citizen advisory groups, other biologists, land managers, and students. MBS staff provide local planners with ecological interpretations describing important sites of biodiversity identified during the Survey to assist with management plans. Staff lead or participate in technical workshops and field trips to exchange ideas on survey methodology and provide training in the application and interpretation of the data. For example, in 2014-15, MBS botanists and plant ecologists in collaboration with partners delivered nine field workshops to over 200 natural resource professionals. These field workshops focused on plant identification, native plant community classification, and how these skills can be used to inform management decisions.

Physical collections are deposited at Minnesota repositories, primarily at the University of Minnesota's J.F. Bell Museum of Natural History and at the Science Museum of Minnesota, St. Paul. As part of a larger network of museums and herbaria, these cooperators are essential to the documentation and sharing of MBS results. MBS and museum staff meet periodically to address curatorial, data management, and interpretive needs. During this project period, MBS deposited over 2,000 plant specimens to the Bell Museum Herbarium.

MBS also delivers data through an international organization, NatureServe, and also shares data with

cooperators at colleges and universities and with others in ecological regions where surveys are ongoing or completed.

Project completed: 6/30/2015

FINAL REPORT

County Geologic Atlases - Part A
Subd. 03b $1,200,000 TF

Dale Setterholm
U of MN - Minnesota Geological Survey
2642 University Ave W
St. Paul, MN 55114-1057

Phone: (612) 627-4780 x2
Email: sette001@umn.edu
Web: http://www.mngs.umn.edu/county_atlas/countyatlas.htm

Appropriation Language
$1,200,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to continue the acceleration of the production of county geologic atlases that define aquifer boundaries and the connection of aquifers to the land surface and surface water resources for the purpose of sustainable management of surface water and groundwater resources. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
The Minnesota County Geologic Atlas program is an ongoing effort begun in 1979 that is being conducted jointly by the University of Minnesota's Minnesota Geological Survey and the Minnesota Department of Natural Resources (DNR). This portion, called Part A and conducted by the Minnesota Geological Survey, collects geologic information to produce maps and databases that define aquifer boundaries and the connection of aquifers to the land surface and surface water resources. The information is used in planning and environmental protection efforts at all levels of government, by businesses, and by homeowners to ensure sound and sustainable planning, management, and protection of water resources used for drinking, agriculture, industry, and more. This appropriation will initiate Part A geologic atlases for three additional counties yet to be determined depending on county participation and other priorities.

OVERALL PROJECT OUTCOME AND RESULTS
The Minnesota Geological Survey maps sediment and rock because these materials control where water can enter the subsurface (recharge), where and how much water can reside in the ground (aquifers), where the water re-emerges (discharge), and at what rates this movement occurs. This information is essential to managing the quality of our water and the quantity that can be sustainably pumped. This project completed geologic atlases for Meeker, Redwood, and Kanabec counties, and contributed to ongoing atlas work in Brown, Wadena, Becker, and Hubbard counties. Information about the geology is gleaned from the records of domestic wells, and from drilling conducted for this project. In Meeker County we used 3,600 wells and 6 cores, in Redwood we used 1,900 wells and 10 cores, in Brown County we used 1,700 wells and 8 cores, in Wadena County we used 2,787 wells and 3 cores, in Becker

we used 8,887 wells and 5 cores, in Hubbard we are using 9,550 wells and 3 cores, and in Kanabec we used 4,055 wells and 7 cores. In all cases these are augmented with soil borings and geophysical surveys. From the data we created maps of the geology immediately beneath the soil; the aquifers within the glacial sediment; and the shape, elevation, and rock types of the bedrock surface. These maps and data support monitoring, wellhead protection, water appropriation, clean-ups, and water supply management.

In large portions of Redwood counties the glacial materials are relatively thin, and most of the bedrock types present do not provide much water. This makes the mapping of glacial sand bodies, which are potential aquifers, very important. In Becker, Hubbard, and Wadena counties the glacial deposits are the only viable water source. Irrigation is an important water use in those counties, and the atlas information will be useful in managing water for maximum benefit. In Meeker, Brown, and Kanabec counties, the glacial deposits vary in thickness, and the bedrock includes some formations that can serve as aquifers. In every county the database of well construction records we have compiled is an excellent indicator of which aquifers the population is currently relying on. Printed and digital versions of all these atlases will be delivered to LCCMR.

PROJECT RESULTS USE AND DISSEMINATION
The Minnesota County Geologic Atlas program is an ongoing effort begun in 1979 that is being conducted jointly by the University of Minnesota's Minnesota Geological Survey and the Minnesota Department of Natural Resources (DNR). This portion, called Part A and conducted by the Minnesota Geological Survey, collects geologic information to produce maps and databases that define aquifer boundaries and the connection of aquifers to the land surface and surface water resources. The information is used in planning and environmental protection efforts at all levels of government, by businesses, and by homeowners to ensure sound and sustainable planning, management, and protection of water resources used for drinking, agriculture, industry, and more. This appropriation will initiate Part A geologic atlases for three additional counties yet to be determined depending on county participation and other priorities.

Project due to be completed: 6/30/2016

FINAL REPORT (PDF)

Updating the National Wetland Inventory for Minnesota - Phase IV
Subd. 03d $1,000,000 TF

Steve Kloiber
MN DNR
500 Lafayette Rd, Box 25
St Paul, MN 55155

Phone: (651) 296-1811
Email: steve.kloiber@state.mn.us
Web: http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html

Appropriation Language
$1,000,000 the first year is from the trust fund to the commissioner of natural resources to continue the update and enhancement of wetland inventory maps for Minnesota. This appropriation is available until

June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Over the past 100 years, about half of Minnesota's original 22 million acres of wetlands have been drained or filled. Some regions of the State have lost more than 90 percent of their original wetlands. The National Wetland Inventory, a program initiated in the 1970s, is an important tool used at all levels of government and by private industry, non-profit organizations, and private landowners for wetland regulation and management, land management and conservation planning, environmental impact assessment, and natural resource inventories. The data behind the National Wetlands Inventory for Minnesota is now considerably out-of-date and a multi-phase, multi-agency collaborative effort coordinated by the Minnesota Department of Natural Resources is underway to update the data for the whole state. This appropriation is being used to conduct the fourth of six phases of this effort, which involves wetlands maps for portions of Lake, Cook, and St. Louis counties in northeastern Minnesota. A completed wetlands inventory will help improve wetland protection and management.

OVERALL PROJECT OUTCOME AND RESULTS
Updating the National Wetland Inventory (NWI) is a key component of the State's strategy to ensure healthy wetlands and clean water for Minnesota. This effort is a multi-agency collaborative under leadership of the Minnesota Department of Natural Resources. These data are intended to replace the original 1980s NWI data. The NWI data provide a baseline for assessing the effectiveness of wetland policies and management actions. These data are used at all levels of government, as well as by private industry and non-profit organizations for wetland regulation and management, land use, conservation planning, environmental impact assessment, and natural resource inventories. The update project is being conducted in phases with data released for each region as it is finalized.

In this fourth phase of the overall effort, the DNR updated wetland inventory maps for 14,700 square miles in northeast Minnesota covering all of Lake, Cook, and St. Louis counties as well as portions of Carlton and Koochiching counties. The overall accuracy for wetland identification is 86%.

The updated NWI data was created in accordance with federal wetland mapping guidance. This update used spring aerial imagery acquired in 2009, summer imagery acquired in 2013, and lidar elevation data as well as other ancillary data. Quality assurance of the data included visual inspection, automated checks for attribute validity and consistency, as well as a formal accuracy assessment based on an independent field data. Further details on the methods employed can be found in the technical procedures document for this project located on the project website (http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html).

PROJECT RESULTS USE AND DISSEMINATION
All wetland map data and aerial imagery are available free of charge to the public. The data have been made available through the Minnesota Geospatial Commons (https://gisdata.mn.gov/) as well as through an online wetland viewer (http://www.dnr.state.mn.us/eco/wetlands/map.html). A copy of the data has also been provided to the US Fish and Wildlife Service for inclusion in the national wetland database.

Use of the NWI data is being promoted through a variety of channels. The DNR has given presentations about the NWI data at both the Minnesota Water Resources Conference and the Minnesota GIS/LIS Conference. The DNR and MnGeo have presented at the Minnesota GIS/LIS Conference regarding the availability of the spring aerial imagery. A press release has also been drafted for an expected

September release. A peer-reviewed journal article was published in the journal Wetlands based on the work from the previous NWI project phase and a book chapter has been prepared for an upcoming publication on wetland assessment.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Photo Interpertation Guide: For Updating The National Wetland Inventory In Minnesota (PDF)
Updating the National Wetland Inventory in Northest minnesota: Technical Documentation (PDF)

Conservation Easement Stewardship Program - Phase III
Subd. 03e $60,000 TF

Susan Damon
MN DNR
500 Lafayette Rd
St. Paul, MN 55155

Phone: (651) 259-5961
Email: susan.damon@state.mn.us
Web: http://www.dnr.state.mn.us

Appropriation Language
$200,000 the first year is from the trust fund to the commissioner of natural resources for the final phase to bring conservation easements held by the Department of Natural Resources up to minimum conservation standards, through monitoring, baseline data collection, and baseline report preparation.

Project Overview
The purchase of conservation easements - restrictions on land use that protect natural features while keeping land in private ownership - has proven to be an effective means to protect land at a lower initial cost than full state ownership. However, once an easement is purchased there are ongoing stewardship, monitoring, and enforcement responsibilities necessary to ensure the terms of the agreement between the easement holder and the landowner are met. Earlier efforts funded by the Environment and Natural Resources Trust Fund in 2008 and 2011 allowed the Minnesota Department of Natural Resources (DNR) to retroactively bring existing conservation easements up to minimum standards by developing a central inventory and management system of the conservation easements held by the DNR, along with a plan for how they would be administered into the future. This appropriation is the final phase of this effort allowing the DNR to continue and accelerate the implementation of the previously developed plan. Additionally, tools will be developed to enhance monitoring efficiency using remote sensing.

OVERALL PROJECT OUTCOME AND RESULTS
This was the last phase of a three-phase project to establish procedures and tools to effectively monitor conservation easements held by the DNR. One project goal was to monitor and create baseline reports for 75 existing conservation easements-actual attainment was 85 easements. As detailed in the Phase III Supplemental Report, additional goals were to investigate the use of image processing software coupled with LiDAR and current imagery to improve the efficiency of conservation easement stewardship. Two areas were explored: 1) can these tools be used to accurately redraw stream centerlines after changes in stream courses; and 2) can remote sensing tools be written to automatically identify possible violations

of easement terms? DNR trout stream easement boundaries are typically 66' from stream centerlines and move with stream course changes. It is essential to have accurate maps of easement boundaries for monitoring, but it is time consuming to edit boundaries manually. Staff created a novel approach to generate stream centerlines from LiDAR and adjust them with imagery where stream course changes had occurred. Tests of a 15km stream section demonstrated the accuracy and usefulness of this approach. Manual effort of 90 minutes to digitize the stream section was reduced to 11 minutes. In the second problem area, staff utilized eCognition image analysis software to classify land cover in easement corridors utilizing imagery with three levels of resolution and LiDAR and identify objects/conditions that could be easement violations. Staff concluded that to effectively monitor easements remotely would require image resolution no coarser than 6" and LiDAR that had been acquired at the same time. Possible violations identified in this fashion still need on-site verification, but this technique can highlight areas of concern and reduce on-site visit time. Tools developed in this project have potential application for statewide riparian buffer mapping and monitoring.

PROJECT RESULTS USE AND DISSEMINATION
Results for Activity 1 of the project are being assembled in a fashion where they can be presented to personnel in Fish and Wildlife who are responsible for the maintenance of the stream centerline GIS layers for possible broader application. In addition, a presentation is being planned for BWSR and DNR personnel involved in mapping the public waters and ditches as part of the new 50 foot buffer legislation. There is potential for applying both the centerline and land cover techniques developed for this project to buffer mapping and monitoring.

Results for Activity 2, using tools developed in project phases I and II to visit 75 additional easements for the purposes of collecting baseline property information and creating those reports, was disseminated primarily to DNR management for the purposes of directing monitor efforts. One update was generated for the Conservation Easement Stewardship User Manual during the project for staff training use. During the project, wild and scenic river easement baseline property reports were signed and mailed to fee title owners of the properties.

Periodic project updates and preliminary results were presented to the Conservation Easement Stewardship committee for the purposes of gathering additional direction from that group during the project. A conservation easement stewardship cost calculator was disseminated to DNR fiscal staff. Information about the calculator was presented to the LCCMR on June 25, 2015.

Project completed: 6/30/2015

FINAL REPORT

Harnessing Soudan Mine Microbes: Bioremediation, Bioenergy and Biocontrol
Subd. 03f $838,000 TF

Christine Salomon
U of MN
MMC 204, 516 Delaware St SE, 7-132 PWB
Minneapolis, MN 55455

Phone: (612) 626-3698
Email: csalomon@umn.edu

Web: http://www.cdd.umn.edu/Members/Salomon/index.htm

RESEARCH

Appropriation Language
$838,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to continue the characterization of unique microbes discovered in the Soudan Underground Mine State Park that have potential applications for metal remediation in water resources, microbial electrofuels, and biocontrol of white-nose bat syndrome. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
The Soudan Iron Mine near Ely, Minnesota is no longer an active mine and is now part of a state park, as well as the home to a state-of-the-art physics laboratory at the bottom of the mine. The mine has also been discovered to contain an extreme environment in the form of an ancient and very salty brine bubbling up from a half-mile below the Earth's surface through holes drilled when the mine was active. Strange microorganisms - part of an ecosystem never before characterized by science - have been found living in the brine. Scientists from the University of Minnesota will use this appropriation to continue to study this unique ecosystem and its organisms and build upon findings from a previous Environment and Natural Resources Trust Fund supported effort to explore potential applications of using the microorganisms living there for removing metals from mine waters, producing biofuels, and developing a biocontrol for White-Nose Syndrome, which is decimating bat populations around the country.

OVERALL PROJECT OUTCOME AND RESULTS
The Soudan Iron Mine in Minnesota provides direct access to microbes with special adaptations that can be harnessed for biotechnology. We conducted research to harness these microbes to approach some of the most critical environmental challenges in Minnesota:

Metal Bioremediation:
Our goal was to explore the native fungi living in the mine. These fungi live in extremely harsh and variable chemical conditions, including high metal concentrations in water. Because the Soudan Iron Mine fungi have adapted to the conditions in the mine, they might possess properties that we can use for cleaning up metal-contaminated water. When we use plants or microorganisms (like fungi) to remove metals from water, it is termed bioremediation. We investigated mine fungi that thrive in heavily contaminated waters with metals such as copper, cobalt, zinc, nickel, and mercury. We isolated 1014 different strains of fungi representing 140 different taxa, including novel species. We screened 60 fungal isolates and discovered that several species accumulate metals within their living biomass. These findings confirmed that: (1) many Soudan Iron Mine fungal isolates have promising metal removal characteristics in solid and liquid growth conditions; (2) the amount of metal removed from water was similar between natural and lab specimens; and (3) metal binding can be reversed in some cases. These results can be used to develop a suite of bioremediation strategies using fungi as passive sorbent materials or in living self-regenerating bioreactor.

Electrosynthesis Project:
We characterized and developed methods for understanding two bacterial isolates from the Soudan Mine: Marinobacter subterrani and Desulfuromonas soudanensis. D. soudanensis is capable of producing electricity and dissolving rust in high salt concentrations, making it a very unusual organism. We sequenced and characterized its genome to better understand how electricity production works at

high salt concentrations, a process that could be important for future applications in microbial bioremediation and desalination. We are currently in the process of developing a genetic system in D. soudanensis to further our understanding of how it generates electricity in high salt conditions. M. subterrani is a model for the study of metal precipitation, a process that, if better understood, could allow us to feed electricity directly into bacteria. These bacteria could then be engineered to produce desired products using electricity. Given the complexities of this biological process, we are still an early stage of understanding the fundamental pathway that enables metal precipitation. Our students working on these two projects have presented their work at national and international meetings and have produced 2 peer reviewed scientific manuscripts on their work as well.

White Nose Bat Syndrome Biological Control:
White Nose Syndrome is a devastating bat disease causing catastrophic economic and biodiversity losses throughout the US. Our primary goal was to identify microbes that inhibit the fungal pathogen, Pseudogymnoascus destructans that could eventually be developed as a treatment in caves and mines. As part of this biocontrol strategy, we collected and screened new microbes from the Soudan Mine. In total, 32/121 fungal strains and 60/262 bacterial isolates inhibited growth of P. destructans. Analysis of active strains provided us with a picture of which types of inhibitory microbes may be found in various mine locations, which may help future screening and discovery efforts. With this library of nearly 100 antifungal strains, we are poised to move forward into phase II, which will involve testing the ability of each active strain to inhibit P. destructans on specific substrates both in the lab and in the environment. An additional outcome is that a subset of at least 50 strains had activity against human pathogens and these will be further explored in a separate project.

PROJECT RESULTS USE AND DISSEMINATION
Information, discoveries, approaches and questions from our project have been used and disseminated in a number of different ways: Presentations about individual projects have been given to school groups, college students, local community groups and at professional scientific conferences (see examples, below). Several components of this project were completed and shared as peer-reviewed scientific manuscripts. Some of the fundamental scientific discoveries have been used to further develop and expand new ideas that were not a part of the original research plan. These new ideas and hypotheses have been incorporated into new grant proposals, resulting in successful new funding at both the state and federal levels (including several new LCCMR proposals that build directly on initial research accomplished in this period as Phase II projects). Some additional uses include the screening of these new, diverse microbial libraries against other targets, including human infectious disease pathogens. For example, several of the bacterial strains that showed no activity against the fungal bat pathogen did exhibit inhibition of human yeast pathogens. These strains will be further studied to purify and identify the active components for potential development as human therapeutics.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Improved Rapid Forest Ecosystem and Habitat Inventory
Subd. 03g $262,000 TF

Alan Ek
U of MN
2004 Folwell Ave

St Paul, MN 55108

Phone: (612) 624-3400
Email: aek@umn.edu
Web: http://www.forestry.umn.edu/People/Ek/index.htm

Appropriation Language
$262,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to evaluate a new approach to forest inventory, based on statewide forest inventory and analysis (FIA) data.

Project Overview
Minnesota has 15.9 million acres of forest land managed by a variety of county, state and federal agencies, and private landowners for timber production, wildlife habitat, and ecological considerations. Forest managers rely on inventory data to make effective planning and management decisions. Because forests are continually changing through natural and human processes, forest inventory data is periodically updated. However, doing so is an expensive and time-consuming endeavor and, as a result, much of Minnesota's forest inventory data is currently out of date. This appropriation is being used by scientists at the University of Minnesota to evaluate an innovative approach to forest inventory using existing statewide Forest Inventory and Analysis (FIA) data that could help reduce costs, expedite future updates, and improve overall usability.

OVERALL PROJECT OUTCOME AND RESULTS
Forests cover one-third of Minnesota and contain 15.9 million acres of timberland managed in large part by county, state and federal agencies and private landowners. Of this, 53% is public. DNR forest stand inventory records alone include nearly 200,000 stands. Stand inventories are central to the management of these lands. But forests change rapidly (e.g., 14% of field plots change cover type within 5 years) and stands can shift from sapling to old forest stage in 2-4 score years. Thus inventories need updating, but such efforts have fallen far behind. Why? They are costly (say $6 per acre, $3 for field plots, $3 for mapping) and can total millions of dollars statewide. Consequently these data are typically insufficient and out of date.

The project questioned existing inventories and explored new ideas, methodology and tools to dramatically reduce costs and to expand ecological and habitat detail. The findings below will foster inventories with greater frequency, timeliness and detail:

1. A major use of inventories is in forest planning (harvest scheduling), but results indicate such analyses do not require large numbers of field plots.
2. Forest yield estimates, essential to planning, likewise do not require large numbers of field plots-nearby and past inventories can satisfy much of this data need.
3. Data mining analyses indicate numerous ecological variables can be imputed to inventory stands from data already available such as physiographic class, soil maps, location, and tree species present. Results show moderate to high accuracy for native plant community class (NPC) estimation.
4. Habitat suitability models have been refined and packaged for PC use. This enables local to large area habitat characterization for 150+ wildlife species across past, present and projected inventories.
5. Based on the above findings, cost effective alternative inventory designs are now available to fit diverse situations. These can reduce field plot costs to half or less.

6.

PROJECT RESULTS USE AND DISSEMINATION

1. Workshops, training, software tools and publications are already underway to foster implementation among DNR and county participants and other landowners. Some these will be offered through the Sustainable Forests Education Cooperative (SFEC) from the University's Cloquet Forestry Center. These workshops will cover developing local yield tables, the use of efficient judgment (located) plots, and choosing your inventory design from among alternatives. Lidar workshops have already been held. We are also making the data mining and habitat imputation capability available as software for PCs. Further details on project findings and tools and their implementation will be made available as University of Minnesota Forestry Research Notes at www.forestry.umn.edu and on the Interagency Information Cooperative website at iic.umn.edu.
2. The project manager and staff have presented project progress and various results at several meetings of participating professionals and agencies (e.g., the Minnesota Forest Resources Partnership). These communications have focused on inventory design. This includes advising on the development of a DNR Forestry led implementation proposal directed to the LCCMR. Staff has also been working with DNR Forestry on the implementation of ecological imputation findings. A report on parts of this work has been accepted for presentation at the 2015 National Convention of the Society of American Foresters in Baton Rouge, LA in November.
3. Combinations of Lidar, spectral imagery and automated cover type mapping software explored in the project are are coming soon and will likely reduce mapping costs to half or less.
4. It is anticipated that these project findings will be examined and implemented by most project participants.
5. The subject of this LCCMR project is an increasingly common and internationally important topic. Many states and countries are faced with similar inventory cost and effectiveness problems. Thus publications and methods developed from this project will likely spur further study by others well beyond Minnesota.

Project completed: 6/30/2015

FINAL REPORT

Finding Disease Resistant Elm Trees in Minnesota
Subd. 03h $200,000 TF

Robert Blanchette
U of MN
1991 Upper Buford Cir, 495 Borlaug Hall
St Paul, MN 55126

Phone: (612) 625-0202
Email: robertb@umn.edu
Web: http://forestpathology.cfans.umn.edu/default.htm

RESEARCH

Appropriation Language
$200,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to

evaluate and identify native Minnesota elms resistant to Dutch elm disease to assist with limiting the susceptibility of the state's elms to Dutch elm disease. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview

Elms were once a very widespread tree in Minnesota and amongst the most common and popular in urban landscapes due to their size, shading capability, and tolerance of pollution and other stresses. Over the past five decades, though, Dutch elm disease, an exotic and invasive pathogen, has killed millions of elms throughout the state. However, scientists at the University of Minnesota have observed that some elms have survived the disease and appear to have special characteristics that make them resistant to Dutch elm disease. This appropriation is being used to identify, propagate, and evaluate native Minnesota elms resistant to Dutch elm disease to assist with limiting the susceptibility of the state's remaining elms to Dutch elm disease and possibly lay the foundation for re-introductions of the tree in the future.

OVERALL PROJECT OUTCOME AND RESULTS

Dutch elm disease is caused by an exotic invasive fungus (Ophiostoma novo-ulmi) that was introduced into Minnesota in the 1960's. Since that time the disease has killed millions of elms in urban and forested landscapes across the state. Although most American elms have no resistance to this pathogen, some continue to survive the disease and remain healthy in locations where all other elms have died. To determine if these trees have some tolerance to the disease or just escaped infection, we collected and inoculated a group of selected elms from across Minnesota. These trees were found from surveys with the help of city officials and the general public and they are from metropolitan and rural areas throughout the state. Accomplishments included:

1. Twenty-five trees were selected for testing during the first phase of the project.
2. All trees were successfully propagated to produce clones.
3. Successful inoculation methods were developed.
4. Clones were screened in greenhouse and field for resistance.
5. 600 trees representing different native elm selections have been planted in the elm research nursery at the University of Minnesota for continued testing and evaluation.
6. Over 50 additional selections have been identified and are available for propagation for the future.

Results indicate that there is a range of elm genotypes that vary in their tolerance to Dutch elm disease. We are continuing our efforts to find the highest degree of resistance among different genotypes so more Minnesota-hardy elms can be added to our urban and rural landscapes. New elm selections will provide the much needed diversity in these important native species and will provide more options for replanting in communities devastated by the emerald ash borer and other exotic pests and diseases. A Phase II elm project which began on July 1, 2016 with funds from the Minnesota Environment and Natural Resource Trust Fund will allow the testing of more elms, study the mechanisms of resistance found in the trees and continue to field test our selections to ensure trees with the greatest resistance and best growth characteristics are available for planting by the people of Minnesota.

PROJECT RESULTS USE AND DISSEMINATION

Over the duration of this project many presentations, magazine articles, and scientific publications have been completed providing information about the project to a large audience of stakeholders including the arborists, nursery managers, foresters, researchers and the general public. We have received a great

deal of feedback from the public supporting this project to find hardy Minnesota elms that are resistant to Dutch elm disease. With this information we are closer to our goal of introducing more Minnesota native elms back to our urban and rural landscape. Since the 1960's, Minnesota has lost millions of elms to this disease, changing the landscape. The results from our investigations show that there is hope to obtain resistant elms that are native to Minnesota and these will provide benefits to the environment and people of Minnesota.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Enhancing Timber Sale Program Environmental and Economic Sustainability
Subd. 03i $336,000 TF

Charles Blinn
U of MN
1530 Cleveland Ave N
St Paul, MN 55108

Phone: (612) 624-3788
Email: cblinn@umn.edu

Web: http://www.forestry.umn.edu/People/Blinn/

Appropriation Language
$336,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to evaluate the impacts of timber payment methods on postharvest forest ecological conditions and net revenue generated from public timber sale programs. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Minnesota has 9.5 million acres of public forest lands that play an important role in sustaining Minnesota's environment and economy. The policies and programs used by public timber sale programs can impact post-harvest ecological conditions and have pronounced effects on the composition, structure, and productivity of the forest in the future. Additionally, timber harvesting revenues play an important role in economic activity, employment, and tax revenue. Currently, timber on public lands is sold in of two ways: pay based on volume harvested and pay based on appraised volume available for harvest, regardless of the actual harvest. Scientists at the University of Minnesota are using this appropriation to evaluate how timber payment methods impact post-harvest forest ecological conditions, net revenue generated from public timber sale programs, and barriers perceived by forest managers and loggers. This information will help gauge economic and ecological tradeoffs between the two methods in order to maximize future forest productivity, wildlife habitat, and biodiversity.

OVERALL PROJECT OUTCOME AND RESULTS
The method used by a timber sale program to collect payment for timber sold was perceived by land managers and others to have a substantial impact on post-harvest ecological conditions and net timber sale revenue. The two payment methods used are consumer scale (scale) and lump sum. Under the scale method, the buyer only pays for timber that has been harvested and scaled by a qualified scaler.

With this method, the seller tracks harvested volume using scale tickets which require administrative time to process. The lump sum method requires the buyer to pay a fixed amount for the timber, regardless of the timber volume actually harvested.

Our study goals were to evaluate how the two timber payment methods: a) impact post-harvest ecological conditions; b) impact the cost-effectiveness within Minnesota's public timber sale programs; and c) are perceived by natural resource managers and loggers. To accomplish these study goals, we collected data from post-harvest sites, reviewed agency records, conducted a field economic experiment using a timber sale auction, conducted time studies, administered a mail survey, and conducted interviews and focus groups.

We found that the perceptions of ecological and economic impacts of timber payment method often exceed actual impact. Timber payment method did not impact post-harvest ecological conditions, gross stumpage revenue or stumpage price bids. Numerous factors (e.g., pre-harvest operator conditions, operator) had a greater impact on post-harvest ecological conditions than payment method. A strong biomass market could increase utilization and thus post-harvest ecological conditions under a lump sum method. The impact of using the consumer scale method on net timber sale revenue is less than one percent of the timber sale's value. Logging business owners participating in the study ranked timber payment method lower in importance than other factors when bidding on a sale. As each payment method has its strengths and weaknesses (see table below), agencies need the flexibility to select the approach which best meet their needs.

Summary of factors favoring use of scale and lump sum payment methods.

Factors favoring scale method	Factors favoring lump sum method
1) Less administrative time and accuracy needed to estimate sale volume	1) Less time needed to administer active timber sale and to process paperwork and other related documents
2) Appraisal staff have low probability of accurately estimating sale volume and value	2) Facilitates simultaneously administering several timber sales
3) Timber sales with a high percentage of low value timber and/or where operating costs are expected to be high	3) Fewer personnel required for timber sale
4) More woody material may be retained on-site for wildlife purposes	4) High utilization can facilitate manual reforestation efforts
5) Salvage timber sales	5) Timber sale has uniform characteristics (e.g., pine plantation)

PROJECT RESULTS USE AND DISSEMINATION

Project cooperator meetings were conducted annually to discuss upcoming areas of focus, data and methods, and to present results to date. Semi-annual project summary reports submitted to LCCMR were shared with all project cooperators. During the March 24, 2016 project cooperator meeting in Willow River, final results from all project components were presented during a highly interactive session and four one-page fact sheets were distributed. Participants at that March 2016 meeting were so interested in the study results that they suggested and helped arrange additional presentations to the Minnesota Association of County Land Commissioners (June 9, 2016) and the Minnesota Forest Resources Partnership (June 23, 2016). Additional project outreach included a meeting with the DNR

Forest Operations and Management Section in 2014, four papers and presentations at the Council on Forest Engineering annual meetings in 2014 and 2015, a seminar presented during the 2015 International Symposium for Society and Resource Management, three seminars to University of Minnesota graduate students and faculty, and a poster presented during the 2015 Society of American Foresters Annual Meeting. Three graduate students completed M.S. theses on their work in this project. Two University of Minnesota, Department of Forest Resources Staff Papers were produced. Everyone who participated in the Activity 2 mail survey was sent an electronic summary letter with instructions for how to receive the full report. At least two manuscripts are being prepared for peer-review journals and will be submitted after project completion.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Enhancing Environmental and Economic Benefits of Woodland Grazing
Subd. 03j $190,000 TF

Diomy Zamora
U of MN
1530 Cleveland Ave N
St. Paul, MN 55108

Phone: (612) 626-9272
Email: zamor015@umn.edu
Web: http://www.extension.umn.edu/agroforestry/

RESEARCH

Appropriation Language
$190,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to evaluate management options for woodlands used for grazing to improve ecological and economic benefits. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Over 527,000 acres of unmanaged woodlands are being used for livestock grazing throughout Minnesota. Managing these grazed woodlands based on the use of best management practices can provide environmental and economic opportunities, including improved water quality, maximized forage production, and higher-quality timber. The best management practices involved are commonly used in other parts of the country with other types of ecosystems, but have not been widely adopted in Minnesota due to a lack of knowledge and experience with implementing them within the ecosystems of Minnesota. This appropriation is being used by scientists at the University of Minnesota to evaluate and demonstrate how to effectively adapt and implement these best management practices for improved woodland grazing for use in Minnesota.

OVERALL PROJECT OUTCOME AND RESULTS
Over 527,000 acres of unmanaged woodlands are being used for livestock grazing throughout Minnesota. Managing these grazed woodlands based on the use of best management practices can

provide environmental and economic opportunities, including improved water quality, maximized forage production, and higher-quality timber. The best management practices involved are commonly used in other parts of the country with other types of ecosystems, but have not been widely adopted in Minnesota due to a lack of knowledge and experience with implementing them within the ecosystems of Minnesota. This appropriation is being used by scientists at the University of Minnesota to evaluate and demonstrate how to effectively adapt and implement these best management practices for improved woodland grazing for use in Minnesota.

PROJECT RESULTS USE AND DISSEMINATION

Over 527,000 acres of unmanaged woodlands are being used for livestock grazing throughout Minnesota. Managing these grazed woodlands based on the use of best management practices can provide environmental and economic opportunities, including improved water quality, maximized forage production, and higher-quality timber. The best management practices involved are commonly used in other parts of the country with other types of ecosystems, but have not been widely adopted in Minnesota due to a lack of knowledge and experience with implementing them within the ecosystems of Minnesota. This appropriation is being used by scientists at the University of Minnesota to evaluate and demonstrate how to effectively adapt and implement these best management practices for improved woodland grazing for use in Minnesota.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Silvopasture: Establishment and Management Principles for Northern Hardwood Forests in Minnesota and the North Central United States (PDF)

Subd. 04 Land, Habitat, Restoration and Recreation

State Parks and State Trails Land Acquisition
Subd. 04a $1,000,000 TF

Jennifer Christie
MN DNR
500 Lafayette Rd
St Paul, MN 55155

Phone: (651) 259-5633
Email: jennifer.christie@state.mn.us
Web: http://www.dnr.state.mn.us/state_parks/

Appropriation Language
$1,000,000 the first year is from the trust fund to the commissioner of natural resources to acquire authorized state trails and critical parcels within the statutory boundaries of state parks. State park land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards, as determined by the commissioner of natural resources. A list of proposed acquisitions must be provided as part of the required work plan. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview

Minnesota's extensive state park and trail system, the second oldest in the country, is currently comprised of a total of 76 state parks and recreation areas and 13 state trails scattered throughout the state. Some of Minnesota's state parks and trails have privately owned lands within the designated park boundaries or trail corridors. Purchase of these lands from willing landowners for addition to the state park and trail system makes them permanently available for public recreation and enjoyment and facilitates more efficient management. Additional benefits include preserving contiguous wildlife corridors, facilitating preservation and restoration of native plant communities and cultural resources, reducing impacts of future development, and providing riparian buffers along wetlands, creeks, and lakes. The Minnesota Department of Natural Resources is using this appropriation to fund the acquisition of approximately 245 acres to add to the state park and trail system, which includes:

- 50 acres for Great River Bluffs State Park in Winona County
- 115 acres for Cuyuna Country State Recreation Area in Crow County
- 80 acres for the Mill Towns State Trail in Rice County

OVERALL PROJECT OUTCOME AND RESULTS
Minnesota Environment and Natural Resources Trust Fund funding resulted in the Department of Natural Resources acquiring approximately 103 acres of land within the statutory boundaries of two Minnesota State Parks and one Minnesota State Trail.

- Acquired approximately 29 acres in Frontenac State Park comprised Lowland forested wetlands with a small stream and exposed dolomite bluff face partially covered with a mix of native prairie and some upland trees.
- Acquired approximately 8 acres of an entire island located within the new Lake Vermilion-Soudan Underground Mine State Park. This acquisition preserves unique island habitat, viewshed and enhances outdoor recreation opportunities such as canoe campsite and a new day use area.
- Partially funded the acquisition of approximately 66 acres of land for Mill Towns State Trail to preserve and protect ~6 miles of a former railroad corridor for future development of the legislatively authorized trail that will eventually connect cities of Faribault and Dundas.

PROJECT RESULTS USE AND DISSEMINATION
These project results and dissemination have been communicated through updated state park and state trail maps reflecting state managed land instead of private in-holdings, and are identified as public land open to be used and enjoyed by all visitors.

A news release promoting the recent acquisition for the Mill Towns State Trail is scheduled for July 2016, and credits Minnesota Environment and Natural Resources Trust Fund as a partial funding source.

Signage at the above listed locations lists ENRTF as a funding source for these State Parks or State Trails.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Scientific and Natural Areas Restoration, Enhancement and Citizen Engagement
Subd. 04b $1,500,000 TF

Peggy Booth
MN DNR
500 Lafayette Rd
St Paul, MN 55155

Phone: (651) 259-5088
Email: peggy.booth@state.mn.us
Web: http://www.dnr.state.mn.us/eco/sna/index.html

Appropriation Language
$1,500,000 the first year is from the trust fund to the commissioner of natural resources to conserve sites of biodiversity significance by restoring and enhancing lands established as scientific and natural areas as provided in Minnesota Statutes, section 86A.05, subdivision 5, and providing volunteer engagement and outreach. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Minnesota's Scientific and Natural Areas (SNA) Program is an effort to preserve and perpetuate the state's ecological diversity and ensure that no single rare feature is lost from any region of the state. This includes landforms, fossil remains, plant and animal communities, rare and endangered species, and other unique biotic or geological features. These sites play an important role in scientific study, public education, and outdoor recreation. The Minnesota Department of Natural Resources is using this appropriation to conduct restoration and enhancement activities on approximately 1,600 acres in existing SNAs and to increase citizen and student knowledge and skills pertaining to ecological restoration and biodiversity conservation through engagement with SNAs.

OVERALL PROJECT OUTCOME AND RESULTS
Habitat restoration and enhancement actions increased the quality of habitat on more than 1500 acres of designated Scientific and Natural Areas (SNAs) through achieving: restoration of about 235 acres at 4 SNAs; woody invasive species control on 371 acres at 49 SNAs, herbaceous invasive species treatment on 266 acres at 44 SNAs, and installation of invasive species control boot brush kiosks at 5 SNAs; about 26 miles of burn breaks at 24 SNAs and completion of 720 acres of prescribed burns at 25 SNAs and 141 acres of prescribed haying at 7 SNAs; and site development work (e.g. entry and boundary signs, new gates, and site cleanup) at over 50 SNAs. Conservation Corps Minnesota was involved in 42 of these projects. Adaptive Management Plans have been completed for 19 SNAs. Ecological monitoring has been completed at 7 SNAs; including monitoring of snakes at an SNA which is yielding new information that will inform natural resource management work.

The public's and youth involvement in SNAs and their knowledge and skills about biodiversity conservation has significantly increased through the SNA Outreach Initiative in its second phase through this appropriation. As of September 2015: the SNA Facebook page reached over 34,000 people with over 1500 likes of the page and the quarterly SNA e-newsletter Nature Notes reached over 3,250 subscribers. From January 2014 through June 2015, about 170 SNA events were held involving over 1550 people and volunteer site stewards were helping monitor and care for 128 or 80% of SNAs. The statewide color map locating all SNAs was updated and 5000 copies of this second addition were printed.

PROJECT RESULTS USE AND DISSEMINATION

Dissemination is primarily achieved through the upgraded SNA webpage on the DNR website: http://www.mndnr.gov/snas and through other electronic/social media which are linked through this webpage. With support through this funding, the SNA Facebook page was launched in February 2014; the SNA Facebook page has achieved over 1,500 page likes and total monthly reach of over 34,000 by March 2015. The 11th (Winter 2014) issue of the Nature Notes e-newsletter was delivered to over 3,250 subscribers. The statewide color map locating all SNAs (with directions to all sites and ENRTF acknowledgement on the back) was updated and 5000 copies of this second addition were printed and nearly all have been distributed.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Restoration Evaluations (PDF)
Outreach (PDF)

Native Prairie Stewardship and Prairie Bank Easement Acquisition
Subd. 04c $750,000 TF

Judy Schulte
MN DNR
500 Lafayette Rd, Box 25
St Paul, MN 55155

Phone: (651) 259-5130
Email: judy.schulte@state.mn.us
Web: http://www.dnr.state.mn.us/eco

Appropriation Language
$750,000 the first year is from the trust fund to the commissioner of natural resources to acquire native prairie bank easements, prepare baseline property assessments, restore and enhance native prairie sites, and provide technical assistance to landowners. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Prior to European settlement more than 18 million acres of prairie covered Minnesota. Today less than 1% of that native prairie remains, and about half of those remaining acres are in private landownership without any formal protection currently in place. Through this appropriation the Minnesota Department of Natural Resources will work with private landowners of high quality native prairie sites to protect remaining native prairie using a variety of tools. Approximately 200 acres are expected to be permanently protected through Native Prairie Bank conservation easements. A variety of restoration and enhancement activities will be implemented on a total of about 690 acres. Additionally, education and technical assistance will be provided to interested landowners to help them improve the management and stewardship of native prairie sites they own.

OVERALL PROJECT OUTCOME AND RESULTS
Native Prairie Bank (NPB) conservation easements were acquired on 330 acres thereby permanently protecting valuable native prairie. Specifically, 3 easements were acquired in part with this appropriation located in Wilkin, Traverse and Big Stone Counties (194 acres pro-rated to this

appropriation). In total, 12 baseline property reports were written through this appropriation (including 2 of the 3 newly acquired easement baselines). In addition to baseline reports, 16 existing Native Prairie Bank easements were monitored and data entered into the Department of Natural Resource (DNR)'s Conservation Easement Monitoring database.

Restoration and enhancement activities were completed on a total of over 850 acres exceeding the project's target acreage. Specific accomplishments are 18 prescribed burns on 702 acres, 4 prairie reconstructions on 6 acres, and 21 invasive species control projects on 147 acres; 9 of these 43 projects involved Conservation Corps Minnesota (CCM) crews. Boundary signing has been completed on 5 NPB easements.

Through this appropriation, 9 different events were held aimed at getting prairie stewardship information to landowners. NPB staff also worked with all 10 Prairie Conservation Plan Local Technical Teams to insure that landowners being approached by other practitioners are made aware of their prairie stewardship options such as Native Prairie Bank that are available through the Scientific and Natural Area (SNA) Program. Prairie specialists engaged 70+ different priority prairie landowners one-on-one to discuss prairie protection and management options for their property. One landowner received a comprehensive Prairie Stewardship plan.

PROJECT RESULTS USE AND DISSEMINATION
Native Prairie Tax Exemption brochures were updated and printed to aid in prairie outreach, encourage prairie preservation and improve prairie stewardship of native prairie acres that may not be protected long-term by other means. A .pdf copy of this brochure is included with the final report and a paper copy can be made available upon request. A total of 3000 Prairie Tax Exemption brochures were printed, 1000 of which were paid for through this appropriation.

Additionally, included with the final report is an article written about a landowner technical assistance success story. This article was written to promote the technical assistance available to private land prairie landowners through this appropriation and encourage pro-active prairie land management. An abbreviated version of this story was shared in the SNA Nature Notes which is published quarterly and distributed to over 3,250 subscribers. One Prairie Stewardship Plan was completed and is being followed by the landowner.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Restoration Evaluations (PDF)

Metropolitan Conservation Corridors (MeCC) - Phase VII
Subd. 04d $2,000,000 TF

Wayne Ostlie
Minnesota Land Trust
2356 University Ave W, Ste 240
St Paul, MN 55114

Phone: (651) 917-6292
Email: wostlie@minnesotalandtrust.org

Web: http://www.mnland.org

Appropriation Language

$2,000,000 the first year is from the trust fund for the acceleration of agency programs and cooperative agreements. Of this appropriation, $10,000 is to the commissioner of natural resources for agency programs and $1,990,000 is to the commissioner of natural resources for agreements as follows: $304,000 with Friends of the Mississippi River; $368,000 with Dakota County; $208,000 with Great River Greening; $310,000 with Minnesota Land Trust; $400,000 with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $400,000 with the Trust for Public Land for planning, restoring, and protecting priority natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through contracted services, technical assistance, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards, as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work plan. This appropriation may not be used for the purchase of habitable residential structures, unless expressly approved in the work plan. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work plan. Lands that would require payments in lieu of taxes under Minnesota Statutes, section 97A.061 or 477A.12, shall not be acquired with money from this appropriation. Up to $54,000 is for use by Minnesota Land Trust in a monitoring and enforcement fund as approved in the work plan and subject to subdivision 16. An entity that acquires a conservation easement with appropriations from the trust fund must have a long-term stewardship plan for the easement and a fund established for monitoring and enforcing the agreement. Money appropriated from the trust fund for easement acquisition may be used to establish a monitoring, management, and enforcement fund as approved in the work plan. An annual financial report is required for any monitoring, management, and enforcement fund established, including expenditures from the fund. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

OVERALL PROJECT OVERVIEW

Though many parts of the Twin Cities metropolitan area are urbanized, there are also has large areas of natural lands that continue to serve as important habitat for fish, wildlife, and plant communities. However, pressure on these remaining lands continues to intensify as population and development pressures increase. This appropriation represents the seventh phase of an ongoing effort by a partnership of state and non-profit organizations, called the Metro Conservation Corridors (MeCC) partnership, to conduct strategic and coordinated land protection, restoration, and enhancement activities that build connections between remaining high quality natural areas in the greater Twin Cities metropolitan area and ensures their benefits are available for future generations. Efforts will strengthen and protect biodiversity; improve water quality in lakes, rivers, and streams; and improve connectivity and access to outdoor recreation. This phase involves six partners and is expected to result in the permanent protection of more than 260 acres and the restoration and enhancement of more than 260 acres. Organizations involved in this phase include Dakota County, Friends of the Mississippi River, Great River Greening, Minnesota Land Trust, MN Valley National Wildlife Refuge Trust, and Trust for Public Land.

Individual Partner Project Overviews

- *1.1/1.2: Coordination and Mapping - Minnesota Land Trust ($20,000)*
  The Minnesota Land Trust provides coordination, mapping, and data management for the Metropolitan Conservation Corridors partnership. Funds are being used to coordinate the partnership, guide strategic outreach and implementation efforts, manage project data, and provide reporting and mapping of accomplishments.
- *2.1 & 3.4: Protect, Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($304,000)*
  Friends of the Mississippi is using this appropriation to permanently protect six acres through fee title acquisition for addition to Fish Creek Natural Area near Maplewood, MN, and to restore and enhance approximately 134 acres of permanently protected prairie, savanna, wetland, and forest habitat in Dakota, Washington, Ramsey, and Hennepin counties. Specific restoration and enhancement activities will include updating management plans, soil preparation, prescribed burning, native vegetation installation, woody encroachment removal, and invasive species control.
- *2.3: Restoring Our Lands and Waters - Great River Greening ($208,000)*
  These funds will enable Great River Greening to restore approximately 90 acres of permanently protected forests, savanna, prairie, and wetland habitat and 0.18 miles of shoreland habitat while engaging hundreds of volunteers in the stewardship of the Metropolitan area's remaining natural areas. Specific activities include invasive species control, seeding/planting, prescribed burning, and other associated activities.
- *2.6 & 3.7: Dakota County Lakeshore and Riparian Protection - Dakota County ($368,000)*
  Through this appropriation Dakota County plans to permanently protect approximately 27 acres of shoreland and contiguous upland in the Marcott Lakes area of Inver Grove Heights by securing a conservation easement from willing landowner. For all acres protected, natural resource management plans will be prepared to ensure their long term stewardship. Additionally, restoration and enhancement activities are expected to occur on approximately 40 acres.
- *3.1: 2013 TPLs Critical Land Protection Program - Trust for Public Land ($400,000)*
  The Trust for Public Land is using this appropriation to purchase approximately 24 acres of land and 0.2 miles of shoreline with high ecological value and then convey the land to state or local governments for long-term stewardship and protection. Lands being considered for permanent protection in this round of funding include an areas around the Rum River in Anoka County, Lindstrom Natural Area in Chisago County, and Carnelian Creek and Keystone Woods area in Washington County.
- *3.2: Protect Signifcant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($300,000)*
  With this appropriation, the Minnesota Land Trust plans to protect 100 acres of high quality forest, prairie, wetland, or shoreline habitat by securing permanent conservation easements and dedicating funds for their perpetual monitoring, management, and enforcement. Lands being considered for permanent protection in this round of funding are located in Chisago, Goodhue, Hennepin, Isanti, and Washington counties.
- *3.3: Priority Expansion of Minnesota Valley National Wildlife Refuge - Minnesota Valley National Wildlife Refuge Trust Inc. ($400,000)*
  The Minnesota Valley National Wildlife Refuge Trust is using this appropriation to purchase a total of approximately 100 acres of land and donated to the U.S. Fish and Wildlife Service to expand the Minnesota Valley National Wildlife Refuge. Many benefits are anticipated from this

project, including improved habitat connectivity, protection of native species, improved water quality in the Minnesota River, and increased public access to natural lands for activities such as hiking, hunting, and fishing. Restoration and management plans will be completed for all acquired lands.

OVERALL PROJECT OUTCOME AND RESULTS

Metro Conservation Corridors partners continued their work to accelerate protection and restoration of high-quality natural lands within the greater Twin Cities Metropolitan Area. Six partner organizations participated - Minnesota Land Trust, Friends of the Mississippi River, Dakota County, Great River Greening, Trust for Public Land, and Minnesota Valley National Wildlife Trust. Minnesota Valley National Wildlife Trust received a 1-year extension to their grant and will report their final outcomes separately. Three specific areas of activity were pursued:

1. **Partnership Coordination, Mapping, and Database Management:** An upgrade to the MeCC web-based project database was completed and the MeCC corridor map was revised and posted for public use. Partners met quarterly to review project accomplishments, share information, and to strategically plan and coordinate conservation activities.

2. **Restore and Enhance Significant Habitat:** Partners restored/enhanced 364.5 acres of habitat (282.6 acres through ENRTF) and 0.42 miles of shoreline (0.35 miles ENRTF), exceeding overall proposed outcomes in both areas and leveraging an additional $342,658. Despite the Partnership achieving its collective goals, Dakota County fell short of its habitat restoration/enhancement goal by 75%, returning $17,000 (42%) of its funding for this activity. A landowner with whom they expected to work instead opted to enroll in CRP, ultimately restoring habitat and receiving a payment.

Partner	Proposed (Habitat/Shoreline)	Accomplished Habitat/Shoreline (ENRTF)	Accomplished Habitat/Shoreline (Other)	Expenditures (ENRTF / Other)
Friends of the Mississippi River	134 acres/0 miles	135.5 acres/0 miles	0.0 acres/0 miles	$142,000/$4,546
Great River Greening	90 acres/0.18 miles	137 acres/0.35 miles	73 acres/0.07 miles	$184,270/$315,178
Dakota County	40 acres/0 miles	10.1 acres/0 miles	8.9 acres/0 miles	$22,808/$22,935
Totals	**264 acres/0.18 miles**	**282.6 acres/0.35 miles**	**81.9 acres/0.07 miles**	**$349,078/$342,658**

3. **Acquire Significant Habitat:** Partners protected 308 acres of land (189 acres ENRTF) and 2.5 miles of shoreline (1.25 miles ENRTF) through fee and conservation easement acquisition. This exceeded proposed outcomes for shoreline protection by 625% (0.2 miles proposed vs 1.25 miles achieved), but fell short in acres protected by 28% (189 acres achieved vs 262 proposed). The $1,053,216 from ENRTF leveraged $3,373,183 through other sources.

Two partners turned back funding:

- Minnesota Land Trust was unable to complete an easement due to financial considerations or tax implications of easements on the part of landowners. $251,388 (84% of grant) was returned.

- akota County exceeded its proposed protection goals, but turned back $132,196 (40% of its grant for protection) due to setbacks with two landowners.

The amount of funding returned to the State (33% of total appropriation for protection) is proportional to the shortfall in ENRTF acres protected (28% below goal).

PROJECT RESULTS USE AND DISSEMINATION

Partners publicized accomplishments through a diverse array of press releases, organization newsletters and the internet. Additionally, the MeCC Partnership maintains an interactive public web map that shows the locations of MeCC projects over time. This web map can be directly accessed at: http://www.dnr.state.mn.us/maps/MeCC/mapper.html.

Project completed: 6/30/2016

FINAL REPORT (PDF)

ABSTRACTS AND FINAL REPORTS OF INDIVIDUAL PARTNER PROJECTS (Click project # to go to listing for that project)

- **1.1/1.2** - MeCC VII - Coordination and Mapping - Minnesota Land Trust ($20,000)
- **2.1/3.4** - MeCC VII - Protect, Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River - Friends of the Mississippi River ($304,000)
- **2.3** - MeCC VII - Restoring Our Lands and Waters - Great River Greening ($208,000)
- **2.6/3.7** - MeCC VII - Dakota County Lakeshore and Riparian Protection - Dakota County ($368,000)
- **3.1** - MeCC VII - 2013 TPL's Critical Land Protection Program - Trust for Public Land ($400,000)
- **3.2** - MeCC VII - Protect Significant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($300,000)
- **2.6/3.3** - MeCC VI - Priority Expansion and Restoration MN Valley NW Refuge - Minnesota Valley National Wildlife Refuge Trust, Inc. ($400,000)

1.1/1.2 FINAL REPORT - MeCC VII - Coordination and Mapping - Minnesota Land Trust ($20,000)

Project Outcome and Results

In this seventh phase of the Metro Conservation Corridors the partners met quarterly to review project accomplishments, share information related to each respective partner's conservation work across the MeCC program area, and to strategically plan and coordinate conservation activities.

The MeCC web-based project database upgrade work was completed by the DNR during Spring 2016 and made available for partner review, planning, and coordination purposes. Based on partner feedback, the web-based map was revised and was posted for public use which was made available for use in June 2016. The web-based map for public use can be accessed on the DNR's website.

Project Results Use And Dissemination

The MeCC Partnership maintains an interactive public web map that shows the locations of MeCC projects over time. This web map can be directly accessed at: http://www.dnr.state.mn.us/maps/MeCC/mapper.html, while the web-based project database can be accessed by authorized partners at:https://webapps15.dnr.state.mn.us/mecc/.

Project completed: 6/30/2016

2.1/3.4 FINAL REPORT - Metro Conservation Corridors (MeCC) Phase VII-Friends of the Mississippi River. Protect, Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($304,000)

Project Outcome and Results

FMR had three goals for this project: Increase the amount of native habitat, enhance the quality of existing habitat and acquire and permanently protect habitat along the Mississippi River in Maplewood. To approach the first two goals we committed to restoring 10 acres of prairie and enhancing 54-acres of prairie, 10-acres of savanna and 60 acres of forest/woodland for a total of 134 acres improved. We accomplished the goals through the following projects:

- Gelhar-Emrick (Ravenna Township): A 6-acre unit at this property was restored to prairie.
- Pine Bend Bluffs SNA (Inver Grove Heights): A restored prairie and two native bluff prairies were managed for invasive weeds by spot-spraying and burning. Total prairie enhanced: 39
- Old Mill Park (Hastings): This project resulted in 10 acres of enhanced oak savanna.
- Ravenna Block (Ravenna Township): A total of 5 acres of a previously installed prairie was managed for the initial two-year establishment period (mowing, spot-treat weeds). 34 acres of forest were managed for invasive woody plants (cut and stump-treat, fall foliar treatment).
- Spring Lake Park Reserve (Rosemount): Prairie was installed in a 17.5-acre old field.
  Heritage Village Park (Inver Grove Heights) : We controlled invasive weeds and seeded native prairie/savanna species on 2 acres of woodland and 7 acres of savanna.
- Mississippi River Gorge (Minneapolis): 7 acres of woodland were enhanced by controlling invasive woody plants.
- Gateway North Open Space Area (Cottage Grove): 6 acres if woodland were enhanced by controlling woody invasive species.
- River Oaks Park (Cottage Grove): Controlled woody and herbaceous plants on an acre each of prairie and woodland.

Project totals: 23.5 acres of prairie installed/restored and 45 acres of existing prairie, 17 acres of savanna and 50 acres of forest/woodland were enhanced for a total of 135.5 acres of habitat improved. The third goal was accomplished by acquiring 6 acres of bluffland habitat in the Fish Creek Natural area, Maplewood.

Project Results Use And Dissemination

Information about this project was disseminated in several ways. FMR published articles about the site specific projects in our traditional newsletter and in our electronic newsletter. Articles could also be found on our website. An article about the Fish Creek acquisition appeared in the St. Paul Pioneer Press and in the Minneapolis Star Tribune. We often organize volunteer events for our project sites and we share information with our participants.

Project completed: 6/30/2016

2.3 FINAL REPORT - MeCC VII - Restoring Our Lands and Waters - Great River Greening ($208,000)

Project Outcome and Results

Along with partners and volunteers, Greening undertook restoration projects to reduce habitat fragmentation, enhance habitat quality, reconnect habitat corridors, and build connections with local communities. Habitats included prairie, oak savanna, woodland, wetland, and riparian. Significantly exceeding all of our goals, we:

1. restored/enhanced 141 acres of upland habitat and an additional 77 acres with leveraged non-state funds for a total of 218 acres,
2. restored/enhanced 0.35 mile of shoreland habitat and an additional 0.08 mile using leveraged non-state funds for a total of 0.42 miles ,

3. engaged over 1750 (>500 youth) volunteers in meaningful parts of these projects
4. leveraged $315,178 in non-state funds

Table 1: Summary of Deliverables by Parcel

Parcel Name	City	County	Acres	Shoreline (mi)	Volunteers
Trout Brook Nature Preserve	St. Paul	Ramsey	7		882
Long Pond Elk Ranch II	Princeton	Sherburne	3		-
Doyle-Kennefick Regional Park	Elko	Scott	10		142
Katherine Abbott Park I	Mahtomedi	Washington	19		313
Wild & Scenic Rivers II - Rum	Cambridge	Isanti	1	0.15	-
Pilot Knob Hill III	Mendota Heights	Dakota	1		24
Cedar Creek Conservation Area	Oak Grove	Anoka	67		-
Central Corridor II and III	Woodbury / Cottage Grove	Washington	6		337
Spring Lake Regional Park III	Cedar Lake Twsp	Scott	20		-
Arcola Mills Maintenance	May Township	Washington	-		-
Cedar Lake Farm Regional Park	New Prague	Scott	3	0.20	-
Dodge Nature Center Lilly Preserve	Mendota Heights	Dakota	4		63
TOTALS			**141**	**0.35**	**1,761**

Sites hosted five documented rare species (2 plants, 3 vertebrates), and three native plant communities with biodiversity of statewide significance.

We restored and de-fragmented habitat in ecological corridors, and at several ecological cores. Restorations protected water quality along the Mississippi River and the Rum River and its watershed.

Volunteers planted over 4,500 trees/shrubs and 5,600 forb/grass plugs, and received presentations from a Greening ecologist as part of their workday.

Project Results Use And Dissemination

Volunteer event descriptions acknowledging Trust Fund contributions and qualitative results were emailed to Greening's e-subscribers in July 2013, Feb 2014, July 2014, February 2015, July 2015, and

spring 2016 in advance of our spring and fall volunteer event seasons. Over the course of the grants, the number of subscribers increased from approximately 5,000 to about 6,500. Information about the Metro Conservation Corridors is on our website in the Initiatives and Volunteer Events sections at http://www.greatrivergreening.org/. Over the course of the grant, the visits to the Greening website increased from over 1,200 to over 1,500 visits per month. Seven press articles disseminated information about the projects. Greening is in active partnership with landowners, other land managers, service providers, conservation peers, and volunteers resulting in a dynamic and timely exchange of information and results.

Project completed: 6/30/2016

2.1/3.4 FINAL REPORT - MeCC7: Dakota County Lakeshore and Riparian Protection - Dakota County ($368,000)

Project Outcome and Results

The project goal was to acquire permanent conservation easements or land along rivers, streams, and undeveloped lakeshore in Dakota County; prepare Natural Resource Management Plans (NRMPs) for conservation easements; and restore/enhance protected land. The project scope encompassed some of the best natural resource features found in the metropolitan region. A sound fiscal and ecological conservation approach was taken, while attempting to balance the interests, rights and responsibilities of private landowners, with public concerns about water, wildlife habitat, outdoor recreation, and climate change.

In November 2011, Dakota County adopted a comprehensive Land Conservation Vision that includes establishing permanent vegetative buffers along all rivers, streams and undeveloped lakeshore, and protecting quality natural areas. The County's land conservation programs targeted specific areas in the County and mailings were issued to determine landowner interest. Program applications were reviewed and evaluated using County Board-approved criteria; and top-ranking projects were considered for permanent protection. Appraisals were conducted for recommended projects. NRMPs and baseline Property Reports were prepared for projects where landowners accepted purchase offers; and landowners agreed to cash or in-kind restoration and management contributions. Restoration projects were also completed on existing easement and fee title properties.

The project goals were to acquire an estimated five permanent conservation easements and one fee title property, totaling 235 acres, and restoring/enhancing 40 acres of protected land. In spite of significant County efforts, a wide variety of issues prevented projects from being completed. Landowner inflated value expectations, lack of family agreement to move forward, and inability to make timely decisions delayed and derailed projects. Subsequently, the County didn't meet its acquisition goals, but exceeded its restoration goals, and overall, accomplished the following:

Project Name	Acres	Miles of Shoreline	Ecological Significance	Activity Description	ENRTF Cost
Cemstone	61.7	1.7	Designated trout stream area on Vermillion River	Fee title acquisition	$104,932
Ruppe	17.2	0.5	Chub Creek riparian area	Easement acquisition	$25,450
Schweich	20.7	0.3	Chub Creek riparian area/upland	Easement acquisition	$60,400

Cemstone	19	1.7	Designated trout stream riparian area/upland	Initial site preparation, seeding and first phase restoration of formerly cultivated and disturbed areas	$4,845
Malecha	27	0.9	Wetland restoration	Wetland berm construction and initial seeding	$6,000
Ruppe	NA	0.5	Chub Creek riparian area	Natural Resource Management Plan (NRMP) completed	$5,625
Schweich	15	0.3	Chub Creek riparian area, and formerly cultivated upland area	NRMP completed and buffer seeded	$4,238 (NRMP only)

Project Results Use And Dissemination

Information about the specific projects funded through this State appropriation is integrated with information about the County's comprehensive land conservation efforts that were initiated in 1998, with a farmland and natural areas protection plan partially funded by the Environment and Natural Resources Trust Fund. Implementation of the initial plan and subsequent revisions resulted in the permanent protection of 11,244 acres of natural areas and agricultural land and over 51 miles of shoreland outside of the regional park and greenway system. This project informed and improved internal and external County land conservation practices, procedures and policies. County staff has provided numerous local, regional and national presentations about how Dakota County has developed and implemented its successful programs. Information has appeared on TV and radio, as well as metropolitan newspapers and residential newsletters. Information can also be found on the County's web site at: https://www.co.dakota.mn.us/Environment/LandConservation/Pages/default.aspx.

Project completed: 6/30/2016

3.2 FINAL REPORT - MeCC VII - 3.2 - Protect Significant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($300,000)

Project Outcome and Results

In this seventh phase of the Metro Conservation Corridors, the Minnesota Land Trust (Land Trust) sought to protect 100 acres of critical habitat through conservation easements within designated Metro conservation corridors. To facilitate this outcome, the Land Trust implemented an RFP process (a revision of the MMAPLE framework developed for the ENRTF-funded Avon Hills program in Stearns County) to solicit bids from interested landowners within areas of high biological value targeted for the program. A framework for scoring and prioritizing bids was developed for the Metro Corridors program that placed emphasis on a set of ecological criteria (size of habitat to be protected, condition of the habitat, ecological/protection context within which the parcel lies, and threat) and cost. Along with their proposal for inclusion into the program, landowners identified the funding level necessary for their participation.

The Land Trust utilized an array of strategies to effectively target landowners within priority areas,

ranging from direct mail to face-to-face meetings and web-based methods (Facebook and web postings). Anoka and Washington Conservation Districts were contracted to engage local landowners within priority areas. Anoka Conservation District (ACD) sent 17 mailings out to landowners of high priority properties within the Rum River Watershed. Washington Conservation District utilized both GIS-generated mail merge and direct contact to reach 100 landowners. The Land Trust also sent out targeted mailings to 26 landowners of property meeting criteria for the program elsewhere in the Metro.

Twelve bids were received and ranked relative to the established criteria; three projects were identified as highest priority for the program. These landowners were engaged in easement negotiations but eventually declined to continue forward due to financial considerations, specifically low appraised land values (relative to landowner expectations/desires) and tax implications for the landowner. As a result, no conservation easements were procured through this grant.

Project Results Use And Dissemination
The Land Trust developed partnerships with local conservation partners (Anoka and Washington Conservation Districts) to conduct targeted landowner outreach in priority geographies to identify interested landowners. Outreach materials, including program fact sheets and application materials, were developed and shared with local partners and or were direct-mailed to landowners by the Land Trust. In addition, the Land Trust marketed the easement program and RFP process through social media and on its web site. Over 140 landowners were reached via direct mail or through face-to-face meetings, and an unknown number of individuals were reached through our web-based media. Though no easements were completed from which to disseminate results, the time invested in outreach through local partnerships provides a strong foundation from which to continue protection efforts in the Conservation Corridors area.

Project completed: 6/30/2016

Landscape Arboretum Acquisition Lake Tamarack
Subd. 04e $2,000,000 TF

Peter Moe
U of MN - MN Landscape Arboretum
3675 Arboretum Dr
Chaska, MN 55318

Phone: (952) 443-1408
Email: moexx004@umn.edu
Web: http://www.arboretum.umn.edu

Appropriation Language
$2,000,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to acquire land surrounding Lake Tamarack in Carver County as part of the acquisition of approximately 80 acres. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
The University of Minnesota's Landscape Arboretum is the largest and most diverse horticultural site in

Minnesota. It features gardens and natural areas representative of Minnesota and the upper-Midwest that can be explored using several miles of trails. Additionally it conducts fruit and plant breeding research to develop cultivars that have particular desired characteristics, such as cold hardiness or disease resistance. The arboretum has a long-term goal of protecting the entire watershed of which it is a part. This appropriation is being used by the arboretum to acquire approximately 80 acres of land surrounding Lake Tamarack in Carver County, which will protect a variety of habitat types and 1,300 feet of shoreline in an area threatened by development. This new portion of the arboretum will have free public access and provide additional land for future research that may pertain to restoration ecology, crop production, bio-energy, or wildlife habitat.

OVERALL PROJECT OUTCOME AND RESULTS

The University of Minnesota Landscape Arboretum purchased the property at 400 Arboretum Boulevard, Victoria, (previously known as the Kerber Farm or Lano Burau Property), effective Friday, November 1, 2013. The property consists of 78.13 acres in Carver County. This is the final property purchase identified in the Arboretum's 1995 Boundaries Plan. Over 300 acres have been added to the Arboretum during the last 18 years.

The property is north of State Highway 5 and directly adjacent to the Horticultural Research Center. The property contains native forest, wetlands, tillable land, and 1,300 feet of lakeshore on Lake Tamarack. Current structures on the property will be evaluated for condition and safety and some will likely be retained for unheated storage while others may be demolished.

The property will be used in the future for research; protection of wildlife, wetlands and water quality; protection of big woods, oak savanna and upland meadow; and educational and public low impact recreational purposes. Research uses have not been determined and roads, fencing, and irrigation will be installed in the 10 acre area designated for research. Some of the current soybean fields could also be used for alternative crop, forage crop, or restoration research projects, and the Arboretum is considering partners from across the University of Minnesota or other conservation and natural resources groups.

Funding for this purchase was provided by the Environment and Natural Resources Trust Fund (ENRTF) - recommended by the Legislative Citizens Commission for Minnesota Resources (LCCMR), the Lessard Sams Outdoor Heritage Council (LSOHC) and the Minnesota Landscape Arboretum Foundation. Because we received LCCMR and LSOHC funding to purchase the property, the Arboretum will provide FREE public access. The University of Minnesota is charging the City of Victoria $1 for the 50 year Use License Agreement for the Trail that crosses the Lake Tamarack Property and $1 for the Use License Agreement for Temporary Construction Access for this trail. There are no fees beyond the $2 for the entire trail including the sections that do not cross the Lake Tamarack Property. Finally, the Arboretum will work over the next several months to develop public access policies and install signage.

PROJECT RESULTS USE AND DISSEMINATION

The acquisition was successfully publicized by the Arboretum with a press release issued on November 11, 2013 and was also covered in the Arboretum E-News with 10,000 subscribers. It was then covered in the local media:

- U to expand arboretum with 78-acre purchase, Minnesota Daily, January 28, 2013
- U Arboretum expands base in Chanhassen by 78 acres, Star Tribune, November 12, 2013
- Minnesota Landscape Arboretum grows by 78 acres, Finance & Commerce, November 13, 2013

- Minnesota Landscape Arboretum Grows By 78 Acres, WCCO-CBS News Online, November 13, 2013

Project completed: 6/30/2014

FINAL REPORT

Conservation Program Technical Assistance
Subd. 04f $3,000,000 TF

Tim Koehler
Board of Water and Soil Resources
520 Lafayette Rd N
St. Paul, MN 55155

Phone: (651) 297-1894
Email: tim.koehler@state.mn.us
Web: http://www.bwsr.state.mn.us

Appropriation Language
$3,000,000 the first year is from the trust fund to the Board of Water and Soil Resources to continue providing grants to soil and water conservation districts and other units of local and state government for the employment of staff to reenroll expiring lands into programs for conservation purposes. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Enrollment of private lands in conservation programs can provide important natural resource and other public benefits by taking the lands out of production so that they can provide various wildlife, water quality, and ecological benefits. This appropriation is enabling the Minnesota Board of Soil and Water Resources to continue to provide grants to local soil and water conservation districts for employment of technical staff to assist private landowners in implementing conservation programs. This effort is expected to assist with the enrollment, retention, and management of 170,000 private acres of grasslands, wetlands, and forests in federal and state conservation programs, particularly in areas expected to lose enrollments in the Conservation Reserve Program (CRP).

OVERALL PROJECT OUTCOME AND RESULTS
During this project a total of 42,474 private landowner contacts were made resulting in 8,235 contracts on 160,258 acres of land positively impacted (restored, enhanced or managed) with grassland and wetland programs. A contact is defined as a personal interaction between the Farm Bill Assistance Partnership (FBAP) staffer and a landowner. It may be a phone conversation discussing program benefits and opportunities, office visit to review plan documents or an in-field visit to stake out a practice. In order for a contract to be completed it takes several contacts to move a landowner through the process, once again demonstrating the value of these positions.

Program	CCRP *	CCRP *	CCRP *	CCRP *	General	Other local, state and federal **

Type	Filter Strips	Riparian Buffers	Wetlands	Windbreaks	**General CRP** Gen. Erosion and water quality	**CRP and CCRP** Mgt. Activities to sustain site	Various conservation concerns	Total
Contracts	2,002	355	1,829	510	237	1,180	2,122	8,235
Acres	14,044	4,235	71,265	1,335	3,817	22,091	43,471	160,258

89,544 acres of this total were critical wetland and riparian CRP contracts and this exceeded our goal of 80,000 acres. With this project, targeted local outreach, enrollment and implementation has occurred which directly led to the project accomplishments.

The primary environmental benefits tied to the land use conversion from row crops to perennial vegetation due to CRP and other programs, includes the reduction of sediment and nutrient pollutants to water bodies as well as increased habitat for resident and migratory species.

The new Federal Farm Bill reduced the national CRP acreage limit and drastically curtailed General CRP sign-ups and encouraged more focused Continuous CRP (CCRP). This allowed local staff hired through this project to assist landowners who wanted to focus on CCRP, management of existing CRP contracts to optimize the environmental benefits as well as other programs to reach the goals of this project. Due to these facts local staff were still able to accomplish 94% of the overall acreage goal for the project (160,258 acres compared to 170,000 goal).

This project is built upon the framework of a multi partner group called the Farm Bill Assistance Partnership (FBAP) created in 2002 to accelerate private lands conservation program implementation. Emphasis is on the maximum use of federal and state conservation programs to retain and restore grasslands and wetlands on private lands primarily in the agricultural region of MN. At the core of the project is the hiring of Soil and Water Conservation District (SWCD) or Pheasants Forever (PF) staff to engage and lead landowners through conservation practice enrollment and implementation. At the close of this project there were 47 counties participating with 30.40 full time staff equivalents hired (18 SWCD and 12 PF employees housed in SWCD offices).

This $3M ENTRF funded project was leveraged with $873,737 of local and non ENTRF funds to bring the grand total for the project to nearly $3.9M.

PROJECT RESULTS USE AND DISSEMINATION

The work of this project, past, present and future is tracked as part of the MN Conservation Lands Summary. This document is the only accounting of our collective private and public conservation estate here in MN. As CRP comes and goes and as we add permanently protected lands it is imperative that we have a foundation of our conservation estate. This report is updated annually and is posted on the BWSR web site at http://www.bwsr.state.mn.us/easements/CLS%20Statewide%20Summary%20August%2013%202015.pdf.

The Farm Bill Assistance Partnership has been a model for local-state-federal agency and NGO

cooperation and has been used for other conservation related acceleration projects. At the local level biologists utilize past successes and future goals to provide widespread and one-on-one outreach to landowners in their covered areas.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Moose Habitat Restoration in Northeastern Minnesota
Subd. 04g $200,000 TF

Ron Moen
U of MN - NRRI
5013 Miller Trunk Hwy
Duluth, MN 55811

Phone: (218) 720-4279
Email: rmoen@nrri.umn.edu
Web: http://www.nrri.umn.edu/moose/

RESEARCH

Appropriation Language
$200,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute to develop best practices guidelines for creating moose foraging habitat efficiently and cost-effectively. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Moose, one of Minnesota's most iconic wildlife species, are dying at increasingly higher rates in Minnesota and there is uncertainty as to why. Estimates suggest the population declined 35 percent just between 2012 to 2013, and projections suggest moose could be nearly gone from the state by 2020 if this trend is not halted and, ideally, reversed. Scientists at the University of Minnesota are using this appropriation to identify appropriate management and habitat needs and the sorts of actions that can be implemented to help slow or prevent continued population declines amongst Minnesota's moose populations. The project is a continuation and expansion of work completed and underway by two other past Environment and Natural Resources Trust Fund supported projects on determining the cause for the increasing mortality.

Project due to be completed: 6/30/2016

Work Plan (PDF)

Bee Pollinator Habitat Enhancement
Subd. 04h $200,000 TF

Marla Spivak
U of MN

219 Hodson Hall, 1980 Folwell Ave
St. Paul, MN 55108

Phone: (612) 624-4798
Email: spiva001@umn.edu
Web: http://www.beelab.umn.edu

Appropriation Language
$200,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to assess the potential to supplement traditional turf grass by providing critical floral plant resources to enhance bee pollinator habitat. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Bees play a key role in ecosystem function and in agriculture, including more than one hundred U.S. crops that either need or benefit from pollinators. However, bee pollinators are in dramatic decline in Minnesota and throughout the country. One of the potential causes appears to be a scarcity of bee-friendly flowers, particularly in urban areas, which is leading to nutritional deficiencies, chronic exposure to pesticides, and debilitating diseases and parasites. Scientists at the University of Minnesota are using this appropriation to assess options that can be broadly implemented in urban areas to enhance bee pollinator habitat and counteract declining populations and bee health. The effort will examine ways to supplement traditional turfgrass landscapes, particularly in areas that primarily serve an aesthetic purpose, with flowering plants that can provide increased nutrition and less potential exposure to pesticides.

OVERALL PROJECT OUTCOME AND RESULTS
Our goal was to develop an innovative way of helping bee pollinators by enhancing turf areas with native flowering plants. Planting "bee lawns" could help reduce intensive inputs (pesticides and fertilizers) and provide low-growing floral areas, which would beautify Minnesota and provide a creative model for a simple yet effective way to help pollinators and protect our natural resources. First, we identified turf grasses that are well suited to incorporating flowering plants. We found that hard fescue, Festuca brevipila, like other fine leafed fescues, demonstrates drought tolerance, slow vertical growth rate, and excellent winter hardiness making it suitable for a lower-input lawn species. Next, we found that native floral species, Prunella vulgaris spp. lanceolata and Astragalus crassicarpus established well in hard fescue, with Prunella establishing better in loamy soil and Astragalus in sandy soil. We also found that Symphyotrichum lateriflorum (native calico aster) would bloom at a low height under light mowing pressure, making it a third native species for incorporation into turf. These experiments were important first steps in identifying native plants to diversify lawns that are both attractive to pollinators and can withstand mowing pressure. To assist homeowners in establishing flowers in their own existing home lawns, we subjected turf areas in two locations to scalping and/ or aeration and then seeded them with native flowers. The flowers established at higher rates at the location that used minimal turfgrass management (infrequent mowing and no fertilizer use) compared to the more intensively managed site. This latter finding indicates that flowering lawns will do best with lower inputs, which will contribute to more sustainable landscapes that are beneficial to pollinators. Ian Lane, graduate student that conducted this work, defended his Master's degree in May 2016.

PROJECT RESULTS USE AND DISSEMINATION
This project reached a broad audience with research-based information about bee lawns. Professional

audiences have been reached through articles in trade journals. Hobbyist audiences have been reached through presentations at local, regional, and national meetings. Scientific audiences have been engaged through departmental seminars and national scientific meetings. Ian Lane, graduate student, will produce at least three peer-reviewed publications from this project. Most importantly, the general public has been reached in a number ways: we hosted five field days, 3,000 copies of a new brochure on Bee Lawns were distributed, and a new page on the Bee Lab website at the University of Minnesota was developed with information on planting and maintenance of Bee Lawns: https://www.beelab.umn.edu/ A pdf copy of the brochure and evaluations from attendees of the 2016 field day are included as an Addendum to this report.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Bee Lawn Brochure (PDF)
Bee Lawn Info (PDF)

Preserving the Avon Hills Landscape - Phase II
Subd. 04j $772,000 TF

Thomas Kroll
Saint Johns Arboretum and University
Box 3000
Collegeville, MN 56321

Phone: (320) 363-3163
Email: tkroll@csbsju.edu
Web: http://www.csbsju.edu/arboretum/avonhills

Appropriation Language
$772,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Saint John's University in cooperation with the Minnesota Land Trust to secure permanent conservation easements on high quality habitat in Stearns County, prepare conservation management plans, and provide public outreach. A list of proposed easement acquisitions must be provided as part of the required work plan. Up to $80,000 is for use by Minnesota Land Trust in a monitoring and enforcement fund as approved in the work plan and subject to subdivision 16. An entity that acquires a conservation easement with appropriations from the trust fund must have a long-term stewardship plan for the easement and a fund established for monitoring and enforcing the agreement. Money appropriated from the trust fund for easement acquisition may be used to establish a monitoring, management, and enforcement fund as approved in the work plan. An annual financial report is required for any monitoring, management, and enforcement fund established, including expenditures from the fund. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
The Avon Hills area is a unique 65,000-acre glacial moraine landscape located in Stearns County just west of St. Cloud. It has been identified as having statewide ecological significance and includes the highest concentration of native plant communities in the county - including oak and maple-basswood forests, tamarack and mixed-hardwood swamps, and wet meadows - and several rare plants and animal

species, including American ginseng, cerulean warbler, red-shouldered hawk, and Blanding's turtle. This appropriation is being used by the St. John's Arboretum at St. John's University to secure permanent protection, via conservation easements, for an additional 350-550 acres of high quality habitat in the Avon Hills area, prepare conservation management plans for the easement lands, and provide public outreach on the significance of the Avon Hills landscape and options for its protection. St. John's Arboretum previously used a 2008 Environment and Natural Resources Trust Fund appropriation to permanently protect more than 1,000 acres in the area.

OVERALL PROJECT OUTCOME AND RESULTS
Conservation easements to permanently protect private land from development are the main goal of this project located in the Avon Hills 10 miles west of St. Cloud, MN. We tested a reverse bidding system termed the MN Multi-faceted Approach for Prioritizing Land Easements (MMAPLE) to rank submitted easement locations. MMAPLE ranks proposed easements by comparing the land's inherent ecological features to the cost per acre for the easement, thereby focusing on the best value. Land which has many inherent ecological values receives a higher score. Conversely, landowners who bid a higher price per acre for the easement receive a lower score.

The MMAPLE process resulted in seven bids for easements. Pursuit of easements was discontinued with five of these landowners due to concerns with future tax implications, or land use restrictions imposed by the easement itself. In this regard, MMAPLE proved effective as a ranking tool in identifying the next highest-scoring eligible landowner within the candidate pool; this enable the Land Trust to move quickly in engaging the landowner. MMAPLE also proved its ability to efficiently leverage the grant funding under this phase of the project; both easement acquisitions were bargain sales by the landowners. On the first easement acquisition of 170 acres, the easement was purchased for $126,100 below its full market value; the second easement of 61 acres was purchased for $67,800 below its full market value. Total appraised value of the two purchased easements was $635,300, with the grant providing $441,400 towards acquisition; donated value of these bargain sales amounted to $193,900.

The grant also funded outreach and education to increase landowner awareness of easements and land protection as well overall conservation. Landowner conferences held at Saint John's University were the main vehicle for this outreach with 559 total attendees.

PROJECT RESULTS USE AND DISSEMINATION
The Land Trust shared news of the easement acquisitions on both the Avon Hills (Riesner) and (Dwyer) parcels on its website and Facebook page. MMAPLE was also featured as a new model for acquiring conservation easements in the Fall 2015 publication of the academic journal, Natural Resources & Environment. The MMAPLE model was being advocated for use in other grants by advisors and staff of the LCCMR and other funders such as the Lessard-Sams Outdoor Heritage Council.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Frogtown Farm and Park Acquisition
Subd. 04k $1,500,000 TF

Robert McGillivray
The Trust for Public Land

2610 University Ave W, Ste 300
St. Paul, MN 55114

Phone: (651) 999-5307
Email: rjm@tpl.org
Web: http://www.tpl.org/what-we-do/where-we-work/minnesota/frogtown-park-and-farm.html

Appropriation Language
$1,500,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the Trust for Public Land to acquire a portion of 12 acres for Frogtown Farm and Park to be established as a St. Paul city park.

Project Overview
The Frogtown area of St. Paul is a culturally diverse, low-income neighborhood having less green space per child than any other neighborhood in the city and was recently identified as an area in need of a new park. This appropriation is being used by The Trust for Public Land, in partnership with the City of St. Paul, to acquire a portion of twelve acres of a currently vacant space in the area to establish the multi-purpose Frogtown Farm and Park. The vision for the space is to provide a safe space for neighborhood children to experience nature and families to recreate while simultaneously acting as a demonstration urban farm for community members to learn about growing food locally as a vehicle for advancing self-sufficiency, environmental stewardship, healthy living, and community collaboration.

OVERALL PROJECT OUTCOME AND RESULTS
On December 4, 2013, The Trust for Public Land acquired +/- 13 acres from the Wilder Foundation and conveyed it to the City of Saint Paul. The land will be used to create Frogtown Farm and Park - a much-needed public green space for this culturally diverse, low-income neighborhood. The new Frogtown Farm and Park will include a six-acre urban demonstration farm, a recreation area, and a nature sanctuary that preserves a grove of large mature oak trees. When complete, this urban park will be the site of a variety of activities demonstrating green and sustainable inner-city living and providing exceptional educational opportunities.

The land was purchased for $2,200,000. Of that, $1,498,000 was from the Environment and Natural Resources Trust Fund and $702,000 was from the City of St. Paul.

Creation of this public park and demonstration farm will advance environmental and social justice, and strengthen residents' self-sufficiency, environmental stewardship, healthy living and community collaboration. The project furthers the LCCMR Six-Year Strategic Plan in multiple ways including: protecting important land resources (especially the oak grove), supporting research and demonstration projects of natural resources, supporting community based conservation, encouraging outdoor recreation, and promoting public education and dissemination of information about natural resources (for both students and community residents).

The City of Saint Paul has put the project out to bid, and construction is expected to begin on the initial park and farm improvements in the summer of 2015.

PROJECT RESULTS USE AND DISSEMINATION
This project is highlighted on The Trust for Public Land's website at: http://www.tpl.org/our-work/parks-for-people/frogtown-park-and-farm

The Trust for Public Land also issued a press release with the City of Saint Paul:
http://www.tpl.org/media-room/frogtown-park-deal-finalized

There have also been a number of news stories covering this project:

- http://www.minnpost.com/political-agenda/2013/12/deal-finalized-new-park-st-pauls-frogtown-neighborhood
- http://www.twincities.com/stpaul/ci_24654416/st-pauls-frogtown-park-and-urban-farm-set
- http://kstp.com/news/stories/S3296801.shtml?cat=1

FINAL REPORT

Project completed: 6/30/2015

Restoration Evaluations
Subd. 04l $200,000 Transfer from M.L. 2009, Chp. 143, Sec. 2 ,Subd. 8b as amended by M.L. 2011, First Special Session, Chp. 2, Art. 3, Sec. 2, Subd. 18, Para. A, Clause 8

Susan M. Galatowitsch
University of Minnesota
135 Skok Hall
2003 Upper Buford Circle
Saint Paul, Minnesota 55108

Phone: (612) 624-3242
Email: galat001@umn.edu
Web: http://fwcb.cfans.umn.edu/Faculty/Galatowitsch/index.htm

Appropriation Language
$200,000 from Laws 2009, chapter 143, section 2, subdivision 8, paragraph (b), Legislative-Citizen Commission on Minnesota Resources, as amended by Laws 2011, First Special Session, chapter 2, article 3, section 2, subdivision 18, paragraph (a), clause (8), is transferred to the Board of Regents of the University of Minnesota for evaluation of lands restored using money from the trust fund. The lands to be evaluated shall be identified and prioritized in consultation with the Legislative-Citizen Commission on Minnesota Resources.

Project Overview
Ecological restorations aim to aid the recovery of native ecosystems that have been degraded or lost. However, very seldom are restorations evaluated past the initial implementation phase to determine whether the efforts achieved their goals and the funds spent were a strategic conservation investment. Monitoring and evaluation of restorations can teach what works and what does not in order to advance restoration practices and increase the likelihood of success for future projects. The Environment and Natural Resources Trust Fund has funded restoration activities on hundreds of thousands of acres since its inception. The University of Minnesota is using this appropriation to evaluate the outcomes and effectiveness of some of those restoration efforts in order to inform and improve future land restoration techniques and best practices and future state investments in restoration activities.

OVERALL PROJECT OUTCOME AND RESULTS

In 2013 LCCMR requested an evaluation of ENRTF restorations, from 1990-2010, to assess ecological outcomes of past projects, to determine factors tied to successful outcomes, and to develop evaluation criteria for proposed and completed projects. Our evaluation was based on information gathered from LCCMR files (450 projects), project manager files (78 projects), project manager interviews (59 projects) and field surveys (59 projects). Project managers were interviewed to gain insight into restoration process and organizational capacity to implement restorations. To quantify the extent of ecological recovery of each site we calculated: 1) proportion of plant species considered part of the potential natural vegetation following DNR Native Plant Community manuals (%PNV) and 2) an index of abundances of invasive species (CISA). These two parameters were used to classify ecological condition as high, medium or low quality. High quality restorations were those with greater than average %PNV and lower than average CISA; low quality restorations have the opposite scores, i.e., lower than average %PNV and higher than average CISA. 32% of projects evaluated were deemed high quality and 27% low quality. Using contingency analysis, we screened a variety of factors related to site history, organizational capacity, and type of ecosystem to determine which have the greatest potential to predict post-restoration ecological condition. This analysis found that starting condition, type of ecosystem, and an organization's internal capacity have the strongest effect on restoration outcome. Restorations of highly altered sites are much riskier than those undertaken on remnant natural areas, and so are less likely to result in high quality outcomes. Restorations of forests are riskier than prairie or wetland restoration. Common problems hindering restoration teams' capacity to keep their ecological restoration projects on track are inadequate staffing and expertise, insufficient funds, incomplete records, and leadership change: Evaluation guidelines, monitoring protocols, planning tool documents are included with the final report.

PROJECT RESULTS USE AND DISSEMINATION

The results of this project have been (or will be) disseminated in several ways:

1. A summary report (i.e., Restoration Evaluation Guidelines) that outlines the key findings of the evaluation has been developed. The guidelines will be posted on the Ecological Restoration Practitioners network and website (https://cceevents.umn.edu/restoring-minnesota).
2. Two webinars summarizing key elements of restoration project planning and recordkeeping were hosted in winter 2016. The webinar "Planning to Avoid Pitfalls: The Key to Restoration Success", with guests Dan Shaw from the Board of Water and Soil Resources and Wiley Buck from Great River Greening was hosted on February 23, 2016. The webinar "Learning by Doing: Why Restoration Records Matter" with guests Mark Cleveland from the Department of Natural Resources and Karen Schik from Friends of the Mississippi River was hosted on March 29, 2016. The target audience for the webinars were the project managers as well as other restoration professionals. Each webinar was viewed by approximately 55 professionals. The webinars began with a summary of the results of the restoration evaluation presented as an introduction and context for each topic. The invited expert guests for each webinar presented the perspectives of a state agency and a non-profit engaged in ecological restoration respectively. The webinars are archived on the Ecological Restoration Practitioners website (https://cceevents.umn.edu/restoring-minnesota). In partnership with the DNR, we offered a webinar to agency staff in November 2014.
3. Presentations describing the evaluation process and preliminary findings were made at 3 professional meetings: the Eighth SER Midwest Great Lakes Chapter meeting in Bloomington, IN in April 2016, the Society for Ecological Restoration 6th World Conference on Ecological

Restoration in Manchester England in August 2015, and the Seventh SER Midwest Great Lakes Chapter meeting in Glencoe, IL in March 2015.

4. The results of the restoration evaluation will be summarized and submitted for publication in at least two peer-reviewed journals.
5. Content in the Site Assessment and Monitoring courses of the online Ecological Restoration Training Consortium will be reviewed and updated to reflect recommendations and best practices developed as outcomes of the restoration evaluation project.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Guidelines (PDF)
Restoration Planning Tool (MS Excel
Vegetation Monitoring Protocol Part 1 (PDF)
Vegetation Monitoring Protocol Part 2 (MS Excel)

Subd. 05 Water Resources

Sustaining Lakes in a Changing Environment - Phase II
Subd. 05a $1,200,000 TF

Jeff Reed
MN DNR
23070 N Lakeshore Dr
Glenwood, MN 56334

Phone: (320) 634-4573
Email: jeffrey.reed@state.mn.us
Web: http://www.dnr.state.mn.us/fisheries/slice/index.html

RESEARCH

Appropriation Language
$1,200,000 the first year is from the trust fund to the commissioner of natural resources in cooperation with the United States Geological Survey, the University of Minnesota, and the University of St. Thomas to continue development and implementation of monitoring, modeling, and reporting protocols for Minnesota lakes to be used in water and fisheries management. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Minnesota's environment is changing in response to a variety of stressors - including population growth, residential development, industry, agriculture, invasive species, and climate change - and the state's iconic lakes, and the goods and services they provide (e.g., fishing and water recreation), are an important part of what's being impacted. To manage effectively for these changes it is important to understand how the state's many lakes respond to these stressors. This includes knowing baseline habitat conditions, observing long-term changes to the baseline, and developing models that can forecast the risks posed and expected impacts of various stressors. In 2009 the Minnesota Department of Natural Resources (DNR) began an ambitious long-term monitoring effort of 24 "sentinel" lakes

throughout the state specifically identified to represent the breath of basic conditions (e.g., water chemistry, habitat conditions, fishery types, surrounding ecosystem types) present in Minnesota's most common aquatic environments. The DNR is using this appropriation to continue and expand on that effort to develop and implement improved monitoring, modeling, and reporting protocols that will provide timely information on lake trends, reduce uncertainty about potential causes, and guide conservation approaches for improving water quality, reversing problematic trends, and preventing further degradation into the future.

OVERALL PROJECT OUTCOME AND RESULTS

Phase 2 of the Sentinel Lakes Long-Term Monitoring Program comprised a wide variety of monitoring and research activities on the 25 Sentinel Lakes selected to provide representation of Minnesotass major lake-types. During 2013-2016, the Sentinel Lakes Program continued to integrate the activities of key, collaborative agencies and partners (e.g. DNR, MPCA, USGS, and universities) which focus on determining the effects of large-scale ecological stressors (e.g., eutrophication, invasive species, and climate changes) on lake ecosystems. Highlights include:

- Detailed summaries of fish and aquatic plant sampling activities were prepared to guide future data analyses and monitoring activities.
- High-resolution water column temperature and dissolved oxygen tracking reveals progression of oxythermal-habitat changes for important fish species in Elk Lake.
- Continuation of specialized sampling of Cisco population in 3 Sentinel Lakes further enhanced our understanding of the relationships between Cisco and climate change and the presence of invasive species.
- Evaluations of biological indicators of lake status including pupal skins of aquatic midges, and White Sucker biology. Results indicate aquatic fly composition reflects lake nutrient status, while assessing White Sucker biology proved difficult. At least 141 species of midge were detected.
- A detailed report of phytoplankton and zooplankton composition, seasonal cycling, and interactions in 13 Sentinel Lakes was completed.
- Food web research conducted to understand impacts of zebra mussels finds that lake biota (insects and fish) shifted to alternative food sources.
- Long-term water quality and baseline aquatic plant surveys at Shaokotan Lake detected a major shift in 2015 from algae-dominance to clear water, aquatic plant-dominance due to watershed restoration and BMP implementation.
- New biophysical lake models were developed Pearl and Madison lakes, while previous models were used to simulate impacts of future climate conditions in Elk and Trout lakes. Surface water temperatures increase dramatically under future climate scenarios and oxygen depletion dynamics differed between lakes.

PROJECT RESULTS USE AND DISSEMINATION

The information gathered during the second phase of Sentinel Lakes sampling continues to provide insights useful to lake managers. The continued ability to collect water quality, zooplankton, fisheries, aquatic vegetation, and land use data over consecutive years from a set suite of lakes has added to the strong foundation of long-term monitoring that was established during the first phase of the project (2009 to 2013). Refining metrics and more fully developing our understanding of how they react to specific ecological stressors will continue to assist managers faced with developing management strategies and practices in lakes. The value to fisheries and lake managers is perhaps most evident in the Department of Natural Resource's commitment to hire and fund a full-time Sentinel Lakes coordinator position. That internally funded position was filled in May of 2016 and will provide project continuity going forward.

As was the case in Phase 1 we again included partner institutions with different areas of expertise, thus the project was able to gain valuable insights into 1) how lake systems in agricultural zones function (USGS), 2) how Chironomid (midge) populations may serve as important indicators of trophic status (University of Minnesota), and 3) how stable isotope analysis can lead to fuller understanding of the effects invasive species such as zebra mussels have on lake food webs (University of St. Thomas). The techniques developed by partners as well as their final results should provide valuable tools and information for some time to come. Continued, consecutive, sampling of Cisco populations has not only furthered our understanding of their population dynamics and their vulnerability to climate change and invasive species but has also added to the development of specific methods for monitoring this important climate- and land-use sensitive species in lakes across the state.

Finally, the project has become an excellent training tool for undergraduates, graduate students, and professionals. More than a dozen undergraduates have been able to gain valuable field experience and mentoring from research staff over the course of the project. The project has also served as a valuable entry point into fisheries for early-career professionals.

Much of the focus of disseminating information gathered during the project has been focused on a scientific audience but with an emphasis on making that information relevant to lake and fisheries managers. To that end, all collaborators past and present were invited to attend and present their findings at a Sentinel Lakes Summit which was held in Brainerd in 2015. Over 50 managers from DNR and PCA attended the event. A similar event is being planned for 2017. Additionally, a number of manuscripts covering a wide variety of topics are currently being prepared for submission to peer-reviewed publications. Already a number of presentations have been made at national, regional, and state-level professional meetings.

For general audiences the Department of Natural Resources maintains a series of Sentinel Lakes-related pages on their website (http://www.dnr.state.mn.us/fisheries/slice/index.html) and the Pollution Control Agency hosts Sentinel Lake Assessment reports on their website (https://www.pca.state.mn.us/water/sentinel-lakes).

Project completed: 6/30/2016

FINAL REPORT (PDF)
Phytoplankton Report (PDF)
Algal Community Dynamics Report (PDF)

Heron Lake Sediment and Phosphorus Reduction Implementation Projects
Subd. 05c $122,000 TF

Jan Voit
Heron Lake Watershed District
1008 3rd Ave, PO Box 345
Heron Lake, MN 56137

Phone: (507) 793-2462
Email: jan.voit@mysmbs.com
Web: http://www.hlwdonline.org/hlwd/

Appropriation Language
$122,000 the first year is from the trust fund to the Board of Water and Soil Resources for an agreement with the Heron Lake Watershed District for public outreach and installation and monitoring of water quality improvement projects. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Once known for its clean water, fertile soil, and healthy habitat, in more recent times the Heron Lake Watershed in southwestern Minnesota has been heavily impacted by pollution from intensive agriculture, feedlots, non-compliant septic systems, and urban stormwater runoff. The Heron Lake Watershed District is using this appropriation for public outreach and installation and monitoring of water quality improvement projects aimed at reducing sediment and nutrient loading for the benefit of public health, recreation, and wildlife habitat.

OVERALL PROJECT OUTCOME AND RESULTS
The Heron Lake watershed, approximately 472 square miles, is located within portions of Nobles, Jackson, Murray, and Cottonwood Counties in southwestern Minnesota. Heron Lake, a public water of the State of Minnesota, is impaired for phosphorus. Decreasing the amount of phosphorus and sediment entering Heron Lake would be valuable for reducing water pollution. The Heron Lake Watershed District Watershed Management Plan and county water plans recognize on-the-ground projects as the most effective way to address phosphorus and sediment.

Funding from the Minnesota Environment and Natural Resources Trust Fund was used to install projects in Nobles, Jackson, and Murray Counties. They included a biodetention basin, multiple water and sediment control basins, a bioretention basin, and a streambank stabilization. The purpose of these projects was to reduce sediment and nutrient loads into streams and lakes. The projects affected more than 300 acres and have an estimated reduction rate of 620 pounds of phosphorus and 575 tons of sediment per year. The grant dollars covered 75 percent of the project costs, with the landowner paying 25 percent.

Funds were also used to gather water samples at three sites in the watershed - Jack Creek, Okabena Creek, and the Heron Lake Outlet. The water samples were analyzed and compared to data gathered since 1996. The Jack Creek and Okabena Creek sampling sites decreased in phosphorus. Okabena Creek showed an increase. All sites showed a reduction in sediment.

Plans were made to visit three project sites in April of 2016. A newsletter summarizing the grant activities and promoting the project site tour was distributed to approximately 3,500 watershed residents, agency personnel, and legislators. Attending the event were eleven members of the general public, one Board of Water and Soil Resources staff, two news reporters, two Heron Lake Watershed District board members and three employees.

PROJECT RESULTS USE AND DISSEMINATION
Over the course of the grant period, information about the grant was presented at many meetings and events. Each year annual reports contained a project summary. The grant activities were summarized in a newsletter which was distributed to approximately 3,500 watershed residents, agency personnel, and legislators. In addition, reporters published articles regarding the project site tour in the Daily Globe, Tri County News, and Fulda Free Press.

Project completed: 6/30/2016

FIANL REPORT (PDF)
Project Brochure (PDF)

Southern Minnesota Lakes Restoration
Subd. 05d $463,000 TF

Joshua Mankowski
Le Sueur County
88 S Park Ave
Le Center, MN 56057

Phone: (507) 357-8540
Email: jmankowski@co.le-sueur.mn.us
Web: http://www.co.le-sueur.mn.us/

Appropriation Language
$463,000 the first year is from the trust fund to the Board of Water and Soil Resources for an agreement with Le Sueur County to install shoreland and agricultural best management practices to improve water quality for up to 14 lakes in a tri-county area in southern Minnesota. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Lakes and streams located in Blue Earth, Le Sueur, and Waseca Counties provide important public benefits such as hydrologic storage, economic and recreational opportunities, and regional water quality improvement. However, several of the lakes and streams have been listed as impaired because of excess nutrients and sediment from runoff. Le Sueur County is using this appropriation to install shoreland and agricultural best management practices such as wetland enhancements, infiltration basins, stream restoration, and native plantings to improve the water quality of up to 11 lakes in the region.

OVERALL PROJECT OUTCOME AND RESULTS
The Grant consisted of 14 projects spread out in a region that covered Le Sueur, Blue Earth and Waseca Counties and provided environmental benefits to a number of different bodies of water.

In Blue Earth County, one project on Madison Lake was completed.

1. Bray Park Ravine Stabilization was a highly visible project that provided reductions of 30.3 T/yr. TSS, 30.3 T/yr. Soil and 34.8 lbs./yr. Phosphorus from entering Madison Lake.

In Waseca County, two shoreline projects were completed on Clear Lake.

1. Clear Lake Park Shoreline Restoration resulted in the reduction of TSS by 37.13 T/yr., Soil by 37.13 T/yr. and Phosphorus by 31.56 lbs./yr.
2. Kanewischer Shoreline Restoration provided reductions of 11.55 T/yr. TSS, 11.55 T/yr. Soil and 9.82 lbs./yr. Phosphorus. In Le Sueur County, eleven projects were constructed.

Five projects total were completed in the City of Waterville and resulted in reduced pollutant loads to a number of different waterbodies. A stream shoreline stabilization project and two retention areas were

constructed along White Water Creek which directly flows into Upper Sakatah Lake. Two large stormwater projects were completed near the City's water tower that discharges to the Cannon River directly before it enters Upper Sakatah Lake.

1. Lions Park retention project reduced TSS by 110.08 T/yr., Soil by 127.05 T/yr. and Phosphorus by 126.59 lbs./yr.
2. Mini Park restoration resulted in reductions of 42.0 T/yr. TSS, 42.0 T/yr. Soil and 48.3 lbs./yr. Phosphorus.
3. Streambank work and retention project at the WEM School District Bus Garage resulted in the reduction of 55.04 T/yr. TSS, 63.53 T/yr. Soil and 63.29 lbs./yr.
4. Water Tower A & B Reduced TSS by 1.36 T/yr. (72% Removal Efficiency), Soil by 1.36 T/yr. (72% Removal Efficiency) and Phosphorus by 2.35 lbs./yr. (11% Removal Efficiency). Water Tower Area (due to their high level of interconnection, reduction numbers for both Water Tower Area and Water Tower A & B are combined.

Six additional projects were done throughout Le Sueur County. Including wetland enhancements were completed at two Waterfowl Production Areas (WPA). These projects created enhanced areas for waterfowl as well as providing pollutant reductions.

1. Vail Ravine Stabilization resulted in reduction loads of 31.43 T/yr. TSS, 31.73 T/yr. Soil and 89.10 lbs./yr. Phosphorus from Upper Sakatah Lake.
2. The Rain Garden located at Lake Washington County Park removes 35.0 T/yr. TSS, 35.0 T/yr. Soil and 40.25 lbs./yr. Phosphorus from stormwater runoff before it ultimately reaches Lake Washington.
3. The Elysian City Park Shoreline Restoration Project on Lake Francis resulted in reductions of 19.620T/yr. TSS, 17.0 T/yr. Soil and 19.62 lbs./yr. Phosphorus.
4. The Koppelman Ravine Stabilization provided reductions of 76.5 T/yr. TSS, 153.0 T/yr. Soil and 76.5 lbs./yr. Phosphorus from entering Lake Jefferson.
5. The Pruess WPA resulted in reductions of 31.43 T/yr. TSS, 31.43 T/yr. Soil and 47.14 lbs./yr. Phosphorus.
6. Rice Lake WPA enhancements reduced loads by 59.40 T/yr. TSS, 59.40 T/yr. Soil and 89.10 lbs./yr. Phosphorus.

PROJECT RESULTS USE AND DISSEMINATION
Information about the projects has been discussed at numerous city, county and lake association meetings. Information on the projects and the grant are posted on Le Sueur County's website and has been submitted to local papers for publication. The City of Waterville will be sending out an informational insert in upcoming water bills. A science teacher at the Waterville public school utilizes the rain garden for his classes. Articles have been published in the Waterville paper about the different projects being constructed. The City also is in the planning stages to hold an on-site open house celebration for the City Water Tower Projects.
Project completed: 6/30/2016

FINAL REPORT (PDF)

Membranes for Wastewater-Generated Hydrogen and Clean Water
Subd. 05g $246,000 TF

Paige Novak
U of MN
122 Civil Engineering Bldg, 500 Pillsbury Dr SE
Minneapolis, MN 55455

Phone: (612) 626-9846
Email: novak010@umn.edu
Web: http://personal.ce.umn.edu/~novak/

RESEARCH

Appropriation Language

$246,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to develop, optimize, and test membranes made of thin film polymers embedded with selected bacteria to generate clean water and energy in the form of hydrogen from wastewater. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview

Waste streams often contain unutilized resources that if properly extracted or otherwise utilized could be used to provide additional sources of renewable energy or other benefits. Wastewater is one of the primary candidate waste streams because of its nutrient content and researchers have been developing technologies such as microbial fuel cells and algal-based biofuel production in order make use of these nutrients. Researchers at the University of Minnesota are using this appropriation to develop, test, and optimize another new technology that can be used to extract energy from wastewater, specifically a polymer membrane embedded with select bacteria that could be used to simultaneously improve wastewater treatment while generating renewable energy in the form of hydrogen. If effective the technology is likely to be scalable with broad application potential for use with any biodegradable liquid waste stream.

OVERALL PROJECT OUTCOME AND RESULTS

In this project we developed a technology that could extract energy from wastewater: a polymer film containing bacteria that generate hydrogen (a clean energy source) while cleaning the wastewater. The system also contained a mesh of small, permeable tubes ("fibers") for efficient hydrogen collection. A finding of this study was that the wastewater treated needed to be high strength to generate adequate quantities of hydrogen. This type of high strength wastewater is produced by food and sugar beet processing facilities, and dairies, among other industries, and is plentiful throughout Minnesota. This technology efficiently produced and collected hydrogen in the laboratory with synthetic wastewater and wastewater from a dairy and a sugar beet processor. When used with vacuum gas collection, the exit gas was approximately 51% hydrogen, which is suitable for use in a fuel cell or for direct combustion. The system was also deployed at a pilot-scale at a brewery and was able to produce and collect hydrogen from the brewery wastewater. After further optimization for ease of scale-up and manufacture, the composite membrane system could allow the extraction of high-quality energy from wastewater while also saving industries on their treatment fees and reducing the need for expensive centralized treatment. In fact, based on our (un-optimized) results, the hydrogen generated in the Metro area would yield approximately $82,000/yr through electricity generation. This same assumption yields over $312,000/yr from the sugar beet industry in the state through electricity generation. This does not include the cost savings associated with reduced treatment fees, which for two Metro area processors alone exceeds $1,000,000/year/company. A patent application was submitted on this

technology and has been approved; the University of Minnesota is exploring commercialization and licensing options. A peer-reviewed manuscript was published from this work and has been submitted to the LCCMR.

PROJECT RESULTS USE AND DISSEMINATION

Information from this project has been shared with several large water technology companies in Minnesota who may have the interest and capability to assist in optimizing and eventually deploying this technology for large-scale energy production from wastewater. Information from this project has also been shared with personnel from the Metropolitan Council Environmental Services, who treat the high strength wastewater of many large food- and beverage-processing plants, the sugar beet industry, and the brewery at which the pilot study was performed. As stated above, a peer-reviewed manuscript was published from this work and has been submitted to the LCCMR. Multiple presentations about the research have been given at both regional and national/international conferences. Additional funding has been obtained from the Minnesota Department of Commerce to study and improve the scalability and manufacturability of the technology and optimize it for deployment.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Journal Article (PDF)

Antibiotics in Minnesota Waters - Phase II - Mississippi River
Subd. 05h $203,000 TF

Kristine Wammer
2115 Summit Ave, OSS 402
2208 Woodale Dr
St. Paul, MN 55105

Phone: (651) 962-5574
Email: khwammer@stthomas.edu
Web: http://www.stthomas.edu/chemistry/faculty/wammer.htm

RESEARCH

Appropriation Language

$203,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the University of St. Thomas to measure antibiotic concentrations and antibiotic resistance levels and assess the contributions of farm runoff and wastewater treatment in a portion of the Mississippi River. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview

The occurrences of contaminants including antibiotics, other pharmaceuticals, and personal care products in the environment have gained increasing attention in recent years because of their potential health and ecological impacts. However, serious gaps remain in our understanding of these contaminants and the significance of the threats they may pose, such as to drinking water. Through this appropriation scientists at the University of St. Thomas, Gustavus Adolphus College, and the University of Minnesota will continue work focused on the threats posed by antibiotics to understand which antibiotics are of the most concern - for example, because of their potential to increase antibiotic

resistance - and to delineate their urban and rural sources. The first phase focused on antibiotics in the Minnesota River and this phase will focus on the Mississippi River. Findings will help develop strategies to manage threats and minimize future impacts posed by antibiotics to human and ecological health.

OVERALL PROJECT OUTCOME AND RESULTS

This project was Phase 2 of a two-part ENRTF-funded study designed to examine the significance of antibiotics and antibiotic resistance in Minnesota surface waters. Both phases of the study analyzed the following:

- Antibiotic concentrations. Cutting-edge analytical techniques were developed to measure antibiotics at concentrations as low as parts per trillion.
- Antibiotic resistance genes. Quantitative polymerase chain reaction (qPCR) was used to quantify several antibiotic resistance genes.
- Antibiotic-resistant bacteria. Culture-based techniques were used to compare ability of bacteria from various sites to grow in the presence of elevated concentrations of antibiotics.

Phase 1, which ended in 2013, focused on a portion of the Minnesota River basin. The results showed that municipal wastewater treatment plants were a significant source of antibiotics, resistance genes, and antibiotic-resistant bacteria; elevated levels of all three were found in waters impacted by wastewater treatment plant effluent. These findings motivated Phase 2, where the focus shifted to surface waters that serve as drinking water sources and tap water samples and therefore a more direct potential connection to human health impacts. Based on the results of Phase 1, we decided to focus primarily on antibiotics used in human rather than agricultural medicine.

Phase 2 initially focused on the Mississippi River, including St. Cloud, Minneapolis, and St. Paul. Discussions with the Drinking Water Protection section of the Minnesota Department of Health about sites potentially impacted by wastewater led us to expand our study to Ely (Burntside Lake), Grand Marais (Lake Superior), Moorhead (Red River) and Burnsville (Kramer quarry). In general, no measurable antibiotic concentrations, no elevated levels of antibiotic-resistant bacteria, and no antibiotic resistance genes were found in drinking water sources. Development of a new membrane filtration technique allowed us to find antibiotic resistance genes in tap water samples at extremely low levels; the importance of these exceptionally low levels with respect to human health is unclear.

PROJECT RESULTS USE AND DISSEMINATION

Four St. Thomas undergraduate students have presented this work at American Chemical Society national meetings; two in 2014, one in 2015, and one in 2016. Dwight Stoll (Gustavus Adolphus) presented at the Quality Assurance meeting of Region 6 of the Environmental Protection Agency in Fall 2015. Kris Wammer (St. Thomas) has presented this work at two national meetings; the Fall 2015 Society of Environmental Toxicology and Chemistry meeting in Salt Lake City, and the Fall 2016 ACS meeting in Philadelphia. A manuscript detailing the findings from this work is also currently in preparation. In addition, we have in the past and will continue to engage relevant personnel at the state level, in particular from state agencies such as MDH, through meetings and formal talks. The MN One Health Antibiotic Stewardship Collaborative, which both Tim LaPara and Kris Wammer participate in, will help facilitate continued interactions with Minnesota stakeholders.

Project completed: 6/30/2016

FINAL REPORT (PDF)

Subd. 06 Aquatic and Terrestrial Invasive Species

An Aquatic Invasive Species Research Center
Subd. 06a $8,700,000 TF

Susan M. Galatowitsch
University of Minnesota
135 Skok Hall
2003 Upper Buford Circle
Saint Paul, Minnesota 55108

Phone: (612) 624-3242
Email: galat001@umn.edu
Web: http://fwcb.cfans.umn.edu/Faculty/Galatowitsch/index.htm

RESEARCH

Appropriation Language
$4,350,000 the first year and $4,350,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to develop and support an aquatic invasive species (AIS) research center at the University of Minnesota that will develop new techniques to control aquatic invasive species including Asian carp, zebra mussels, and plant species. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

Project Overview
Aquatic invasive species pose critical ecological and economic challenges for the entire state and beyond. They can cause irreparable harm to fisheries and aquatic habitat as well as damage to infrastructure. The problems posed by aquatic invasive species continue to grow as existing infestations expand and new exotic species arrive, most of which are poorly understood. New ideas and approaches are needed to develop real solutions. In 2012 the Minnesota Legislature provided the University of Minnesota with $3,800,000 ($2,000,000 from the Environment and Natural Resources Trust Fund; $1,800,000 from the Clean Water Fund) to launch a new, first-of-its-kind research center specifically focused on developing and implementing solutions to control aquatic invasive species. This appropriation provides this new center with additional initial operating funds for conducting research aimed at slowing the spread, reducing, controlling, and/or eradicating aquatic invasive species including Asian carp, zebra mussels, Eurasian watermilfoil, and more. Proven tools and techniques developed at the center are intended to be implemented statewide.

Project due to be completed: 6/30/2019

Work Plan (PDF)

Detection and Monitoring of Asian Carp Populations
Subd. 06b $540,000 TF

Bradford Parsons
MN DNR
1200 Warner Rd
St. Paul, MN 55106

Phone: (651) 259-5789
Email: bradford.parsons@state.mn.us
Web: http://www.dnr.state.mn.us/fisheries

Appropriation Language
$540,000 the first year is from the trust fund to the commissioner of natural resources to accelerate a search and monitoring program directly targeting Asian carp to be used in the development of potential control strategies.

Project Overview
Asian carp pose a real and serious threat to Minnesota's aquatic ecosystems. While there are a few instances of individual carp being found in Minnesota waters, including the Mississippi and St. Croix Rivers, it is not presently believed that there are significant established populations in the state. In order to quickly and effectively respond to threats posed by Asian carp in the future, though, detailed information about the fish themselves is needed. The DNR is using this appropriation to establish an aggressive search and monitoring program directly targeting Asian carp to determine existing distribution and abundance, measure current reproductive success, and evaluate impacts on native fish populations. The information will inform rapid response efforts aimed at control and removal of Asian carp as they emerge.

OVERALL PROJECT OUTCOME AND RESULTS
Invasive Carp, especially Bighead Carp and Silver Carp, pose an imminent and serious threat to Minnesota's aquatic ecosystems. From the 2013 appropriation, the MN DNR was able to appoint three non-classified positions to monitor and remove Invasive Carp from Minnesota waters, assist with environmental DNA collection, and collect groundbreaking native species biological data to determine the effects to native species if Invasive Carp become established. As a result, the MN DNR has established and developed the state's Invasive Carp management, monitoring, and detection program including all life stages. The program collected data from 255,750 feet of contracted commercial gill net, 18 commercial seines, 55,800 feet of gill net, 168 hours electrofishing, 422 larval samples, 622 hoop net and 223 fyke net sampling nights.

We would prefer to catch no Invasive Carp, however it is irresponsible not to be prepared. From the funding, the program caught 7 Invasive Carp via contract commercial fishing, 1 Bighead Carp from targeted sampling, and process an additional 5 Invasive Carp caught by other commercial fishermen and anglers. Sampling has also allowed researchers to determine areas to target from an increased understanding of their biology, associations with native species, and catch records. Specifically, Lower Grey Cloud Slough and the King plant on the St. Croix River were identified as target areas after more than one fish was captured. The program has implemented processing protocols and gained the ability to work-up fish in-house including ageing, determining sex and maturity, and collect all structures necessary for microchemistry analysis. The results can be accessed from the MN DNR 2012 - 2015 Invasive Carp Sampling Reports.

The project furthers the LCCMR Six-Year Strategic Plan in multiple ways including: protecting important water resources, management of invasive species, supporting research of natural resources, and promoting public education and dissemination of information about natural resources.

PROJECT RESULTS USE AND DISSEMINATION

Project plans and results have been disseminated through annual MN DNR reports including, In addition, results have been presented at numerous conferences and meetings including Minnesota's American Fisheries Society annual meetings, the Midwest Fish and Wildlife Conference, U.S. Fish and Wildlife annual meetings, and many others.

This project is highlighted on the MN DNR website at: http://www.dnr.state.mn.us/invasive-carp/index.html

The project is described in the:

- Minnesota Invasive Carp Action Plan, online at: http://files.dnr.state.mn.us/natural_resources/invasives/carp-action-plan-draft.pdf
- The First Annual Report to Congress: Summary of Activities and Expenditures to Manage the Threat of [Invasive] Carp in the Upper Mississippi and Ohio River Basins, June 2012 to June 2014, online at: https://www.fws.gov/midwest/fisheries/asian-carp/WRRDA2015.pdf

Project completed: 6/30/2016

FINAL REPORT (PDF)

Elimination of Target Invasive Plant Species
Subd. 06d $350,000 TF

Monika Chandler
Minnesota Department of Agriculture
625 Robert St N
St. Paul, MN 55155

Phone: (651) 201-6537
Email: Monika.Chandler@state.mn.us
Web: http://www.mda.state.mn.us/plants/badplants/noxiouslist.aspx

Appropriation Language
$350,000 the first year is from the trust fund to the commissioner of agriculture to train volunteers and professionals to find, control, and monitor targeted newly emergent invasive species. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
New invasive plant species continue to emerge in Minnesota and will pose ongoing threats to Minnesota's economy, ecology, and environment if able to spread across the state. It is cheapest, easiest, and least harmful to find and control small populations of invasive plants before they become widespread. The Minnesota Department of Agriculture is using this appropriation to increase the state's flexibility and rapid response to newly emergent terrestrial invasive plant species by training professionals and volunteers to find, control, and monitor certain invasive plants that presently exist only as small, isolated populations in the state. Targeted species include Dalmatian toadflax (NW MN), cutleaf teasel (various isolated areas of state), Japanese hops (SW MN), Oriental bittersweet (Areas along St. Croix and Mississippi Rivers), and Grecian foxglove (Washington County).

OVERALL PROJECT OUTCOME AND RESULTS

The goals of the Elimination of Target Invasive Plants species were 1) Train volunteers and professionals to find target species; 2) Control these species before they spread; and 3) Monitor to prevent reinfestation. Target species are invasive plants that cause severe ecological harm. There are localized infestations of these plants and controlling them will prevent them from becoming widespread. Target species include Dalmatian toadflax, cutleaf teasel, Japanese hops, Oriental bittersweet and Grecian foxglove. We completed Phase 1 of this project and will expand the effort in Phase 2.

University of Minnesota Extension led education and outreach. A total of 34 workshops educated 772 people about target plants. Invasive Blitz was a workshop with 12 sessions across the state that trained volunteers to organize and conduct invasive species removal events. Volunteers reported 434 service events with management activities that impacted 9,582 acres in 30 counties.

Minnesota Department of Agriculture led survey and project coordination. A total of 1,542 road miles and 125 river and trail miles were surveyed with a multitude of volunteers and agency partners. Distribution data for target species can be accessed at http://www.eddmaps.org/. Coordination with private landowners and crew leaders was necessary. An agreement was written with each private landowner where crews worked to ensure clarity about expectations and activities. We wrote agreements with 162 landowners.

Conservation Corps Minnesota led the effort to control target invasives. There were 144 unique and 194 total (some returning members) crew members who worked on this project. Together, they treated 1,360 acres of target invasives.

This project was about eradicating plants, but people were key to success. Project achievements were due to the involvement of hundreds of volunteers, landowners, crew members and state and local partners. Engaging people has vital for long-term success.

PROJECT RESULTS USE AND DISSEMINATION

In addition to 34 workshops with 772 participants, there were 4 field tours, 10 presentations, 8 articles, 3 media events and mailings to hundreds of private landowners. Weed of the Month articles were run in local papers throughout the state. Overall, this dissemination reached thousands of Minnesotans.

Other Extension materials created to support this work, often funded with other grant and internal Extension funds including those generated from participant fees from workshops sponsored by the this project include:

- Oriental Bittersweet Fact Sheet (Extension produced)
- Bittersweet ID for Crafters (short version) (Joint funded: Extension & ENRTF)
- Bittersweet ID for Crafters (long version) (Joint funded: Extension & ENRTF)
- Defeating a Killer Vine: Oriental bittersweet (Farm Bill funded, via MDA)
- Going Rogue: The Story of Japanese Barberry (Farm Bill funded, via MDA)
- Keep a Lookout for New Invasive Plants in Minnesota flyer (MDA funded)
- Five 3D printed invasive plant models of Grecian foxglove (2), Japanese hops (2) and black swallow-wort (1) were produced (Farm Bill funded via MDA). To our knowledge, this is the first time 3D printing has been used to generate invasive plant models. This work is being received very well in by natural resource professionals.

If the live links to videos do not work, please go to the University of Minnesota Extension YouTube channel.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Prioritizing Invasive Plant Control Report (PDF)
Invasive Species Management Matrix (PDF)
Invasive Species Project Planning Worksheet (PDF)

Biological Control of Garlic Mustard
Subd. 06e $140,000 TF

Laura Van Riper
MN DNR
500 Lafayette Rd, Box 25
St. Paul, MN 55155

Phone: (651) 259-5090
Email: laura.vanriper@state.mn.us
Web: http://www.mndnr.gov/invasives

RESEARCH

Appropriation Language
$140,000 the first year is from the trust fund to the commissioner of natural resources in cooperation with the University of Minnesota to continue the implementation of biological control for invasive garlic mustard plants. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Garlic mustard is a non-native, invasive plant species that is severely threatening native plant communities and degrading wildlife habitat in forest and riparian zones throughout the state. The plant is considered the highest priority species for development of long-term management solutions such as biological control, which involves using natural enemies of a non-native species from its native region to control or reduce the impact of the species in the areas where they are invasive. Introducing one non-native species to control another, though, is something that must be done with care so that the introduction does not have unintended consequences. This appropriation is enabling the Minnesota Department of Natural Resources and the University of Minnesota to continue ongoing research and evaluation of biological control options for garlic mustard. With this phase the aim is to be able to release multiple biological control inserts and monitor their effectiveness.

OVERALL PROJECT OUTCOME AND RESULTS
This project advanced the goal of having effective biological control insects for garlic mustard (Alliaria petiolata). Host-specificity testing focused on the potential biocontrol insects Ceutorhynchus scrobicollis (a crown feeding weevil) and C. constrictus (a seed-feeding weevil). Monitoring garlic mustard populations in Minnesota provided information on garlic mustard populations in the absence of biocontrol. C. scrobicollis host specificity testing was completed for 15 plant species. Based on these

results, C. scrobicollis has the host specificity to be a successful biocontrol agent of garlic mustard. The researchers wrote a petition for release which summarizes the 18 years of C. scrobicollis host specificity testing. The petition was submitted to the USDA-APHIS Technical Advisory Group in June 2016. Rearing protocols, release methods, and biocontrol manuals were developed for C. scrobicollis. C. constrictus host specificity testing was completed for 19 plant species. The results show that C. constrictus continues to show the host specificity to be a successful biocontrol agent for garlic mustard. Approximately 30 more species need to be tested and then a petition for release of C. constrictus can be submitted to the USDA. Garlic mustard is a biennial and long-term monitoring shows that its populations can fluctuate widely from year to year. When the plots were established in 2005 and 2006, garlic mustard was present in 100% of the plots. Garlic mustard is still present in 88% of the plots as of June 2016. Garlic mustard is currently experiencing very little herbivory in Minnesota with an average amount of leaf removed due to herbivory ranging from 0.6 to 4.5% in 2014 - 2016. It is expected that after biological control release, garlic mustard cover and density will decrease and shoot heights and silique production of individual plants will decrease as well.

PROJECT RESULTS USE AND DISSEMINATION

- Dr. Jeanie Katovich and Dr. Roger Becker presented a poster on this project at the Upper Midwest Invasive Species Conference in Duluth, MN held October 20-22, 2014.
- Dr. Jeanie Katovich gave a presentation on the project to the "Invasive Plant Management" class at the University of Minnesota - Twin Cities during the spring 2015 and 2016 semesters.
- Dr. Roger Becker gave a presentation titled "Petition to release Ceutorhynchus scrobicollis for biological control of garlic mustard (Alliaria petiolata)" at the 2015 Midwest Invasive Plant Network Invasive Plant Symposium (part of the North Central Weed Science Society annual meeting) in Indianapolis, IN on December 9, 2015.
- Dr. Jeanie Katovich gave a presentation on the project to Northeast Region US Forest Service researchers and staff at a meeting in Roseville, MN on March, 3, 2016.
- Dr. Jeanie Katovich presented the host-specificity data for Ceutorhynchus scrobicollis to the USDA APHIS Technical Advisory Group at their annual meeting in Greenbelt Maryland on April 6, 2016.
- Monitoring data has been shared with a consortium of researchers led by Dr. Bernd Blossey of Cornell University. This group will work together to produce a peer-reviewed publication on the results of garlic mustard monitoring plots in the Midwest and Northeast regions of the United States. The paper is currently being written.
- Dr. Laura Van Riper will give the presentation "Perspectives on Garlic Mustard Biocontrol in the Midwest" at the Upper Midwest Invasive Species Conference in La Crosse, WI held October 17-19, 2016.
- The petition for release for C. scrobicollis was submitted to the USDA APHIS Technical Advisory Group.
- Title: A Petition for the Introduction, Experimental Release and Open-Field Release of the Root-Mining Weevil Ceutorhynchus scrobicollis (Coleoptera: Curculionidae) for the Biological Control of Alliaria petiolata (Garlic Mustard) in North America.
- Authors: Laura Van Riper, Esther Gerber, Hariet L. Hinz, Ghislaine Cortat, Elizabeth Katovich, Roger Becker, Mary Marek-Spartz
- Date submitted: June 21, 2016

Project completed: 6/30/2016

FINAL REPORT (PDF)

Back to top of page

Zebra Mussel Control Research and Evaluation in Minnesota Waters
Subd. 06f $600,000 TF

Jeff Meinertz
US Geological Survey, Upper Midwest Environmental Sciences Center
2630 Fanta Reed Rd
LaCrosse, WI 54603

Phone: (608) 783-6451
Email: jmeinertz@usgs.gov
Web: http://www.umesc.usgs.gov/

RESEARCH

Appropriation Language
$600,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the United States Geological Survey, Upper Midwest Environmental Sciences Center, to assess the ecological impacts of a commercially available molluscicide formulation on the reproduction and development of native fish, as well as impacts on larval aquatic insect survival, and to evaluate the effectiveness of these treatment options for detection and control of zebra mussels. The United States Geologic Survey is not subject to the requirements in Minnesota Statutes, section 116P.10. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
Zebra mussels are an aquatic species that are invasive in Minnesota and severely threaten native fish and other aquatic species by disrupting food webs and damaging spawning habitat. Their range continues to expand within Minnesota lakes and rivers, where they are spread through the transporting of water, vegetation, or equipment from an infested water body. Once established zebra mussels are very difficult to control and there is an immediate need for safe and effective control measures to reduce their impacts in the state. Scientists at the United States Geological Survey are using this appropriation to assess the ecological impacts of a commercially available mollusicide formulation (Zequanox) showing some promise for the control of zebra mussels. Findings will be used to determine the extent to which this product can and should be used in Minnesota waters and, if so, to optimize treatment protocols and techniques to maximize zebra mussel control while minimizing undesirable impacts.

OVERALL PROJECT OUTCOME AND RESULTS
Zebra mussels (Dreissena polymorpha) continue to rapidly expand their range within Minnesota's lakes and rivers disrupting aquatic food webs, threaten native species, and damage infrastructure. Zequanox©, which contains killed cells of Pseudomonas fluorescens as the active ingredient, is a potential tool for controlling dreissenid mussels (zebra and quagga mussels D. rostriformis bugensis. The project goals were to determine the safety and efficacy of Zequanox for controlling zebra mussels and to evaluate the use of molecular tools to inform control efforts. Project studies are summarized in supplemental attachments with the final report.

The Zequanox non-target animal impacts database was expanded by evaluating the exposure-related impacts on three life stages of fathead minnow (Pimephales promelas), and on the survival of adult scuds (Gammarus lacustris) and mayfly nymphs (Hexagenia sp.) after applications were conducted in outdoor 1,000-L mesocosm tanks. No significant treatment related impacts were observed in survival of invertebrates or fathead minnows or in hatchability and growth of fathead minnows.

Detailed maps were prepared for portions of Lake Le Homme Dieu and Maple Lake (Douglas County), which had different zebra mussel infestation levels. Maps of depth, substrate hardness, and submerged aquatic vegetation (SAV) depth and biovolume were generated using side-scanning sonar and parallel sonar data transects were collected and processed into component data categories. Processed sonar data and resulting maps are available on the vendor's cloud-based server network and could be combined with new or existing data to generate additional mapping products. Sonar data were used to generate a geospatial database of map characteristics in ArcGIS, and spatial analyses of the data were used to generate additional map products in ArcMap. Conversion to ArcGIS allowed for spatial analysis and sharing in GIS format. Zebra mussel populations were correlated with depth and substrate and submerged aquatic vegetation was found to be an important component of zebra mussel habitat in shallow areas in Lake Le Homme Dieu.

The use of environmental DNA to detect and identify application locations for Zequanox that might have the greatest impact on zebra mussel populations was also evaluated. The use of eDNA could assist management agencies to identify infestations, however, eDNA was found to not be effective for targeting control efforts.

Methods to apply Zequanox under the surface were first evaluated in controlled laboratory and pond-scaled mesocosm studies and further evaluated in 27-m2 enclosures placed in Robinson's Bay (Lake Minnetonka, MN). Whole water column and subsurface applications were evaluated by comparing zebra mussel mortality and biomass reduction between treated and control groups. Approximately 73 and 56% of the zebra mussels in contained samples were killed in the highest whole water column and subsurface Zequanox applications, respectively, and the similarly the adhering zebra mussel biomass was reduced ~79 and 57%, respectively.

Overall, we found that Zequanox has the potential to be used as a management tool for zebra mussels in quiescent water environments, however, Zequanox is not likely to be effective for eradication of zebra mussels in an open water environment. Additionally, eDNA may have utility as a tool for the detection of zebra mussels in a waterbody but it is not an effective tool for determining the biomass of zebra mussels present or for prioritizing the location of zebra control efforts.

PROJECT RESULTS USE AND DISSEMINATION

Three oral presentations describing study methods and results were prepared and disseminated at professional scientific meetings including the Upper Midwest Invasive Species Conference and the Annual Conference of the International Association of Great Lake Research. One webinar entitled "The potential use of eDNA to guide site selection for zebra mussel control treatments" was presented during a USGS hosted Environmental DNA Webinar Series. One peer-reviewed manuscript entitled "Safety of the molluscicide Zequanox© to nontarget macroinvertebrates Gammarus lacustris (Amphipoda: Gammaridae) and Hexagenia spp. (Ephemeroptera: Ephemeridae)" was prepared and published online on June 23, 2016 in the Management of Biological Invasions and is included as a supplemental attachment to the project final report. Five peer-reviewed reports that summarize study methods and

results were prepared and are supplemental attachments to the project final report.

A model was developed for selecting the proper concentration (w/v) of Zequanox to be used in stocks prepared for subsurface applications waters between 7 and 22°C. This prediction model is described in supplemental attachments with the final report.

Molecular markers for the detection of zebra mussels were found to be highly specific to zebra mussels. A water sampling protocol was also developed to improve the probability of detecting zebra mussels. The use of environmental DNA (eDNA) did correlate with zebra mussel biomass. Zebra mussel DNA did accumulate in depositional areas. This suggests that our zebra mussel eDNA assay could assist management agencies to identify infestations, but not inform control efforts. The molecular markers, sampling protocol and depositional areas are described in supplemental attachments with the final report.

Project completed: 6/30/2016

FINAL REPORT (PDF)
Safety of Molluscicide to Nontarget Macroinvertebrates (PDF)
Effects of Spray-Dried Pseudomonas fluorescens on Flathead Minnow (PDF)
Mapping Lakes to Charecterize Substrate Hardness and Vegetated Habitat (PDF)
Environmental DNA Mapping of Zebra Mussel (PDF)
Development of Targeted Delivery Techniques for Zequanox (PDF)
Controlling Zebra Mussels Within Lake Minnetonka Enclosures (PDF)
Response to CO2 Exposure in a Freshwater Mussel (PDF)

Subd. 07 Environmental Education

Minnesota Conservation Apprentice Academy
Subd. 07a $186,000 TF

Jenny Gieseke
Board of Water and Soil Resources
520 Lafayette Rd N
St. Paul, MN 55155

Phone: (507) 381-3131
Email: jenny.gieseke@state.mn.us
Web: http://www.bwsr.state.mn.us

Appropriation Language
$186,000 the first year is from the trust fund to the Board of Water and Soil Resources in cooperation with the Conservation Corps Minnesota to continue a program to train and mentor future conservation professionals by providing apprenticeship service opportunities with soil and water conservation districts.

Project Overview
Many of the most experienced conservation practitioners at local soil and water conservation districts throughout the state are nearing retirement, and with their departure will go much of their practical,

on-the-ground knowledge, experience, and skills. Meanwhile, college students seeking to be the next generation of conservation practitioners have knowledge of emerging technologies and other innovations that can improve and contribute to current conservation efforts. Through this appropriation the Minnesota Board of Soil and Water Resources will work with the Minnesota Conservation Corps to continue a program that places students in apprenticeship positions with county soil and water conservation district offices throughout the state. This unique program provides an opportunity for interns to gain valuable in-the-field experience from current practitioners while sharing their knowledge with those practitioners about the newest ideas and solutions for meeting today's natural resource challenges.

OVERALL PROJECT OUTCOME AND RESULTS

Familiarizing future conservation leaders with Minnesota's various land-use practices, water and soil resources, plant and animal habitats, and landowner concerns is needed to maintain the capacity of local organizations to deliver conservation on the ground. Many of the conservation districts' most experienced conservation professionals and practitioners are nearing retirement age but due to budget constraints will not be replaced until they have left employment. Consequently, Minnesota is missing a great opportunity to transfer professional knowledge and experience to the next generation.

While university graduates with conservation-related degrees are knowledgeable in technology, theory, and research methods, their practical, on-the-ground skills need development. Communicating with landowners and adjusting designs for field nuances are vital to the success of conservation projects and best learned alongside seasoned professionals. In turn, apprentices bring knowledge of emerging technologies to improve the quality and productivity of conservation efforts.

This program funded the placement of 37 conservation apprentices in 35 SWCDs in 2014. During this time, the apprentices stabilized erosion on 7 million square feet of slopes, planted 28,001 plants, trees, shrubs and seedlings, maintained 3.5 million square feet of restored areas, collected 2,465 water samples, spent 2,110 Hours collecting data and mapping using GPS and GIS, and impacted 1,265 people through environmental education and outreach.

This program has benefits to both students and conservation districts. 100% of apprentices indicated they felt more prepared to work in the conservation industry as a result of the program and would recommend it to others. 96% of the Districts were satisfied with the work their apprentices completed, and 100% indicate they would participate in the program again. Managers also indicated that the work conducted by the apprentices increased the amount of conservation practices delivered by their districts during the program period.

This was the third grant awarded to the Apprentice Academy through LCCMR. Grant one addressed the cohorts working during the summers of 2011 and 2012. The state government shutdown of 2011 produced a small balance in the 2010 grant that was used to fund additional positions in 2012 and 2013; this in turn allowed a small balance the second grant (M.L. 2011) to fund additional positions in the this, the M.L. 2013, Chp. 52, Sec. 2, Subd. 07a plan, and carried funding into the early portion of 2014.

PROJECT RESULTS USE AND DISSEMINATION

Information from the project has been disseminated through reports to LCCMR, press releases by BWSR, local press releases by SWCDs, and through the Conservation Corps newsletter, website and annual report. Information was used to recruit apprentices and increase awareness of the project.

Communication and outreach activities include the aforementioned reports, press releases, and electronic newsletters. Additionally, BWSR and Conservation Corps staff conducted outreach to SWCDs to find optimal matches between districts and apprentices. Through the course of their work, the apprentices conducted significant outreach to land owners and residents in topics ranging from easement protection, to water quality education, to plant biodiversity.

Project completed: 6/30/2015

FINAL REPORT

Youth Outdoors: Mississippi River Education and Employment Opportunities
Subd. 07b $450,000 TF

Chad Dayton
Wilderness Inquiry
808 14th Avenue SE
Minneapolis, MN 55414

Phone: (612) 676-9419
Email: chad@wildernessinquiry.org
Web: http://www.wildernessinquiry.org

Appropriation Language
$450,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Wilderness Inquiry to provide outdoor education, recreation, and youth employment on the Mississippi River from Grand Rapids to St. Cloud, the Twin Cities, Hastings, and Red Wing. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
There has been a sharp decline in participation in outdoor recreation and education amongst youth, particularly in urban areas. Some argue that youth who have meaningful outdoor education experiences are more likely to become engaged in environmental stewardship and invested in outdoor resources as adults. Wilderness Inquiry - in partnership with state and federal agencies, non-profits, and local school districts - is using this appropriation to expand an environmental education and recreation program that provides youth with hands-on educational and recreational experiences of the Mississippi River. Funds enable the program to offer canoe experiences to an additional 6,000 youth and to expand the types of experiences provided to include overnight camping, aquatic sampling and monitoring, and conservation-related internships. The program is also expanding geographically to serve additional communities in the Twin Cities and outstate, including Grand Rapids, St. Cloud, Hastings, and Red Wing.

OVERALL PROJECT OUTCOME AND RESULTS
Youth in Minnesota and across the country are spending less time outdoors than ever before. Minnesota is home to beautiful wilderness areas and our youth are missing out on opportunities to experience it. The goal of the Youth Outdoors project is to bring more youth outside to experience the wilderness -- urban and remote -- and gain a new appreciation for their environment and community through guided outdoor experiences.

Between July 1, 2013 and September 1, 2015 Wilderness Inquiry (WI) engaged 12,000 youth in outdoor programming. More than 11,000 youth joined WI for an introductory outdoor day experience and more than 830 youth participated in an overnight camping experience. Additionally, 31 youth were employed as interns with job responsibilities including supporting participants, leading educational stations, and creating new activities. On single day events, youth canoed, fished, hiked, explored, and collected data from lakes and rivers for hands-on water quality tests. Youth worked in teams to paddle 24-foot Voyageur canoes on urban waterways such as the Mississippi and Minnesota Rivers and Minneapolis Chain of Lakes as well as remote lakes and rivers across the state such as Voyageurs National Park and Lake Itasca. Outdoor Educators, with the support of partner organizations, facilitated activities to engage students with each other and the outdoors. On overnight camping experiences, youth set up tents, built fires, and cooked outside. We reached out to schools, formalized district partnerships, and engaged a variety of groups to offer these experiential and educational opportunities.

The University of Minnesota's Center for Applied Research and Educational Improvement (CAREI) collected data from the project as part of a 5-year plan to evaluate the program outcomes. We are continuing our relationship with CAREI to determine best practice and next steps. By engaging thousands of Minnesota youth in the outdoor educational experiences, we are energizing the next generation of environmental stewards.

PROJECT RESULTS USE AND DISSEMINATION
We disseminated information about the project and its outcomes through a variety of media including our website, social media networks, quarterly newsletter, partner website, and news sources. We have shared our educational resources with schools in an effort to support the continued engagement of their students in the outdoors. Our program has been highlighted in a number of local newspapers.

Project completed: 6/30/2015

FINAL REPORT

Subd. 08 Administration and Contract Management

Contract Management
Subd. 08b $135,000 TF

Amanda Graeber
Organization: MN DNR
Address: 500 Lafayette Road
City, State, Zip: St. Paul, MN 55155

Phone: (651) 259-5533
Email: amanda.graeber@state.mn.us
Web: http://www.dnr.state.mn.us

Appropriation Language
$135,000 the first year is from the trust fund to the commissioner of natural resources at the direction of the Legislative-Citizen Commission on Minnesota Resources for expenses incurred for contract agreement reimbursement for the agreements specified in this section. The commissioner shall provide documentation to the Legislative-Citizen Commission on Minnesota Resources on the expenditure of

these funds.

Project Overview
Appropriations to non-state entities must be made through a formal contract with a state entity that manages all of the funds for the project on a reimbursement basis. This appropriation to Minnesota's Department of Natural Resources (DNR) funds the expenses incurred by the DNR in contracting, contract management, and expense re-imbursement for most of the Environment and Natural Resources Trust Fund appropriations made to non-state entities, including both new projects funded during the biennium and existing projects funded in previous bienniums.

OVERALL PROJECT OUTCOME AND RESULTS
This appropriation, in conjunction with Outdoor Heritage Fund appropriations, was used to support the contract management program, which ensured ENRTF funds were expended in compliance with state law, session law, approved work plans, and Office of Grants Management grants policies.

Services provided under this appropriation included the following:

- Contract Management Services
    - Prepared grant agreements and amendments
    - Encumbered/Unencumbered Funds
    - Executed Use of Funds Agreements
    - Advanced funds for land acquisition (if approved)
    - Communicated regularly with LCCMR staff and grant recipients
    - Contract management documentation, including file management
- Training and Communications
    - Trained recipients on state grant requirements
    - Worked with recipients to ensure grantees understood the state's reimbursement procedures and requirements
    - Provided ongoing technical assistance/guidance to recipients
- Reimbursement Services
    - Reviewed reimbursement requests
    - Arranged for prompt payment once expenses were verified eligible for reimbursement
    - Detailed accounting by pass-through appropriation for each grant recipient
- Fiscal, Audit, and Close-out Services
    - Financial reconciliation
    - Financial reporting
    - Contract management reporting (fund balance/expenditures)
    - Examined or audited records of recipients
    - Worked with recipients to successful close out of grants
    - Worked closely with and responded to requests from the Office of the Legislative Auditor

PROJECT RESULTS USE AND DISSEMINATION
Project personnel were in frequent contact with appropriation recipients and LCCMR staff. Information was disseminated through manuals, training sessions, orientations, meetings, memos, letters, emails, newsletter, and phone.

FINAL REPORT

Project completed: 6/30/2015

4. M.L. 2011 Projects Completed
January 15, 2015 – January 15, 2017

MN Laws 2011, First Special Session, Chapter 2, Article 3, Section 2

M.L. 2011-12 Projects Completed in 2015-2016
MN Laws 2011, 1st Special Session, Chapter 2, Article 3, Section 2 (beginning July 1, 2011)

MN Laws 2012, Chp. 264, Article 4, Section 3 (beginning July 1, 2012)

For Minnesota's FY 2012-13 biennium (July 1, 2011 - June 30, 2013), approximately $25.3 million was available each year (Total = $50,656,000) for funding from the Environment and Natural Resources Trust Fund and a total of $750,000 from the Land and Water Conservation Account (LAWCON). In response to the 2011-12 Request for Proposal (RFP) due April 9, 2010, 241 proposals requesting a total of approximately $163.8 million were received. After full consideration of all proposals received through a competitive, multi-step process, on 07/14/10 the LCCMR selected 92 projects to be included in 87 appropriation recommendations to the 2011 Minnesota Legislature. The 2011 Legislature adopted 61 of the recommendations, including 52 without any changes and 9 at a decreased or increased dollar amount; dropped 26 of the recommendations; and added 8 additional appropriations for a total of 69 total appropriations. All 69 appropriations were signed into law (M.L. 2011, 1st Special Session, Chapter 2, Article 3) by the Governor on 07/20/11. The 2012 Legislature altered the 2011 appropriations to reduce the amounts appropriated to two projects in 2011 and add one new project in 2012 (M.L. 2012, Chp. 264, Art.4, Sec. 3).

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

When available, we have provided links to web sites related to the project. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

Subd. 03 Natural Resource Data and Information

03b County Geologic Atlases for Sustainable Water Management

03d Updating National Wetland Inventory for Minnesota - Phase III

03f Determining Causes of Mortality in Moose Populations - **RESEARCH**

03j Information System for Wildlife and Aquatic Management Areas

Subd. 04 Land, Habitat, and Recreation

04b State Parks and Trails Land Acquisition

04g Minnesota River Valley Green Corridor Scientific and Natural Area Acquisition

04i Metropolitan Conservation Corridors (MeCC) - Phase VI

04q Restoration Strategies for Ditched Peatland and Scientific and Natural Areas - **RESEARCH**

Subd. 06 Aquatic and Terrestrial Invasive Species

06a Improved Detection of Harmful Microbes in Ballast Water - **RESEARCH**

06c Evaluation of Switchgrass as Biofuel Crop - **RESEARCH**

Subd. 08 Environmental Education

08b Minnesota Junior Master Naturalist Program

Subd. 09 Emerging Issues

09a Minnesota Conservation Apprentice Academy

MN Laws 2011, 1st Special Session, Chapter 2, Article 3, Section 2

Subd. 03 Natural Resource Data and Information

County Geologic Atlases for Sustainable Water Management
Subd. 03b $1,800,000 TF

Part 1 ($1,200,000)
Dale Setterholm
U of MN - Minnesota Geological Survey
2642 University Ave W
St. Paul, MN 55114-1057

Phone: (612) 627-4780 x2
Email: sette001@umn.edu
Web: http://www.geo.umn.edu/mgs

Part 2 ($600,000)
Jan Falteisek
MN DNR
500 Lafayette Rd
St Paul, MN 55155

Phone: (651) 259-5665
Email: jan.falteisek@state.mn.us
Web: http://mndnr.gov

Appropriation Language
$900,000 the first year and $900,000 the second year are from the trust fund to accelerate the production of county geologic atlases to provide information essential to sustainable management of ground water resources by defining aquifer boundaries and the connection of aquifers to the land surface and surface water resources. Of this appropriation, $600,000 each year is to the Board of Regents of the University of Minnesota for the Geologic Survey and $300,000 each year is to the commissioner of natural resources. This appropriation is available until June 30, 2015, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The Minnesota County Geologic Atlas program is an ongoing effort begun in 1982 that is being conducted jointly by the University of Minnesota's Minnesota Geological Survey and the Minnesota Department of Natural Resources (DNR). The program collects information on the geology of Minnesota to create maps and reports depicting the characteristics and pollution sensitivity of Minnesota's ground-water resources and their interaction with surface waters. The information from County Geologic Atlases is used in planning and environmental protection efforts at all levels of government, by

businesses, and by homeowners to ensure sound and sustainable planning, management, and protection of water resources used for drinking, agriculture, industry, and more. This appropriation will:

- Support completion of geologic atlases for Carlton, McLeod, Carver, Benton, and Chisago counties.
- Support ongoing work on geologic atlases for Anoka, Blue Earth, Clay, Nicollet, Renville, Sibley, and Wright counties;
- Initiate geologic atlases for three or more additional counties;
- Make collected data available in a digital format.

PART 1 - MINNESOTA GEOLOGICAL SURVEY

OVERALL PROJECT OUTCOME AND RESULTS

The Minnesota Geological Survey maps sediment and rock because these materials control where water can enter the subsurface (recharge), where and how much water can reside in the ground (aquifers), where the water re-emerges (discharge), and at what rates this movement occurs. This information is essential to managing the quality of our water and the quantity that can be sustainably pumped. This project substantially completed geologic atlases for Meeker, Redwood, and Brown counties, and contributed to atlas work in Anoka and Wright counties. Information about the geology is gleaned from the records of domestic wells, and from drilling conducted for this project. In Meeker County we used 3,600 wells and 6 cores, in Redwood we used 1,900 wells and 10 cores, and in Brown County we used 1,700 wells and 8 cores, and soil borings and geophysical surveys. From the data we created maps of the geology immediately beneath the soil; the aquifers within the glacial sediment; and the shape, elevation, and rock types of the bedrock surface. These maps and data support monitoring, wellhead protection, water appropriation, clean-ups, and supply management.

In large portions of Brown and Redwood counties the glacial materials are relatively thin, and most of the bedrock types present do not provide much water. This makes the mapping of glacial sand bodies, which are potential aquifers, very important. Our maps will guide wise use and protection of these water supplies. In Meeker County, the glacial deposits can be very thick, and the bedrock includes some formations that can serve as aquifers. This is a more diverse and complicated ground water distribution. In all three counties the database of well construction records we have compiled is an excellent indicator of which aquifers the population is currently relying on.

PROJECT RESULTS USE AND DISSEMINATION

County geologic atlases are distributed in print and digital formats. The digital format allows us to include all the data that support the maps and the ability to change the maps or create new ones. The products are available from the MGS web site (http://www.mngs.umn.edu/index.html). We also conduct post-project workshops in the map area to familiarize users with the products and their applications. The products are also distributed to libraries.

Project completed: 6/30/2015

FINAL REPORT

PART 2 - MN DNR

OVERALL PROJECT OUTCOME AND RESULTS

Geologic atlases provide information essential to sustainable management of groundwater resources.

Atlases define aquifer boundaries, the connection of aquifers to the land surface, and the connection of aquifers to surface water resources. They facilitate and enhance the operations of natural resource management and regulation by state and local government units.

County Geologic Atlases are specifically identified as essential data in the Statewide Conservation Plan, and in the efforts of the Environmental Quality Board, DNR Waters, and the Water Resources Center at the University of Minnesota to design a sustainable water management process. County geologic atlases facilitate management activities to identify sustainable water use and to protect water quality.

This project continued the acceleration of County Geologic Atlases, Part B by DNR initiated under M.L. 2009 that provided ENRTF funding through June 30, 2012. This work plan provided support for ongoing Part B atlases in Carlton, Benton, McLeod, Carver, and Chisago counties and to initiate seven new Part B atlases over the project period including Blue Earth, Nicollet, Sibley, Anoka, Clay, Renville, and Wright counties. The Carlton, Benton, McLeod, Carver, and Chisago county geologic atlases, Part B were completed, printed, and distributed; local training workshops were held for all completed atlases. Blue Earth, Nicollet, Sibley, Anoka, Clay, Renville, and Wright county Part B geologic atlases were all initiated. Project staff also assisted the initiation of the Part B Sherburne county geologic atlas.

All initiated projects completed initial analysis and groundwater sample collection with only carbon-14 sample collection and analysis remaining for the Renville atlas project. Well owners received reports of the chemical analysis of samples from their well. The format for new atlas reports was redesigned to a USGS-style science report format that will allow an expansion of the information presented in the report. All future atlas reports beginning with Blue Earth will use the new report format. The Blue Earth report is in final draft in the new format with reports for the Nicollet and Sibley atlases in development. Technical analysis and map development for other projects is underway.

The County Geologic Atlas series of reports is a long-term joint effort by the Minnesota Geological Survey and DNR to complete County Geologic Atlases for all counties in the state. Initiated Part B atlas projects mentioned above will be completed with additional existing ENRTF funding. Future Part B atlases are planned for Part A atlases that have been completed by the MGS, including Morrison, Houston, the Winona revision, and Meeker. Ten additional Part A county geologic atlases are currently underway by the MGS.

PROJECT RESULTS USE AND DISSEMINATION

The Carlton, Benton, McLeod, Carver, and Chisago county geologic atlases, Part B were completed and printed in paper format and distributed to county, libraries, state agencies, and other organizations. Printed reports are available for sale at the MGS. PDF versions of all printed reports were posted to the DNR web site at http://www.dnr.state.mn.us/waters/groundwater_section/mapping/status.html. Through DNR gov.delivery subscription, (sign up on DNR home page http://www.dnr.state.mn.us/index.html) interested persons may self-subscribe to be notified of completed projects and other DNR county geologic atlas news. Project data of completed reports, including water chemistry data and GIS data were also posted to the DNR web site. Following publication of each Part B report, a local workshop was held to introduce the report content and train users in its application. At the completion of each report, the report author prepares an article of atlas highlights for the Minnesota Ground Water Association newsletter. The membership of the MGWA includes many professional hydrogeology colleagues who use the atlas reports.

Project completed: 6/30/2015

FINAL REPORT

Updating National Wetland Inventory for Minnesota - Phase III
Subd. 03d $1,500,000 TF

Steve Kloiber
MN DNR
500 Lafayette Rd, Box 25
St Paul, MN 55155

Phone: (651) 296-1811
Email: steve.kloiber@state.mn.us
Web: http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html

Appropriation Language
$1,500,000 the second year is from the trust fund to the commissioner of natural resources to continue the update of wetland inventory maps for Minnesota. This appropriation is available until June 30,2015, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The National Wetland Inventory, a program initiated in the 1970s, is an important tool used at all levels of government and by private industry, non-profit organizations, and private landowners for wetland regulation and management, land management and conservation planning, environmental impact assessment, and natural resource inventories. The data behind the National Wetlands Inventory for Minnesota is now considerably out-of-date and a multi-phase, multi-agency collaborative effort coordinated by the Minnesota Department of Natural Resources is underway to update the data for the whole state. This appropriation is being used to conduct the third phase of this effort, which involves updating wetland maps for 30 counties in southern Minnesota and acquiring additional data needed to update wetland maps for an additional 22 counties in central Minnesota during a future phase of the inventory.

OVERALL PROJECT OUTCOME AND RESULTS
Updating the National Wetland Inventory (NWI) is a key component of the State's strategy to ensure healthy wetlands and clean water for Minnesota. This effort is a multi-agency collaborative under leadership of the Minnesota Department of Natural Resources. These data are intended to replace the original 1980s NWI data. The NWI data provide a baseline for assessing the effectiveness of wetland policies and management actions. These data are used at all levels of government, as well as by private industry and non-profit organizations for wetland regulation and management, land use, conservation planning, environmental impact assessment, and natural resource inventories. The update project is being conducted in phases with data released for each region as it is finalized.

In this third phase of the overall effort, we updated wetland inventory maps for 36 counties in southern Minnesota (23,856 square miles). The overall accuracy for wetland identification is 94%. We also acquired aerial imagery data for 39,625 square miles in central and northwestern Minnesota needed for the next phases of the update.

The updated NWI data was created in accordance with federal wetland mapping guidance. This update used spring aerial imagery acquired in 2011 and lidar elevation data as well as other ancillary data.

Quality assurance of the data included visual inspection, automated checks for attribute validity and consistency, as well as a formal accuracy assessment based on an independent field data. Further details on the methods employed can be found in the technical procedures document for this project located on the project website (http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html).

PROJECT RESULTS USE AND DISSEMINATION<
All wetland map data and aerial imagery are available free of charge to the public. The data have been made available through the Minnesota Geospatial Commons (https://gisdata.mn.gov/) as well as through an online wetland viewer (http://www.dnr.state.mn.us/eco/wetlands/map.html). A copy of the data has also been provided to the US Fish and Wildlife Service for inclusion in the national wetland database.

Use of the NWI data is being promoted through a variety of channels. The DNR is giving presentation about the updated NWI data at both the Minnesota Water Resources Conference and the Minnesota GIS/LIS Conference. The DNR and MnGeo are co-presenting at the Minnesota GIS/LIS Conference regarding the availability of the spring aerial imagery. A short news article was developed for the Minnesota Geospatial Commons news feed and posted in May 2015. A broader press release has also been drafted for an expected September release. Finally, a peer-reviewed journal article was published in the journal Wetlands based on the work from the previous NWI project phase.

Project completed: 6/30/2015

FINAL REPORT

Determining Causes of Mortality in Moose Populations
Subd. 03f $600,000 TF

Michelle Carstensen
MN DNR
5463C W Broadway
Forest Lake, MN 55025

Phone: (651) 296-2663
Email: michelle.carstensen@state.mn.us

RESEARCH

Appropriation Language
$300,000 the first year and $300,000 the second year are from the trust fund to the commissioner of natural resources to determine specific causes of moose mortality and population decline in Minnesota and to develop specific management actions to prevent further population decline. This appropriation is available until June 30, 2015, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Moose, one of Minnesota's prized wildlife species, are dying at much higher rates in Minnesota than elsewhere in North America. Recently observed increases in mortality rates amongst some moose in northeastern Minnesota have led to concern that the population there may be starting a decline like that seen in the northwestern part of the state, where moose populations fell from over 4,000 to fewer

than 100 in less than 20 years. Additionally the specific causes of increased mortality amongst individual moose, such as potential nutritional factors, remain unknown. Scientists at the Minnesota Department of Natural Resources are using this appropriation to investigate the actual cause of death in recovered individual moose and determine what other factors may also be contributing. Once these causes of death and contributing factors are identified, it may be possible to implement management actions to address the overall population decline and help maintain healthy populations of moose in the state.

OVERALL PROJECT OUTCOME AND RESULTS

Minnesota's moose (*Alces alces*) are dying at rates much higher than elsewhere in North America. Recent aerial surveys indicate the northeastern population has declined 50% since 2006. Previous research in MN reported a 21% average non-hunting mortality rate, much higher than the 8-12% reported for moose elsewhere in North America. In 2013, the Minnesota DNR launched a new study to determining cause-specific mortality by deploying Iridium GPS collars on moose in northeastern MN and investigated mortalities within 24 hours of death to identify proximate cause of mortality and to examine the influence of potential contributing factors. In the first 2.5 years of this multi-year study, 156 moose have been radiocollared and annual mortality rates were 19% and 12% in 2013 and 2014, respectively; 9% of collared moose have died in the first half of 2015. Overall, 41 moose have died and causes of mortality were health-related (61%), which included bacterial infections, winter ticks, brainworm, accident, multiple chronic health issues, and other undetermined health causes, and predator-related (39%), which included confirmed and likely wolf-kills. Predisposing health issues (e.g. brainworm, pneumonia, previous injury) likely contributed to at least 6 of the wolf-killed moose. Response times from initial mortality notification (e.g. text message or email) to a team in the field at the death site were <24 hours in 23 cases (59%), between 24 and 48 hours in 10 cases (26%), and >48 hours in 6 cases (15%). Mortality implant transmitters (MITs) were deployed in 61 moose to detect instantaneous death as well as internal body temperature. Preliminary analyses of data from MITs recovered from moose that have died in Minnesota (n = 8) indicated prolonged elevated temperatures (>102 degrees F) for 10-30% of readings during the summer months. This study has documented key mortality factors to improve our understanding of the moose decline in northeastern Minnesota.

PROJECT RESULTS USE AND DISSEMINATION<

The moose project has received an enormous amount of media coverage, including international, national, regional, and local outlets. Minnesota DNR staff have provided presentations about this research project to international and national scientific meetings, regional meetings, and to local stakeholder groups. Links to some the highlighted media coverage and reports can be found on the project's website: http://www.dnr.state.mn.us/moose/index.html. Further, report on this project was published in the 2013 Summaries of Research Findings:
http://www.dnr.state.mn.us/publications/wildlife/research2013.html.

With the continuation of ENTRF project funding for "Moose Decline and Air Temperatures in Northeastern Minnesota", M.L. 2014, Chp. 226, Sec. 2, Subd. 5m, outreach and dissemination of this project is on-going. Peer-reviewed publication of the findings of cause-specific mortality for adult moose in this study will be initated after the completion of the third full year of the project (December 2015). Other peer-reviewed publications have been initated, including a techniques paper documenting the methods used to respond to moose mortalities within 24 of death, and a collaborative analyses of serum chemistries from moose in Minnesota, New England states (Maine, New Hampshire, and New York), and western US (Colorado, Wyoming, and Montana).

Project completed: 6/30/2015

FINAL REPORT

Information System for Wildlife and Aquatic Management Areas
Subd. 03j $500,000 TF

Steve Benson
MN DNR
1201 E Highway 2
Grand Rapids, MN 55744

Phone: (218) 327-4149
Email: steve.benson@state.mn.us

Appropriation Language
$250,000 the first year and $250,000 the second year are from the trust fund to the commissioner of natural resources to develop an information system to facilitate improved management of wildlife and fish habitat and facilities. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The Minnesota Department of Natural Resources (DNR) manages over 2,135 state Wildlife Management Areas (WMA) and Aquatic Management Areas (AMA) containing over 1.3 million acres. This appropriation is enabling the DNR to develop an information system that will better facilitate the management of the state's WMAs and AMAs by helping to identify needs; prioritize, plan, and carry out related activities; track and assess results of activities; and make the information available to resource management professionals and the public.

OVERALL PROJECT OUTCOME AND RESULTS
The DNR Division of Fish and Wildlife (FAW) needed a system to manage statewide information about Wildlife Management Areas (WMAs) and Aquatic Management Areas (AMAs). This project created a new information system for assessment of and projects on, facilities and habitat on these management areas. The system has a component for proposing and managing field projects. The system also handles information about public use and access to WMAs/AMAs, which will be presented on the DNR web site.

This system is called the Wildlife and Aquatic Habitat Management Application (WAHMA). WAHMA is now being used by staff within FAW. The WAHMA application can be broken down into three components:

- WAHMAGIS - GIS based data entry and management components for WMA/AMA information. This component can be further divided into separate applications:
    - WAHMAGIS-Desktop - a Windows PC based application that can be run from DNR offices, or over any Internet connection. All WAHMA data and project management tools can be used from the Desktop application. All data that has been captured is immediately available for every WMA and AMA in an organized interface.
    - WAHMAGIS-Mobile - a smaller field application that runs on rugged tablet computers. This application can be run over a Wi-Fi connection, a 4g phone connection, or completely disconnected. All existing data about facilities and habitat can be reviewed,

added or updated. Part of the project funding was used to purchase 53 field tablets, which were distributed to FAW field staff managing WMAs and AMAs.

- WAHMA-Work Planning - a web application used for proposing and managing projects. This component allows staff to propose and prioritize projects for funding and then manage the funded projects. Regional and Central Office staff review, prioritize and approve projects. FAW Program staff use the data to bundle appropriate projects for building funding proposals.
- WAHMA-Reporting - The principle report will be the Management Guidance Document, a summary for each WMA/AMA including unit description, goals, management plans and considerations.

PROJECT RESULTS USE AND DISSEMINATION

WAHMA provides a foundation and tools for FAW field staff to update and build out the inventory of facilities and habitat on WMAs/AMAs. As the data is entered and updated in the system, it can then be queried to identify unmet needs and set work priorities via the project management module of the system. WAHMA is also used to record information about public recreation, access, acquisition history, management goals and plans.

WAHMA broke new ground for a project proposal and approval system. Other DNR divisions expressed interest in using the same methods, so multiple demonstrations have been held within DNR. A technical presentation was done for MN.IT Services @ DNR staff. Field users have attended multiple training sessions. Presentations have been made at regional Wildlife meetings, at the bi-annual Wildlife School, and will be made at an upcoming Fisheries Academy.

WAHMA is primarily intended for use by FAW staff in managing lands, and in planning and accomplishing projects. Field staff will be the front line of gathering information, which will be used at all levels in FAW for unit planning and determining land management needs. WAHMA is also being used to manage more detailed recreation and management information for the public, which will be delivered with a public web site redesigned to present the additional maps and information. The GIS data from WAHMA will be available through DNR's internal data resource site, and to the public via the Minnesota Geospatial Commons.

Project completed: 6/30/2015

FINAL REPORT

Subd. 04 Land, Habitat, and Recreation

State Parks and Trails Land Acquisition
Subd. 04b $3,000,000 TF

Jennifer Christie
MN DNR
500 Lafayette Rd
St Paul, MN 55155

Phone: (651) 259-5633
Email: jennifer.christie@state.mn.us
Web: http://www.dnr.state.mn.us/state_parks/

Appropriation Language
$1,500,000 the first year and $1,500,000 the second year are from the trust fund to the commissioner of natural resources to acquire state trails and critical parcels within the statutory boundaries of state parks. State park land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards, as determined by the commissioner of natural resources. A list of proposed acquisitions must be provided as part of the required work program. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Privately owned lands exist within the designated boundaries of state parks throughout Minnesota. Purchase of these lands from willing landowners for addition to the state park system makes them permanently available for public recreation and enjoyment and facilitates more efficient management. Additional benefits include preserving contiguous wildlife corridors, facilitating preservation and restoration of native plant communities and cultural resources, reducing impacts of future development, and providing riparian buffers along wetlands, creeks, and lakes. The Minnesota Department of Natural Resources is using this appropriation to partially fund the acquisition of approximately 120 acres, which includes:

- 64 acres for 6.5 miles of the Brown's Creek Segment of the Willard Munger State Trail in Washington County
- 75 acres for Mille Lacs Kathio State Park in Mille Lacs County
- 3 acres for Crow Wing State Park in Cass County
- 48 acres for Tettegouche State Park in Lake County
- 20 acres for Nerstrand Big Woods State Park in Rice County

OVERALL PROJECT OUTCOME AND RESULTS
Environment and Natural Resources Trust Fund funding resulted in the Department of Natural Resources acquiring approximately 332 acres of land within the statutory boundaries of six Minnesota State Parks and one statutorily designated State Trail:<

- Partially fund acquisition of approximately 64 acres, 6 miles, of the Brown's Creek Segment of the Willard Munger State Trail. This segment connects the existing State Trail to Stillwater and protects a critical section of the Brown's Creek trout stream.
- Acquired approximately 75 acres within Mille Lacs Kathio State Park located in Mille Lacs County. This parcel is located within the Historic Landmark District and contains significant cultural resources and 2/3rds of the lakeshore surrounding Warren Lake.
- Acquired approximately 10 acres within Crow Wing State Park located in Cass County. This parcel contains approximately 700 feet the Crow Wing River at high risk for development, protects shoreline and provides hiking and river access.
- Acquired approximately 3 acres within Lake Vermilion-Soudan Underground Mine State Park in St. Louis County. This property is an entire island located in Cable Bay and protects the riparian resources and viewshed from Minnesota's newest state park.
- Acquired approximately 104 acres within Banning State Park in Pine County. This property preserves the natural setting of the Kettle River and connects the north and south sections of the state park. The master plan was recently updated to include a new rock climbing recreational opportunity on portions of this parcel.
- Acquired approximately 61 acres within Whitewater State Park that preserves oak woodland and small outcrop communities scattered along the cliff features with critical wildlife habitat for prairie and savanna species.

- Partially fund approximately 15 acres within Jay Cooke State Park's Oak Trail. Historical accounts have a portion of a trail passing through Gill Creek, which early European voyagers and Native Americans used this route.

Any restoration needs will be determined in accordance with each state park and/or state trail master plan. Any additional operations, maintenance and/or restoration costs required to manage the additional land will be determined and taken into consideration during the next budget planning cycle. Additional costs are not anticipated to be a significant amount of increase, and will be absorb with existing staffing and within pre-existing Division restoration plans. The State Parks and Trails resource management staff is responsible for the restoration and management of the natural/undeveloped areas not planned for facilities. For restoration efforts like converting an old field to a prairie, bonding and Legacy funds are eligible and used. Legacy monies and other sources, such as general fund and the State Parks working capital fund are used for long-term maintenance of the communities once the site has been restored.

FINAL REPORT

Project completed: 6/30/2015

Minnesota River Valley Green Corridor Scientific and Natural Area Acquisition
Subd. 04g $2,000,000 TF

Brad Cobb
Green Corridor Inc
103 Second St
Redwood Falls, MN 56283

Phone: (320) 493-4695
Email: 1231tlc@charter.net
Web: http://www.tatankabluffs.com

Appropriation Language
$1,000,000 the first year and $1,000,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with the Redwood Area Communities Foundation to acquire lands with high-quality native plant communities and rare features to be established as scientific and natural areas as provided in Minnesota Statutes, section 86A.05, subdivision 5. A list of proposed acquisitions must be provided as part of the required work program. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards, as determined by the commissioner of natural resources. Up to $54,000 may be retained by the Department of Natural Resources at the request of the Redwood Area Communities Foundation for transaction costs, associated professional services, and restoration needs. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Minnesota's Scientific and Natural Areas (SNA) Program is an effort to preserve and perpetuate the state's ecological diversity and ensure that no single rare feature is lost from any region of the state. This includes landforms, fossil remains, plant and animal communities, rare and endangered species, and other unique biotic or geological features. These sites play an important role in scientific study, public education, and outdoor recreation. The Redwood Area Communities Foundation is using this

appropriation to work in partnership with the Minnesota Department of Natural Resources to acquire approximately 420 acres of lands in the Minnesota River Valley containing some of the most ecologically sensitive plant communities, rare species, and other unique natural resources in the area. Acquired lands will be established as Scientific and Natural Areas.

Project due to be completed: 6/30/2016 [Extended in M.L. 2014, Chapter 226 and M.L. 2015, Chapter 76]

Work Plan (PDF)

Metropolitan Conservation Corridors (MeCC) - Phase VI
Subd. 04i $3,475,000 TF

John Brosnan
Minnesota Land Trust
2356 University Ave W, Ste 240
St Paul, MN 55114

Phone: (651) 917-6292
Email: johnbrosnan@minnesotalandtrust.org
Web: http://www.dnr.state.mn.us/metroconservationcorridors/

Appropriation Language
$1,737,000 the first year and $1,738,000 the second year are from the trust fund to the commissioner of natural resources for the acceleration of agency programs and cooperative agreements. Of this appropriation, $150,000 the first year and $150,000 the second year are to the commissioner of natural resources for agency programs and $3,175,000 is for the agreements as follows: $100,000 the first year and $100,000 the second year with Friends of the Mississippi River; $517,000 the first year and $518,000 the second year with Dakota County; $200,000 the first year and $200,000 the second year with Great River Greening; $220,000 the first year and $220,000 the second year with Minnesota Land Trust; $300,000 the first year and $300,000 the second year with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $250,000 the first year and $250,000 the second year with The Trust for Public Land for planning, restoring, and protecting priority natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through contracted services, technical assistance, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards, as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of habitable residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. An entity that acquires a conservation easement with appropriations from the trust fund must have a long-term stewardship plan for the easement and a fund established for monitoring and enforcing the agreement. Money appropriated from the trust fund for easement acquisition may be used to establish a monitoring, management, and enforcement fund as approved in the work program.

An annual financial report is required for any monitoring, management, and enforcement fund established, including expenditures from the fund. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

Overall PROJECT OVERVIEW

Though many parts of the Twin Cities metropolitan area are urbanized, there are also has large areas of natural lands that continue to serve as important habitat for fish, wildlife, and plant communities. However, pressure on these remaining lands continues to intensify as population and development pressures increase. This appropriation represents the sixth phase of an ongoing effort by a partnership of state and non-profit organizations, called the Metro Conservation Corridors (MeCC) partnership, to conduct strategic and coordinated land protection, restoration, and enhancement activities that build connections between remaining natural areas and ensures their benefits are available for future generations. This phase involves seven partners and is expected to result in the permanent protection of more than 600 acres and the restoration and enhancement of more than 750 acres.

Individual Partner PROJECT OVERVIEWs

- *1.1/1.2 - MeCC VI - Coordination, Mapping & Outreach & Mapping and Database Work - Minnesota Land Trust ($40,000)*
  The Minnesota Land Trust provides coordination, mapping, and data management for the Metropolitan Conservation Corridors partnership. Funds are being used to coordinate the partnership, guide strategic outreach and implementation efforts, manage project data, and provide reporting and mapping of accomplishments.
- *2.1 - MeCC VI - Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($200,000)*
  Friends of the Mississippi is using this appropriation to restore and enhance approximately 163 acres of permanently protected prairie and forest lands in Dakota, Washington, Ramsey, and Hennepin counties in order increase the amount of high quality habitat within designated conservation corridors. Specific activities will include updating management plans, soil preparation, prescribed burning, native vegetation installation, woody encroachment removal, and invasive species control.
- *2.3 - MeCC VI - Restoring Our Lands and Waters - Great River Greening ($400,000)*
  These funds will enable Great River Greening to restore approximately 121 acres of permanently protected forests, savanna, prairie, and wetland habitat and 0.18 miles of shoreland habitat while engaging hundreds of volunteers in the stewardship of the Metropolitan area's remaining natural areas. Specific activities include invasive species control, seeding/planting, prescribed burning, and other associated activities.
- *2.6/3.3 - MeCC VI - Priority Expansion and Restoration MN Valley NW Refuge - Minnesota Valley National Wildlife Refuge Trust Inc. ($600,000)*
  The Minnesota Valley National Wildlife Refuge Trust is using this appropriation to purchase a total of approximately 125 acres of land to expand the Minnesota Valley National Wildlife Refuge and to restore and enhance approximately 405 acres of oak savanna and remnant native prairie communities within the refuge. Many benefits are anticipated from this project, including improved habitat connectivity, protection of native species, improved water quality in the Minnesota River, and increased public access to natural lands for activities such as hiking, hunting, and fishing.
- *2.7/3.7 - MeCC VI - Dakota County Riparian and Lakeshore Protection - Dakota County ($1,035,000)*
  Through this appropriation Dakota County plans to permanently protect approximately 287

acres along rivers, including the Vermillion and Cannon Rivers, by securing conservation easements from willing landowners. For all acres protected, natural resource management plans will be prepared to ensure their long term stewardship. Additionally, restoration and enhancement activities are expected to occur on approximately 75 acres.

- *3.1 - MeCC VI - TPL's Critical Land Protection Program - Trust for Public Land ($500,000)*
  The Trust for Public Land is using this appropriation to purchase approximately 30 acres of land and 0.3 miles of shoreline with high ecological value and then convey the land to state or local governments for long-term stewardship and protection. Lands being considered for permanent protection in this round of funding include areas around the Rum River and Rice Creek in Anoka County, Lindstrom Natural Area in Chisago County, Savage Fen Scientific and Natural Area and Pike Lake in Scott County, and St. Croix/Fraconia-Scandia Scientific and Natural Area in Washington County.
- *3.2 - MeCC VI - Protect Significant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($400,000)*
  With this appropriation, the Minnesota Land Trust plans to protect 150 acres of high quality forest, prairie, or wetland habitat by securing permanent conservation easements and dedicating funds for their perpetual monitoring, management, and enforcement. Lands being considered for permanent protection in this round of funding are located in Anoka, Carver, Goodhue, Hennepin, Isanti, Washington, and Wright counties.
- *3.5 - MeCC VI - Aquatic Management Area Acquisition - MN DNR ($300,000)*
  The Minnesota Department of Natural Resources is using this appropriation to purchase 35 acres, with 0.6 miles of shoreline, along the Vermillion River in Dakota County to be managed as Aquatic Management Areas. Priority will be given to lands that have a high risk of development, provide protection to shoreline and riparian zones, and allow access for anglers and habitat improvement projects.

Project completed: 6/30/2015

ABSTRACTS AND FINAL REPORTS OF INDIVIDUAL PARTNER PROJECTS (Click project # to go to listing for that project)

- **1.1/1.2** - MeCC VI - Coordination, Mapping & Outreach and Mapping & Database Work - Minnesota Land Trust ($40,000)
- **2.1** - MeCC VI - Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($200,000)
- **2.3** - MeCC VI - Restoring Our Lands and Waters - Great River Greening ($400,000)
- **2.6/3.3** - MeCC VI - Priority Expansion and Restoration MN Valley NW Refuge - Minnesota Valley National Wildlife Refuge Trust, Inc. ($600,000)
- **2.7/3.7** - MeCC VI - Dakota County Riparian and Lakeshore Protection - Dakota County ($1,035,000)
- **3.1** - MeCC VI - TPL's Critical Land Protection Program - Trust for Public Land ($500,000)
- **3.2** - MeCC VI - Protect Significant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($400,000)
- **3.5** - MeCC VI - Aquatic Management Area Acquisition - MN DNR ($300,000)

1.1/1.2 FINAL REPORT - MeCC VI - Coordination, Mapping & Outreach and Mapping & Database Work - Minnesota Land Trust ($40,000)

Project Outcome and Results

During the sixth phase of the Metro Corridors project, the Minnesota Land Trust worked with landowners throughout the Twin Cities metropolitan area to permanently protect important lands and Minnesota's remaining natural areas. Three perpetual conservation easements were completed that collectively protected 317 acres of land and more than 4,300 feet of shoreline, exceeding the grant obligations by 167 acres. Two easements were purchased, both as bargain sales; one easement was donated. All three projects were unique opportunities to protect high quality natural habitat and riparian areas. These projects include:

- Sunrise Lake (Chisago County): A 79-acre property of mixed hardwood and conifer forest, wetland, grassland and agricultural field in close proximity to Carlos Avery WMA.
- Tennyson Lake (Isanti County): A 158-acre property of wetlands, mixed hardwood and pine forest, open water, grasslands, and agricultural land, with 4,375 feet of undeveloped shoreline on Tennyson Lake and Spencer Brook.
- Rush River (Sibley County): A 79-acre property of open fields, wooded blufflands, sloping ravines, and lowland forest lying adjacent to the Minnesota River and Rush River County Park.

Baseline property reports were prepared for each easement, detailing the condition of the property for future monitoring and enforcement. LCCMR provided $55,000 in grant funds to the Land Trust's dedicated Stewardship and Enforcement Fund for this required perpetual obligation. $45,000 was for the three new projects under this phase of the Metro Corridors project, while $10,500 was for an easement project from the previous phase of the Metro Corridors project. The Land Trust will report to LCCMR annually on both the status of the Stewardship and Enforcement Fund and the easements acquired with funds through this grant.

Total appraised value for the two purchased easements was $267,000, with the grant providing $209,080; donated value of these bargain sales was $57,920. No appraisal was completed for the donated easement. The cost to the State of Minnesota to complete these projects was $801 per acre. Cumulatively, across all phases of the Metro Corridors program, the Land Trust has protected 3,989 acres of critical habitat and 80,000 feet of shoreline, at a cost to the State of $453 per acre. The Land Trust's work on this project demonstrates the continued cost effectiveness of using conservation easements to protect natural and scenic resources within developed and developing areas, as the cost to the State was well below the cost to purchase land in the Twin Cities region.

PROJECT RESULTS USE AND DISSEMINATION

The Land Trust continued to gain more experience with conservation easements, easement management, and issues unique to protecting land in a metropolitan area. This experience and information was shared with our partner organizations, other easement holders, local communities, and policy makers. The Land Trust also disseminated information about the specific land protection projects completed under this grant though our newsletter, annual report (4,200 pieces), web site, and press releases. Additionally, the MeCC Partnership maintains an interactive public web map that shows the locations of MeCC projects over time. This web map can be accessed at: www.dnr.state.mn.us/maps/MeCC/mapper.html

Project completed: 6/30/2015

2.1 FINAL REPORT - MeCC VI - Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($200,000)

Project Outcome and Results

High quality habitat within the Metro area is important for both resident and migratory species. The

Metro Conservation Corridors partnership is working to establish a system of habitat corridors that also provide open space and water quality benefits for the residents of the area. One goal of this project was to increase the amount of high quality habitat within designated conservation corridors. During this project, FMR installed 86 acres of prairie, besting the projected amount by 31 acres. This prairie restoration took place at the Emrick property, Gores Pool WMA, Heritage Village Park, Pine Bend Bluffs SNA, and Mississippi River Gorge sites. FMR conducted woodland restoration activities on 2 acres at Mounds Park and Heritage Village Park, falling short by 3 acres of the proposed goal. Uncommon flooding at Gores Pool WMA prevented woodland restoration at the site. Activities associated with this restoration included updating management plans, soil preparation, seed/plant installation, mowing, and weed control. These additional acres of natural communities will provide critical habitat for many species that rely on prairie and woodland, some of which are rare or in decline.

A second goal was to enhance the quality of existing habitat areas. We conducted enhancement activities, mostly exotic invasive plant control and burning, on 275.8 acres, exceeding the number of acres committed to in the work program by 172.8.

The third goal achieved was to develop a list of potential future restoration and acquisition projects within the corridors by reaching out to 27 landowners. This outreach has lead to meetings and site visits with landowners interested in learning more about the natural resources on their property. In other cases, the follow up contact is still taking place. This outreach centered around existing conservation areas, including Gores Pool Wildlife Management Area, Mississippi River riparian area, Sand Coulee SNA, Pine Bend Bluffs Natural Area & the Vermillion River.

PROJECT RESULTS USE AND DISSEMINATION
FMR organizes many tours and stewardship events at the sites where we conduct restoration activities. We share information about this project with the participants of these events. FMR also occasionally publishes articles in its paper and electronic newsletters regarding restoration projects that it is involved in.

Project completed: 6/30/2014

2.3 FINAL REPORT - MeCC VI - Restoring Our Lands and Waters - Great River Greening ($400,000)

Project Outcome and Results
Along with partners and volunteers, Greening undertook restoration projects to reduce habitat fragmentation, enhance habitat quality, reconnect habitat corridors, and build connections with local communities. Significantly exceeding all of our goals, we:

1. restored/enhanced 191 acres of upland habitat and an additional 192 acres with leveraged non-state funds for a total of 383 acres restored,
2. restored/enhanced 0.26 mile of shoreland habitat and an additional 0.20 mile using leveraged non-state funds for a total of 0.46 miles of restored shoreland,
3. engaged nearly 2,500 volunteers in meaningful parts of these projects, including 700 youth.

Habitats included prairie, oak savanna, woodland, wetland, riparian, and black ash swamp. Sites hosted a total of 14 documented rare species (7 vertebrates, 1 invertebrate, and 6 plant species) (Battle Creek Park, Hidden Valley Park, Katherine Abbott Park, Lake St. Croix Beach, Pilot Knob Hill, Spring Lake Park (Scott Co.), one easement property), and four native plant communities with biodiversity of statewide significance as rated by Minnesota County Biological Survey (Hidden Valley Park, Ike's Creek, Spring Lake Park (Scott Co.), Pond Dakota Mission).

We restored 18 sites using methods such as native species plantings, prescribed burns, and mechanical removal and treatment of invasive species. We restored and de-fragmented habitat along the valleys and banks of the Mississippi and Minnesota Rivers (Heritage Village Park, Battle Creek Park, Pilot Knob Hill, Pond Dakota Mission, Ike's Creek, Valley Park) as well as our Wild and Scenic Rivers (Cedar Creek Conservation Area, Martin's Meadows, five easement properties), and restored prairie/savanna at a site historically connected to Lost Valley Prairie SNA (Central Corridor). We also restored habitat at several ecological cores (Spring Lake Park (Scott Co.), Cedar Lake Farm, Katherine Abbott Park, Freeman Park).

Volunteers planted over 2,400 trees/shrubs and 27,000 forb/grass plugs, and received presentations from a Greening ecologist as part of their workday.

We leveraged a total of $441,000 non-state funds for these projects.

PROJECT RESULTS USE AND DISSEMINATION

Volunteer event descriptions acknowledging Trust Fund contributions and qualitative results were emailed to Greening's e-subscribers in July 2011, Feb 2012, July 2012, February 2013, July 2013, and spring 2014 in advance of our spring and fall volunteer event seasons. Over the course of the grants, the number of subscribers increased from about 5,000 to over 6,000.

Information about the Metro Conservation Corridors is on our website in the Initiatives and Volunteer Events sections at http://www.greatrivergreening.org/. Over the course of the grant, the visits to the Greening website increased from approximately 1,200 to approximately 1,500 visits per month.

A summary of results from our partnership with Metro Conservation Corridors was included in email marketing in January 2012, as part of our 2011 annual report, reaching over 5,000 subscribers. Approximately 300 hard copies of the annual report were also distributed.

Two press articles, complete with correct ENRTF acknowledgement, were released during the grant period:

- The Mendota Heights Patch reported in April 2012 on continued restoration at Pilot Knob Historic Site: http://www.greatrivergreening.org/wp-content/uploads/2013/07/4.23.12-Restoration-Continues-at-Pilot-Knob-Historic-Site-Mendota-Heights-MN-Patch.pdf.
- The Isanti County News reported on a fall 2012 Greening volunteer event in the Wild and Scenic Rum River project area: http://isanticountynews.com/2012/10/31/restoration-effort-preserves-20-acres-of-floodplain-forest-along-rum-river/.

An additional five press articles, missing correct acknowledgement despite our efforts, disseminated information about the projects.

- The Bloomington Crow reported in April 2012 on a volunteer event focused on removing invasive species at Ike's Creek: http://www.greatrivergreening.org/wp-content/uploads/2013/07/4.27.12-Chamber-Community-Outreach-Committee-Pulls-Buckthorn-at-Ike-Bloomington-Crow.pdf.
- The Pioneer Press reported on May 3, 2012 on an upcoming volunteer event to remove invasive species and planting prairie seeds at Pilot Knob Hill: http://www.greatrivergreening.org/wp-content/uploads/2013/07/5.3.12-Volunteers-at-Pilot-Knob-Mendota-Heights-Pioneer-Press.pdf.
- The Mendota Heights Patch reported on May 8, 2012 on the same volunteer at Pilot Knob Hill, discussing the work to restore a prairie with a high biodiversity of native plant species:

http://www.greatrivergreening.org/wp-content/uploads/2013/07/5.8.12-Pilot-Knob-Clean-up-Draws-Volunteers-Public-Officials-Mendota-Heights-MN-Patch.pdf.
- The Sun Current reported in June 2012 on a volunteer event and the history of restoration at Ike's Creek: http://www.greatrivergreening.org/wp-content/uploads/2013/07/6.27.12-Bringing-new-life-to-a-Bloomington-Creek-Sun-Current.pdf.
- The Path, a newsletter published by DNR Division of Parks and Trails for its employees, reported in November 2012 on a volunteer event at a DNR Wild and Scenic River easement along the Rum River.See page 4: http://www.greatrivergreening.org/wp-content/uploads/2013/07/12.11.12-DNR-Parks-and-Trails-Internal-Newsletter.pdf.

Greening is in active partnership with landowners, other land managers, service providers, conservation peers, and volunteers resulting in a dynamic and timely exchange of information and results.

Project completed: 6/30/2015

2.6/3.3 FINAL REPORT - MeCC VI - Priority Expansion and Restoration MN Valley NW Refuge - Minnesota Valley National Wildlife Refuge Trust, Inc. ($600,000)

Project Outcome and Results

Activity 1: The Minnesota Valley Trust, Inc. (MVT) acquired 154.6 acres of priority habitat to expand the St. Lawrence Unit of the Minnesota Valley National Wildlife Refuge on January 14, 2015. Of that, 95.1 acres were acquired with the ENRTF grant and 59.5 acres were acquired with other, non-state funds. This property joins two prior acquisitions for this unit, one of which was acquired in part with a prior ENRTF grant (ML2010 - MeCC V Supplemental). The total land acquired for this unit now stands at 445 acres.

About 60 acres of the acquired lands that had been actively-farmed cropland are being restored to its historic alluvial plain and slope wetland habitat with a 2015 Metro Conservation Partners Legacy Grant. This will restore the native wetland habitat with local ecotype vegetation, promote plant diversity to provide a suite of pollinator habitat, prime nesting cover and expanded forage options, and reclaim a unique ecosystem lost to agricultural practices. The project will increase sediment and nutrient entrainment to the Minnesota River, increase water storage and create additional habitat for wildlife, including game species.

Another 3.5 acres were acquired in July 2012 for the nearby Louisville Swamp Unit of the Refuge as leverage, and 176.5 acres were received in donation in December 2011 to create a new Waterfowl Production Area associated with the Refuge. The latter property was just 1 mile outside the corridors of the Metropolitan Conservation Corridors, so does not technically qualify as leverage acres, but was a priority for the Minnesota Valley National Wildlife Refuge & Wetland Management District and is reported here for information purposes.

Activity 2: The following work was completed for this activity:
- Oak savanna remnant at Long Meadow Lake Unit -- Mechanical removal and chemical treatment of woody invasive plant species on 15 acres; prescribed fire on 15 acres; supplemental seeding of native grass and wildflower species on the 15 acres.
- Oak savanna remnant at Louisville Swamp Unit -- Mechanical removal and chemical treatment of woody invasive plant species on 149 acres; prescribed fire on 155 acres.
- Mesic prairie at the Jessenland Unit - Prescribed fire on 300 acres.

PROJECT RESULTS USE AND DISSEMINATION
Upon completion of the restoration activities, the St. Lawrence Unit property will be posted open for public use and announced through news releases and the MVT website. Signage at the unit will include reference to the ENRTF.

Project completed: 6/30/2015

2.7/3.7 FINAL REPORT - MeCC VI - Dakota County Riparian and Lakeshore Protection - Dakota County ($1,035,000)

Project Outcome and Results
The project goal was to acquire permanent conservation easements along rivers, streams, and undeveloped lakeshore in Dakota County; prepare Natural Resource Management Plans (NRMPs) for conservation easements; and restore/enhance protected land. The project scope encompassed some of the best natural resource features found in the metropolitan region. A sound fiscal and ecological conservation approach was taken, while attempting to balance the interests, rights and responsibilities of private landowners, with public concerns about water, wildlife habitat, outdoor recreation, and climate change.

In November 2011, the Dakota County Board adopted a comprehensive Land Conservation Vision that included establishing permanent vegetative buffers along all rivers, streams and undeveloped lakeshore and protecting quality natural areas. The County's land conservation programs targeted specific areas in the County and mailings were issued to determine landowner interest. Program applications were reviewed and evaluated using County Board-approve criteria; and top-ranking projects were considered for permanent protection. Appraisals were conducted for recommended projects. NRMPs and baseline Property Reports were prepared for projects where landowners accepted purchase offers; and landowners agreed to cash or in-kind restoration and management contributions. Restoration projects were also completed on existing easement properties.

The project goals were to acquire an estimated 28 permanent conservation easements, totaling 287 acres, and restoring/enhancing 75 acres of protected land. Although the County's efforts generated a large number of potential projects, a wide variety of issues prevented projects from being completed. Landowner challenges included requesting unacceptable project changes during the acquisition process, inflated land/easement value expectations, and reluctance to commit to long-term or even short-term restoration/management. As a result, the County only acquired four conservation easements, totaling 195 acres, not meeting its goal; and completed NRMPs and/or restoration projects on eight properties, totaling 98 acres, which exceeded its goal. Approximately 4 miles of shoreline were permanently protected through this project.

PROJECT RESULTS USE AND DISSEMINATION
Information about the specific projects funded through this State appropriation is integrated with information about the County's comprehensive land conservation efforts that were initiated in 1998, with a farmland and natural areas protection plan partially funded by the Environment and Natural Resources Trust Fund. Implementation of the initial plan and subsequent revisions resulted in the permanent protection of 10,362 acres of natural areas and agricultural land and 51.5 miles of shoreland outside of the regional park and greenway system.

This project informed and improved internal and external County land conservation practices, procedures and policies. County staff has provided numerous local, regional and national presentations

about how Dakota County has developed and implemented its successful programs. Information has appeared on TV and radio, as well as metropolitan newspapers and residential newsletters. Information can also be found on the County's web site at:
https://www.co.dakota.mn.us/Environment/LandConservation/Pages/default.aspx

Project completed: 6/30/2015

3.1 FINAL REPORT - MeCC VI - TPL's Critical Land Protection Program - Trust for Public Land ($500,000)
Project Outcome and Results
The Trust for Public Land used Metro Conservation Corridors Phase VI funding to acquire two high quality habitat properties in the Metro Area - Rice Creek Headwaters in Anoka County, and Lindstrom Peninsula in Chisago County.

The Trust for Public Land acquired 343 acres of open space at the headwaters of Rice Creek in the eastern part of Anoka County on December 21, 2012, and conveyed this property to Anoka County on January 3, 2013. This acquisition protected nearly all of the shoreline of Columbus Lake and a half mile of Rice Creek, and has helped to complete public ownership of a 20+ mile conservation corridor along Rice Creek to the Mississippi River. The land provides habitat for many species in conservation need, and has connected large tracts of habitat in Anoka County. Anoka County is managing 258 acres of the land as a new public hunting area called Columbus Lake Conservation Area and the remaining 85 acres has been added to the Rice Creek Chain of Lakes Regional Park Reserve. The Trust for Public Land used $67,000 of its M.L. 2011 MeCC funding, which acquired 14.7 acres, as well as $940,000 from the Outdoor Heritage Fund, which acquired 206.1 acres, and $169,000 from Anoka County, which acquired 37.2 acres, to purchase the 258 acres for the Columbus Lake Conservation Area. The remaining 85 acres of the Rice Creek Chain of Lakes Regional Park Reserve was funded by the Metropolitan Council's Park Acquisition Opportunity Grant Program and Anoka County. Please note that the remaining $10,000 of the appropriated $500,000 from ML 2011 MeCC was released to the MN DNR for their acquisition, reporting and management planning costs as outlined in the Project Budget Summary, and the approved Work Plan.

On October 28, 2014 The Trust for Public Land acquired the 30 acre Lindstrom peninsula and immediately conveyed it to the City of Lindstrom. This 30 acre peninsula will be added to the adjacent 64 acre Allemensratt Natural Area that the City acquired several years ago with partial ENRTF funding. The peninsula contains approximately 5,600 feet of sensitive shoreline and has been added to the existing natural area to be managed as part of the City's park program. This property provides excellent wildlife habitat, water quality benefits and public access in a high growth area. The Trust for Public Land used $423,000 of its M.L. 2011 MeCC acquisition funding and all of its M.L. 2013 MeCC acquisition funding ($395,000) with $82,000 from the City of Lindstrom to purchase the land.

PROJECT RESULTS USE AND DISSEMINATION
The Trust for Public Land disseminates information on the TPL website, www.tpl.org, broadcasts emails to Embrace Open Space (EOS) and TPL list serve members, distributes press releases, and includes information in TPL's newsletters and publications as appropriate.

The Columbus Lake Conservation Area is highlighted in The Trust for Public Land's website at:
http://www.tpl.org/our-work/land-and-water/columbus-lake-conservation-area.

Anoka County, with assistance from The Trust for Public Land, developed a press release that resulted in

several newspaper articles about the Columbus Lake Conservation Area/Rice Creek Headwaters project. Links are below.

- http://abcnewspapers.com/2013/01/15/land-protected-for-conservation-in-eastern-anoka-county/
- http://forestlaketimes.com/2013/01/09/anoka-county-adds-350-acres-for-conservation/
- http://www.presspubs.com/quad/news/article_474e24ae-64db-11e2-8700-0019bb2963f4.html
- http://www.startribune.com/local/north/186635221.html

The Lindstrom project is highlighted on The Trust for Public Land's website at: https://www.tpl.org/our-work/our-land-and-water/allemansratt-wilderness-park. The following information has been published about the Lindstrom site:

- http://www.chisagocountypress.com/main.asp?SectionID=1&SubSectionID=1&ArticleID=19566
- http://www.chisagocountypress.com/main.asp?SectionID=1&SubSectionID=1&ArticleID=19627

Project completed: 6/30/2015

3.2 FINAL REPORT - MeCC VI - Protect Significant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($400,000)

Project Outcome and Results

During the sixth phase of the Metro Corridors project, the Minnesota Land Trust worked with landowners throughout the Twin Cities metropolitan area to permanently protect important lands and Minnesota's remaining natural areas. Three perpetual conservation easements were completed that collectively protected 317 acres of land and more than 4,300 feet of shoreline, exceeding the grant obligations by 167 acres. Two easements were purchased, both as bargain sales; one easement was donated. All three projects were unique opportunities to protect high quality natural habitat and riparian areas. These projects include:

- Sunrise Lake (Chisago County): A 79-acre property of mixed hardwood and conifer forest, wetland, grassland and agricultural field in close proximity to Carlos Avery WMA.
- Tennyson Lake (Isanti County): A 158-acre property of wetlands, mixed hardwood and pine forest, open water, grasslands, and agricultural land, with 4,375 feet of undeveloped shoreline on Tennyson Lake and Spencer Brook.
- Rush River (Sibley County): A 79-acre property of open fields, wooded blufflands, sloping ravines, and lowland forest lying adjacent to the Minnesota River and Rush River County Park.

Baseline property reports were prepared for each easement, detailing the condition of the property for future monitoring and enforcement. LCCMR provided $55,000 in grant funds to the Land Trust's dedicated Stewardship and Enforcement Fund for this required perpetual obligation. $45,000 was for the three new projects under this phase of the Metro Corridors project, while $10,500 was for an easement project from the previous phase of the Metro Corridors project. The Land Trust will report to LCCMR annually on both the status of the Stewardship and Enforcement Fund and the easements acquired with funds through this grant.

Total appraised value for the two purchased easements was $267,000, with the grant providing $209,080; donated value of these bargain sales was $57,920. No appraisal was completed for the donated easement. The cost to the State of Minnesota to complete these projects was $801 per acre. Cumulatively, across all phases of the Metro Corridors program, the Land Trust has protected 3,989 acres of critical habitat and 80,000 feet of shoreline, at a cost to the State of $453 per acre. The Land Trust's work on this project demonstrates the continued cost effectiveness of using conservation easements to protect natural and scenic resources within developed and developing areas, as the cost to the State was well below the cost to purchase land in the Twin Cities region.

PROJECT RESULTS USE AND DISSEMINATION
The Land Trust continued to gain more experience with conservation easements, easement management, and issues unique to protecting land in a metropolitan area. This experience and information was shared with our partner organizations, other easement holders, local communities, and policy makers. The Land Trust also disseminated information about the specific land protection projects completed under this grant though our newsletter, annual report (4,200 pieces), web site, and press releases. Additionally, the MeCC Partnership maintains an interactive public web map that shows the locations of MeCC projects over time. This web map can be accessed at: www.dnr.state.mn.us/maps/MeCC/mapper.html

Project completed: 6/30/2015

Restoration Strategies for Ditched Peatland and Scientific and Natural Areas
Subd. 04q $200,000 TF

Michele Walker
MN DNR
2115 Birchmont Beach Rd NE
Bemidji, MN 56601

Phone: (218) 308-2664
Email: michele.walker@state.mn.us
Web: http://www.dnr.state.mn.us/snas/coniferous_peatlands.html

RESEARCH

Appropriation Language
$100,000 the first year and $100,000 the second year are from the trust fund to the commissioner of natural resources to evaluate the hydrology and habitat of the Winter Road Lake peatland watershed protection area to determine the effects of ditch abandonment and examine the potential for restoration of patterned peatlands. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Thirty-seven percent of the naturally stored carbon in Minnesota occurs in a unique ecosystem type called peatlands that covers only 10% of the state. Peatlands form where water levels are near the surface and drainage is poor, which slows decomposition of plant debris and results in an accumulation of these organic materials in a partially decomposed mass called peat. Peatland ecology is largely governed by the water flowing through them and disruption of this flow can have profound impacts on the accumulation of peat, landforms, and vegetation. One peatland located in Lake of the Woods and Roseau counties, the Winter Road Lake Peatland, experienced such disruption in the early 1900's when a failed attempt to drain the lands for agriculture left behind numerous drainage ditches. The Minnesota Department of Natural Resources is using this appropriation to evaluate the effects of this ditching on peatland hydrology and habitat in order to understand options for peatland restoration and possibly create potential for wetland banking credits. Findings will be used to guide restoration strategies for peatlands throughout the state.

OVERALL PROJECT OUTCOME AND RESULTS

groundwater and surface water. The Winter Road Peatland Scientific and Natural Area (SNA) is one such peatland. Ditches installed in the early 1900's increased the water flow through this system and altered the peat and the vegetative habitat. The current effect of the ditches was evaluated by monitoring the peatland hydrology (groundwater and surface water) and vegetative habitat over three years at four different sites within the most visually impacted and accessible part of the peatland. In addition, the work was conducted to determine if ditch abandonment will improve the ecological health of this patterned peatland.

The monitoring network consisted of 8 surface water monitoring sites and 39 monitoring wells at 4 sites; A, B, C and D. Vegetation monitoring consisted of 19 releve sites and 8 vegetative transects co-located with the groundwater monitoring sites.

Hydrologic data showed that the ditches were removing water from the peatland and that water was removed faster when water levels were low. In addition, the digging of the ditch created a ditch spoil pile/berm on one side that now acts as a dam to groundwater flow, primarily when placed perpendicular to groundwater flow. This is probably due to the compaction of the peat beneath the berm. Peat sampling also showed that the peat is more decomposed next to the ditches. This is due to the lower water levels next to the ditch allowing the peat to dry out and decompose.

The vegetation data identified 106 different species and showed that within 30 meters of the ditch, the wetland condition is of poorer quality. After 30 meters, vegetation rebounds to more normal wetland conditions with minimal impacts at 100 meters away. The poorer quality wetland near the ditch occurs because the spoil piles raise the ground surface and allow lower quality wetland species to establish. It also is a result of the peat decomposing and drying out near the ditch.

The Natural Resources Research Institute evaluated the data from the monitoring and recommended that a limited approach to restoration be conducted at this time, after evaluation of other restoration sites in progress in the State. Site A should be restored first because it is more remote and will have limited upstream effects. Site A is located in the NNW section of the peatland and within a small lateral ditch just outside of the SNA but within the SNA watershed protection area. Restoration should begin by removing vegetation from the spoil/berm. Ditch blocks should be installed to stop flow from this ditch with subsequent partial removal of the spoil/berm. Continued monitoring is necessary to evaluate the effectiveness of this restoration. Restoration would reduce the risk of invasive species establishment near ditches, provide water-quality improvement, flood attenuation, and increase recreational opportunities.

PROJECT RESULTS USE AND DISSEMINATION

Project results will be primarily used to guide restoration of the peatland scientific and natural area as priorities allow. The data will also be used by wetland managers to define negative impact thresholds for wetlands affected by high capacity pumping.

The intention is to publish the data, give presentations to local government units and work with the regional information officer to disseminate the information to the community. The information from this report will be available on the DNR website at:
http://www.dnr.state.mn.us/waters/groundwater_section/publications/restoration_strategies_ditched_peatland_sna.pdf.

Copies of the report have been or will be made available to all the interested parties and land owners including MN DNR (Wildlife and Scientific and Natural Areas), Red Lake Nation, MN Board of Water and Soil Resources, Lake of the Woods County Environmental Director and the U.S. Army Corps of Engineers.

Project completed: 6/30/2015

FINAL REPORT

Subd. 06 Aquatic and Terrestrial Invasive Species

Improved Detection of Harmful Microbes in Ballast Water
Subd. 06a $250,000 TF

Randall Hicks
U of MN - Duluth
1035 Kirby Dr, SSB 207
Duluth, MN 55812

Phone: (218) 726-8438
Email: rhicks@d.umn.edu

RESEARCH

Appropriation Language
$125,000 the first year and $125,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota for the University of Minnesota Duluth to identify and analyze potentially harmful bacteria transported into Lake Superior through ship ballast water discharge. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Ballast water - water carried in tanks on ships to help provide stability and aid steering - is likely the single greatest source for introduction of non-native and invasive aquatic species. Ballast water is collected in one body of water and discharged into another body of water, usually large distances apart. The recent appearance of a deadly fish virus called Viral Hemorrhagic Septicemia (VHS) in the Great Lakes has raised awareness that some bacteria being transported in ballast water, just like certain plant and animal species, also have the potential to be harmful invasive species. Nevertheless, little is actually currently known about what bacteria are being transported and what can be done to prevent their spread. Biologists at the University of Minnesota - Duluth are using this appropriation to identify and analyze bacteria being transported in ballast water in order to determine which are of greatest concern and to inform strategies for early detection and spread prevention.

OVERALL PROJECT OUTCOME AND RESULTS
While the Great Lakes face many threats, the presence of large and small invasive species threatens natural resources, people, and coastal economies. The objective of this project was to identify and evaluate the relative risk of potentially harmful bacterial groups and genes found in commercial ship ballast water that is discharged into the Duluth-Superior Harbor (DSH). Our ultimate goal was to establish a road map that can help direct future work towards higher risk ballast water microbial issues.

To accomplish this goal, ballast water was collected from 16 commercial ships that ply the Great Lakes (i.e., "lakers") containing freshwater ballast water, 10 ocean-going ships (i.e., "salties") containing freshwater ballast water and 2 "salties" containing seawater ballast water in 2011 and 2012. Although there are nearly 1,000 vessel visits per year to this harbor, we collected almost three times as many ballast water samples as expected to create one of the largest repositories of ballast water microbial samples in the Great Lakes.

DNA from portions of these samples was extracted to identify different bacterial taxa while the remaining portions were frozen on membrane filters and stored as a sample repository for future studies. More than 170,000 partial bacterial 16S rDNA sequences were obtained for each sample. All sequence data were screened against two lists of bacterial genera that contain pathogenic bacterial strains. One list contained 20 genera of bacteria that include strains pathogenic to fish or wildlife, and the second list contained 57 genera of bacteria that are potentially pathogenic to humans. DNA from 15 of the 20 bacterial genera harboring fish or wildlife pathogens was detected in at least one ballast water sample. DNA from 37 of 57 bacterial genera that include human pathogens was detected in at least one ballast or harbor water sample. DNA sequences from a few of these bacterial taxa were often more common than DNA sequences from traditional indicator bacteria used for monitoring microbiological water safety.

Two genera containing bacterial strains pathogenic to fish and wildlife (i.e., Tenacibaculum, Piscirickettsia) and one genus containing a human pathogen (i.e., Plesiomonas) were evaluated further because all species within those genera were pathogenic indicating an elevated possibility of introducing a pathogen into the DSH environment. An example of this elevated risk is the bacterium Piscirickettsia, which causes "muskie pox" disease in muskellunge. DNA from this bacterium was found in 25% of the ships sampled, including ships transporting ballast water from Lake St. Clair where Piscirickettsia was found in dead muskellunge during a 2006 fish kill. It was interesting that DNA from Renibacterium species, the causative agent of bacterial kidney disease (BKD) in fish throughout the Great Lakes was not detected in any ballast water sample. Similarly, no DNA sequences related to the ecologically harmful cyanobacerial genera Anabaena and Microcystis were detected in any ballast water or harbor water sample.

Microbes in ballast water may also modify native microbial populations by transferring genes for resistance the effects of antibiotics or the toxic effects of heavy metals. Six unique fosmid libraries containing bacterial metagenomic DNA were created for ship ballast water from Burns Harbor, IN, Hamilton, Ont., Cleveland OH, Detroit, MI and the Atlantic Ocean, and for Duluth-Superior Harbor water. Each fosmid library was screened for resistance to benzylpenicillin, cefotaxime and levofloxacin antibiotics and heavy metals, including cadmium, mercury, and zinc. Ballast water received from ports in larger, more densely populated cities (e.g., Cleveland, OH and Detroit, MI) usually had a larger proportions of microbial antibiotic and heavy metal resistance genes. Receiving ballast water form these harbors should cause greater concern for the spread of these genes to the Duluth-Superior Harbor than receiving ballast water from smaller metropolitan areas (e.g., Burns Harbor, IN). The information generated by this study provided the first step toward assessing the risks and potential impacts of microbial invasions in the Duluth-Superior Harbor and points to directions that warrant further research to develop methods to forecast future invasions.

PROJECT RESULTS USE AND DISSEMINATION

Information discovered by this project was disseminated in several ways. Preliminary results of this research were presented to the Duluth Harbor Technical Advisory Committee (HTAC), middle school

teachers and students, Lake Superior Chapter of Muskies, Inc., and discussed with executives of the Lake Carriers' Association and the Great Lakes Maritime Research Institute. Ten research presentations were given to scientists at four regional and national scientific conferences, a Twin Ports Freshwater Folk meeting, and the U.S. EPA Mid-Continent Ecology Division in Duluth. Participants in the project also organized a scientific session on "Tools for Predicting and Managing Current and Future Invasions of Potentially Harmful Species in the Great Lakes" at the 2013 International Association of Great Lakes conference. DNA data housed at the University of Minnesota will be uploaded into national databases for searching and retrieval. This project provided training for a graduate student seeking a M.S. degree and a postdoctoral investigator. A M.S thesis and two scientific publications are being prepared from the results of this research.

Project completed: 6/30/2015 [Extended in M.L. 2014, Chapter 226]

FINAL REPORT (PDF)

Evaluation of Switchgrass as Biofuel Crop
Subd. 06c $120,000 TF

Jim Eckberg
Central Lakes College
1830 Airport Rd
Staples, MN 56479

Phone: (612) 490-5050
Email: jeckberg@umn.edu

RESEARCH

Appropriation Language
$60,000 the first year and $60,000 the second year are from the trust fund to the Minnesota State Colleges and Universities System for Central Lakes College in cooperation with the University of Minnesota to determine the invasion risk of selectively bred native grasses for biofuel production and develop strategies to minimize the invasion potential and impacts on biodiversity. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Bioenergy, a form of renewable energy derived from biological sources such as wood or grasses, is becoming an important component of the energy production mix. Native switchgrass is a species that has shown potential as a biofuel crop and efforts have been underway to selectively breed and hybridize it for maximize yield. However, these selectively bred switchgrass varieties also show some potential to be invasive and crowd out native biodiversity, resulting in significant ecological and economic impacts. Scientists at Central Lakes College and the University of Minnesota are using this appropriation to evaluate the invasion risk of selectively bred switchgrass varieties and develop strategies to minimize the invasion potential and impacts on biodiversity. Findings will help support long-term biofuel sustainability.

OVERALL PROJECT OUTCOME AND RESULTS
There is concern that native switchgrass bred for bioenergy may become invasive in Minnesota prairies.

This project showed that selecting switchgrass for larger size (biomass) can increase it competitive ability and exacerbate it impacts on other native prairie plants. Switchgrass populations with large seed were more vigorous and produced more biomass leading to larger impacts on prairie diversity. Breeding for small seed size and/or less seed set could mitigate negative effects on prairies. There was a direct tradeoff between biomass production and diversity in a restored prairie, greater biomass was associated with less prairie diversity. Biofuels from switchgrass should use small seeded switchgrass populations to balance production versus diversity goals of prairies. Finally, we determined that poplar buffers can reduce switchgrass biomass 69% and could serve as a management tool in limiting the spread of switchgrass biofuel cultivars.

We conducted 10 experiments in total. In a restored prairie (Ag and Energy Center in Staples, MN) we established 176 1 m2 plots of cultivar and wild switchgrass populations (13 total populations) and monitored them for two or three years. We tested the impacts of switchgrass cultivars in a native prairie at Cedar Creek Ecosystem Science Reserve from 2012-2014 (241 0.64 m2 plots) and 2013-2014 (244 1 m2 plots). Supporting the field studies was a growth chamber test of germination of 12 wild and cultivar populations as well as a greenhouse study testing switchgrass cultivars effects on two native grasses. We also tested poplar buffers and mowing in managing switchgrass from 2012-2014 at the Ag and Energy Center.

Information from this project is being used to inform breeding strategies for reduced invasion risk. We are working with a switchgrass breeder and switchgrass germplasm from our project was re-incorporated into a national breeding program to support the development of cultivars with potentially less invasion risk. Results from this project will support the development of sustainable bioenergy systems in Minnesota that balance biodiversity and production.

PROJECT RESULTS USE AND DISSEMINATION
We have presented results from this project for diverse audiences of ecologists, agronomists and conservations including two presentations at the national Ecological Society of America conference (2012, 2013), three presentations for undergraduate interns at Cedar Creek Ecosystem Science Reserve (2012, 2013, 2014), poster presentations for switchgrass breeders and agronomists at the national conference "Switchgrass II" (2013) and Pioneer seed company symposium (2015), and a webinar for the Minnesota DNR - Conservation Science Chat Series (2015).

To date we have published one peer-reviewed paper in Crop Science "Switchgrass population and cold-moist stratification mediate germination" and a second paper is in later stages of revision "Competitive interactions of cultivar and wild switchgrass with native grasses" and will be submitted to Invasive Plant Science and Management. Two additional peer-reviewed papers will be produced from this project.

Project completed: 6/30/2015

FINAL REPORT

Subd. 08 Environmental Education

Minnesota Junior Master Naturalist Program
Subd. 08b $365,000 TF

Robert Blair
U of MN
1980 Folwell Ave., #200
Saint Paul, MN 55108

Phone: (651) 644-1591
Email: blairrb@umn.edu
Web: http://minnesotamasternaturalist.org/

Appropriation Language
$365,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to expand the junior naturalist after-school programs. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Children are spending increasingly less time outdoors and are often failing to develop an appreciation and connection with nature. This has implications for children's health as well as their knowledge about science, the environment, and the world. In the long term this also impacts the broad public awareness and understanding necessary to ensure long-term protection and stewardship of our environment and natural resources. In order to help reverse this trend the University of Minnesota and the Minnesota Department of Natural Resources are partnering to expand and further develop an after-school program that provides outdoor, science-based educational opportunities for fourth and fifth grade students, particularly in underserved areas, to learn about the ecology and natural history of their schoolyards, neighborhoods, nearby natural areas, and the state.

OVERALL PROJECT OUTCOME AND RESULTS
The Minnesota Master Naturalist Explorers program was created to address the problem that children are spending increasingly less time outside and, consequently, know less about their environment and world. It responded to the needs identified in the 2009 Outdoor Education Legislative Report to increase outdoor learning opportunities for children.

The program connected Master Naturalist volunteers with elementary youth in after-school programs to provide hands-on, outdoor activities. The volunteers were recruited by advertising on the Master Naturalist blog and website. Their training took place in 6-hour workshops that covered techniques for working with youth outdoors and in the use of the Explorers' curricula. The curricula are based on the phenology of fall, winter, and spring. Volunteers were provided with the curricula, nature journals, backpacks, pencils, and nametags. They also received supplemental materials to help implement the program including directions for locating a host site, lesson plan aids, and additional worksheets for youth participants. These materials are available at www.minnesotamasternaturalist.org/juniornaturalist.

The Master Naturalist Explorers programs met for 4-8 weeks each, once a week. Each session lasted from one to two hours. Over the course of the program, 90 Master Naturalist volunteers were trained, 29 volunteers led programs at 33 sites across the state, and 482 youth participated.

Several pilot Explorers programs, which were focused on high-needs urban schools offering numerous after-school programs, were cancelled due to low enrollment. Subsequent enrollment efforts were

more successful in schools that had less-developed after-school programs as well as at schools in rural portions of the state.

Many Master Naturalist volunteers who went through Explorers training did not lead multi-week Explorers programs, but reported using the knowledge and curriculum for other activities including church, Scout, and community education programs. Additionally, the volunteers were more likely to lead Explorers programs that were shorter in duration (e.g. 4 weeks).

Project completed: 6/30/2015

FINAL REPORT

Subd. 09 Emerging Issues

Back to top of page

Minnesota Conservation Apprentice Academy
Subd. 09a $200,000 TF

Jenny Gieseke
Board of Water and Soil Resources
520 Lafayette Rd N
St. Paul, MN 55155

Phone: (507) 381-3131
Email: jenny.gieseke@state.mn.us
Web: http://www.bwsr.state.mn.us

Appropriation Language
$100,000 the first year and $100,000 the second year are from the trust fund to the Board of Water and Soil Resources in cooperation with Conservation Corps Minnesota to train and mentor future conservation professionals by providing apprenticeship service opportunities to soil and water conservation districts. This appropriation is available until June 30, 2014, by which time the project must be completed and the final products delivered.

PROJECT OVERVIEW
Many of the most experienced conservation practitioners at local soil and water conservation districts throughout the state are nearing retirement, and with their departure will go much of their practical, on-the-ground knowledge, experience, and skills. Meanwhile, college students seeking to be the next generation of conservation practitioners have knowledge of emerging technologies and other innovations that can improve and contribute to current conservation efforts. Through this appropriation the Minnesota Board of Soil and Water Resources will work with the Minnesota Conservation Corps to continue an effort that places students in apprenticeship positions with county soil and water conservation district offices throughout the state. This unique program provides an opportunity for interns to gain valuable in-the-field experience from current practitioners while sharing their knowledge with those practitioners about the newest ideas and solutions for meeting today's natural resource challenges.

OVERALL PROJECT OUTCOME AND RESULTS

Familiarizing future conservation leaders with Minnesota's various land-use practices, water and soil resources, plant and animal habitats, and landowner concerns is needed to maintain the capacity of local organizations to deliver conservation on the ground. Many of the conservation districts' most experienced conservation professionals and practitioners are nearing retirement age but due to budget constraints will not be replaced until they have left employment. Consequently, Minnesota is missing a great opportunity to transfer professional knowledge and experience to the next generation.

While university graduates with conservation-related degrees are knowledgeable in technology, theory, and research methods, their practical, on-the-ground skills need development. Communicating with landowners and adjusting designs for field nuances are vital to the success of conservation projects and best learned alongside seasoned professionals. In turn, apprentices bring knowledge of emerging technologies to improve the quality and productivity of conservation efforts.

This program funded the placement of 35 conservation apprentices in 33 Soil and Water Conservation Districts (SWCD) in 2013, and 37 conservation apprentices in 35 SWCDs in 2014. During this time, the apprentices stabilized erosion on 7.1 million square feet of slopes, planted 69,252 plants, trees, shrubs and seedlings, maintained 3.6 million square feet of restored areas, collected 5,514 water samples, spent 4,272 collecting data and mapping using GPS and GIS, and impacted 2,142 people through environmental education and outreach.

This program has benefits to both students and conservation districts. 96% of apprentices indicated they felt more prepared to work in the conservation industry as a result of the program and would recommend it to others. 96% of the Districts were satisfied with the work their apprentices completed, and 98% indicate they would participate in the program again. Managers also indicated that the work conducted by the apprentices increased the amount of conservation practices delivered by their districts during the program period.

This was the second grant awarded to the Apprentice Academy through LCCMR. Grant one addressed the cohorts working during the summers of 2011 and 2012. The state government shutdown of 2011 produced a small balance in the 2010 grant that was used to fund additional positions in 2012 and 2013; this in turn allowed a small balance in this, the 2011 grant to fund additional positions in the M.L. 2013, Chp. 52, Sec. 2, Subd. 07a plan, and carried funding into the early portion of 2014.

PROJECT RESULTS USE AND DISSEMINATION

Information from the project has been disseminated through reports to LCCMR, press releases by BWSR and the Governor's Office, local press releases by SWCDs, and through the Conservation Corps newsletter, website and annual report. Information was used to recruit apprentices and increase awareness of the project.

Communication and outreach activities include the aforementioned reports, press releases, and electronic newsletters. Additionally, BWSR and Conservation Corps staff conducted outreach to SWCDs to find optimal matches between districts and apprentices. Through the course of their work, the apprentices conducted significant outreach to land owners and residents in topics ranging from easement protection, to water quality education, to plant biodiversity.

Project completed: 6/30/2015

FINAL REPORT

5. M.L. 2010 Projects Completed
January 15, 2015 – January 15, 2017

MN Laws 2010, Chapter 362, Section 2

M.L. 2010 Projects Completed in 2015-2016

MN Laws 2010, Chapter 362, Section 2 (beginning July 1, 2010)

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

The following documents are short abstracts for projects funded during the 2010 Legislative Session. The final date of completion for these projects is listed at the end of the abstract. When available, we have provided links to a project's web site. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

Subd. 05	**Water Resources**
Subd. 05d	**Agriculture and Urban Runoff Water Quality Treatment Analysis**

Agricultural and Urban Runoff Water Quality Treatment Analysis
Subd. 05d $485,000

Craig Austinson
Blue Earth County Drainage Authority
410 Jackson Street
Mankato, MN 56001

Phone: (507) 304-4253
Email: Craig.Austinson@blueearthcountymn.gov
Web: http://www.co.blue-earth.mn.us/

Appropriation Language
$485,000 is from the trust fund to the Board of Water and Soil Resources for an agreement with the Blue Earth County Drainage Authority to reduce soil erosion, peak water flows, and nutrient loading through a demonstration model evaluating storage and treatment options in drainage systems in order to improve water quality. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Rising crop prices and the deterioration of old, existing agricultural drainage systems have led to increased demand for new and improved drainage systems. As these new drainage systems are constructed there is a unique and valuable opportunity to implement a fundamental shift in the way drainage systems interact with the landscape by integrating conservation practices that balance with agricultural economics considerations. The Blue Earth County Drainage Authority is using this appropriation to demonstrate a community-based water quality and treatment system in which landowners, local government, and state agencies will collaboratively implement an approach to drainage systems that improves water quality and wildlife habitat while replacing outdated drainage systems. This approach has the potential to be a model for future drainage projects across the state.

OVERALL PROJECT OUTCOME AND RESULTS
This project provided proof to landowners and agencies that conditions for agricultural production were

enhanced and water quality was improved by implementing a combination of Best Management Practices on Blue Earth County Ditch No. 57 (CD57) in the Mapleton area of south central Minnesota. These results surpassed expectations and overwhelmingly proved that water quality was improved by reducing sediment and nutrient loading throughout the system. Water storage and drainage capacity were increased, which reduced flooding and improved field conditions for crop yields.

A combination of BMPs included two water storage basins, buffer strips, two-stage ditch, and a rate control weir. The two storage basins significantly increased storage capacity, with the Klein Pond providing 26.3 acre-feet of storage and the City Pond providing 23 acre-feet. Peak flow rates were reduced with reductions ranging from 10% to 50% at Klein Pond and the rate control weir averaging 6% in reduction for monitored rain events.

Water quality results show dramatic improvements for Total Suspended Solids, Total Phosphorus and Nitrates. Reductions for each pollutant ranged between 15% and 50% for the Klein Pond, averaging nearly 25%. The two-stage ditch and rate control weir had reductions between 2% and 10%, averaging nearly 5%. The Klein Pond was most effective at removing trapped sediments: 230,000 pounds of sediment, 415 pounds of phosphorus, and 23,000 pounds of nitrogen. Of the three BMPs monitored, results showed they removed a total of 251,000 pounds of sediment, equivalent to nearly 75 dump truck loads. Unexpected baseflow water quality improvements include reductions in TSS by more than 33% and TP concentrations reduced by more than 16%. Baseflow water quality also improved and increased habitat for wildlife. This project had a significant improvement in water quality and makes the CD 57 system a thriving place for a variety of species to live.

PROJECT RESULTS USE AND DISSEMINATION

The information from this project has been shared and disseminated in a variety of ways, including the following:

1. Event and Tour: Agricultural Drainage & the Future of Water Quality Workshop 2012
2. Event and Tour: Agricultural Drainage & the Future of Water Quality Workshop 2014 (165 in attendance)
3. Event: Agricultural Drainage & the Future of Water Quality Workshop 2015 (175 in attendance)
4. Multiple Site Visits: Blue Earth County, Minnesota Department of Agriculture, ISG and interested parties
5. Website: http://www.is-grp.com/ag
6. Presentations: By Chuck Brandel and/or Craig Austinson
    - Minnesota State University Mankato, Department of Civil Engineering (2010)
    - American Society of Civil Engineers (2011)
    - Faribault County Drainage Authority (2013)
    - Minnesota Water Resources Conference (2015)
    - Iowa Water Conference (2014)
    - Blue Earth County Soil and Water Conservation District (2014)
    - County Drainage Authority (2015)
    - Article: Conservation Drainage article, DIRT Magazine (Gislason and Hunter Law Firm publication)
7. CD 57 Fun Facts Brochure: Distributed at various events and activities
8. Final Report: Summarizes the entire CD 57 project
9. Water Quality Report: Quantitative data and methods used in the water quality analysis and all results

Project Publications:

- Mapleton Area Agricultural & Urban Runoff Analysis - Final Analysis (PDF - 48.6 MB)
- Mapleton Area Agricultural & Urban Runoff Analysis - Water Quality Report (PDF - 41.7 MB)

FINAL REPORT

Project completed: 06/30/2015

Subd. 06	**Aquatic and Terrestrial Invasive Species**
Subd. 06b	**Ecological and Hydrological Impacts of Emerald Ash Borer**

Ecological and Hydrological Impacts of Emerald Ash Borer
Subd. 06b $636,000

Anthony D'Amato
U of MN
1530 Cleveland Avenue N
St. Paul, MN 55108

Phone: (612) 625-3733
Email: damato@umn.edu
Fax: (612) 625-5212
Web: http://silviculture.forestry.umn.edu/index.htm

RESEARCH

Appropriation Language
$636,000 is from the trust fund to the Board of Regents of the University of Minnesota to assess the potential impacts of emerald ash borer on Minnesota's black ash forests and quantify potential impacts on native forest vegetation, invasive species spread, and hydrology. This appropriation is available until June 30, 2015, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The Emerald Ash Borer is an invasive insect that has been decimating ash trees throughout the Great Lake states and is currently advancing into Minnesota, where it threatens ash forests that occur across much of the state. Of particular concern is the impact Emerald Ash Borer will have on the ecology and functioning of black ash swamps, which cover over one million acres in Minnesota and represent the state's most common ash forest type. Scientists at the University of Minnesota's Department of Forest Resources are using this appropriation to conduct a five year study that will assess the likelihood of this invasive insect extending into the black ash forests in the northern part of Minnesota and its potential impact on these marshy forest areas. Findings will inform management recommendations for mitigating the potential impacts of Emerald Ash Borer.

OVERALL PROJECT OUTCOME AND RESULTS
The Emerald Ash Borer (EAB) has been decimating ash throughout the Lake States and is currently threatening the future of the ash forests that occur across much of Minnesota. Of particular concern is

the impact of EAB on black ash swamps, which cover over one million acres. This project was designed to increase our understanding of the impacts of EAB through the establishment of a network of research sites in black ash forests. Treatments simulating EAB-induced mortality (all trees girdled in 4-acre areas) and associated management responses (i.e., clearcutting and group selection harvests) were implemented at eight, large-scale (20 acre) research sites on the Chippewa National Forest. Each treatment included two levels of planting (planting or no planting) to evaluate the potential for planting non-host species to increase the resilience of these areas to EAB. Planted seedlings included American elm, white cedar, yellow birch, tamarack, and swamp white oak. Results from this project indicate that loss of black ash will have significant impacts on the hydrology of these areas with clearcut and girdled (EAB mortality) plots experiencing flooded conditions that extended six to eight weeks longer than other areas. Estimates of black ash's contribution to the water budget indicate it accounts for 40-80% of total evapotranspiration, reinforcing the important role it plays in ash swamp hydrology. Three-year survival of planted seedlings also reflect its hydrologic influence, with lowest overall survival rates in clearcuts due to flooded, marsh-like conditions in these areas. Swamp white oak, hackberry, and American elm had the greatest survival rates of planted species (>80% in non-clearcut areas) with the lowest rates observed for black spruce, northern white cedar, and tamarack (<20%). Collectively, these results underscore the importance of maintaining black ash canopies in these areas to increase the success of plantings aimed at reducing vulnerability to EAB.

PROJECT RESULTS USE AND DISSEMINATION

The results of this project have been shared on numerous occasions with resource professionals, policy makers, citizens, and scientists over the past five years in efforts to inform forest conservation decisions regarding the impacts of emerald ash borer on black ash forests in Minnesota. These dissemination activities have included the development of a fact sheet for LCCMR members that was distributed on the LCCMR tour of Itasca State Park on July 18, 2013. In addition, we have shared the results from this project with private forest landowners, and county, state, tribal and federal natural resource managers on multiple occasions, including at the Aitkin County Land Department Ash Workshop on March 9, 2012, Forest Health Workshop in Walker, MN on February 12, 2013, and North Central Forest Pest Workshop in Frontenac, MN on September 24, 2013. We organized and led a Black Ash Field Day at our research sites on August 21, 2013 for 38 field foresters, loggers, and landowners and also included several stops at our research sites as part of a Climate-Informed Forest Management field tour of the Chippewa National Forest on May 8, 2014 for 100 participants. We have developed a "silviculture case study" of the five-year results of this project that will posted online on the "Great Lakes Silviculture Prescription Library" website this fall. Result of the project have also been presented at the Midwest-Great Lakes Society for Ecological Restoration Chapter Meeting in St. Paul, MN on March 28, 2014, Midwest Invasive Species Conference in Duluth, MN on October 22, 2014, Black Ash Symposium in Orono, ME on November 4, 2014, and Sustainable Forests Education Cooperative Wildlife and Forest Research Review in Cloquet, MN on February 24, 2015. Finally, the project PI has served on the Minnesota DNR black ash management guideline committee since the inception of this project and has shared project results to influence the current recommendations for managing MN black ash forests in the face of EAB. Publications resulting from this work are available for download from the Department of Forest Resources web site (www.forestry.umn.edu). Additional publications from this work that are currently in development will also be posted on this site and shared with LCCMR staff for dissemination.

FINAL REPORT

Project completed: 6/30/2015

6. M.L. 2005 Projects Completed
January 15, 2015 – January 15, 2017

MN Laws 2005, First Special Session, Chapter 1, Article 2, Section 11

M.L. 2005 Projects Completed in 2015-2016

MN Laws 2005, First Special Session, Chapter 1, Article 2, Section 11 (beginning July 1, 2005)

NOTE: If a project has been completed the Final Report has been posted under the project descriptions here. For projects still underway, contact us to obtain the most up-to-date work programs (project updates are required twice each year).

The following documents are short abstracts for projects funded during the 2006-2007 biennium. The final date of completion for these projects is listed at the end of the abstract. When available, we have provided links to a projects web site. The sites linked to this page are not created, maintained, or endorsed by the LCMR/LCCMR office or the Minnesota Legislature.

Subd. 06	**Recreation**
Subd. 06m	**Mesabi Trail**

Mesabi Trail
Subd. 06m $1,000,000

Bob Manzoline
St. Louis/Lake Counties Reg. Railroad Authority
801 SE Hwy 169, suite #4
Chisholm, MN 55719

Phone: (218) 254-2575
Email: bob.manzoline@ironworld.com
Fax: (218) 254-7972

Overall Project Outcome and Results:
The Mesabi Trail Master Plan, drafted in year 1992, was a collaborative effort by the St. Louis & Lake Counties Regional Railroad Authority and Itasca County, hereafter referred to as "Rail Authority", to develop a multi-use trail from Grand Rapids to Ely. The trail length was planned to be 132 miles long, 10-14 foot wide bituminous surface and located or aligned to emphasize the scenic, environmental, educational, and historic aspects of the region. The Master Plan identified the utilization of abandon railways, logging roads, mining roads, highways, and trails with four major trailheads built in Grand Rapids, Hibbing, Virginia, and Ely.

A trail "Citizens Advisory Group" was formed to support the Mesabi Trail whom secured 2,000 signed pledge cards and held an event on July 23, 1994 that attracted 7,000 people to a day of family activities, events, and music. The year 2005 ENRTF appropriation was used for the development and construction of several 10' wide, bituminous surfaced trail segments totaling 32 miles in length. Federal, State & Local funds were also used to construct these segments as seen within the "Results" section of this report. Funds were used on all facets of trail development including environmental, cultural resource, land acquisition, engineering and construction work.

Trail segments funded with this appropriation include trail within Vermillion State Park, 6 miles in length; and Vermillion State Park to Bearhead Road, 3.5 miles in length; and Scenic Highway 7 to

Marble, 2 miles in length; and McKinley to Biwabik, 5.5 miles in length; and Giants Ridge to Embarrass, 5 miles in length; and Eveleth to Fayal, 2.5 miles in length.

FINAL REPORT

Project completed: 01/15/2015

- Spreadsheet of all research projects completed between January 1, 2015 and December 31, 2016.

Environment and Natural Resources Trust Fund (ENRTF)

Research Projects completed between January 1, 2015 and December 31, 2016

Full abstracts are included in Section III. Completed Research Projects

Appropriation Year	Subdivision	Title	Organization	Project Ending	Funding Amount	Project Manager
Research Projects completed by June 30, 2015						
MN Laws 2010, Chapter 362, Section 2						
M.L. 2010	06b	Ecological and Hydrological Impacts of Emerald Ash Borer	U of MN	6/30/2015	$ 636,000	D'Amato
MN Laws 2011, 1st Special Session, Chapter 2, Article 3, Section 2						
M.L. 2011	03f	Determining Causes of Mortality in Moose Populations	MN DNR	6/30/2015	$ 600,000	Carstensen
M.L. 2011	04q	Restoration Strategies for Ditched Peatland and Scientific and Natural Areas	MN DNR	6/30/2015	$ 200,000	Walker
M.L. 2011	06a	Improved Detection of Harmful Microbes in Ballast Water	U of MN - Duluth	6/30/2015	$ 250,000	Hicks
M.L. 2011	06c	Evaluation of Switchgrass as Biofuel Crop	Central Lakes College	6/30/2015	$ 120,000	Eckberg
Research Projects completed by June 30, 2016						
MN Laws 2013, Chapter 52, Section 2						
M.L. 2013	03f	Harnessing Soudan Mine Microbes: Bioremediation, Bioenergy and Biocontrol	U of MN	6/30/2016	$ 838,000	Salomon
M.L. 2013	03h	Finding Disease Resistant Elm Trees in Minnesota	U of MN	6/30/2016	$ 200,000	Blanchette
M.L. 2013	03j	Enhancing Environmental and Economic Benefits of Woodland Grazing	U of MN	6/30/2016	$ 190,000	Zamora
M.L. 2013	04g	Moose Habitat Restoration in Northeastern Minnesota	U of MN - NRRI	6/30/2016	$ 200,000	Moen
M.L. 2013	05a	Sustaining Lakes in a Changing Environment - Phase II	MN DNR	6/30/2016	$ 1,200,000	Reed
M.L. 2013	05g	Membranes for Wastewater-Generated Hydrogen and Clean Water	U of MN	6/30/2016	$ 246,000	Novak
M.L. 2013	05h	Antibiotics in Minnesota Waters - Phase II - Mississippi River	University of St Thomas	6/30/2016	$ 203,000	Wammer
M.L. 2013	06e	Biological Control of Garlic Mustard	MN DNR	6/30/2016	$ 140,000	Van Riper
M.L. 2013	06f	Zebra Mussel Control Research and Evaluation in Minnesota Waters	US Geological Survey, Upper	6/30/2016	$ 600,000	Gaikowski