M.L. 2014, Chp. 226, Sec. 2, Subd. 05b **Project Abstract**
For the Period Ending June 30, 2017

PROJECT TITLE: State Spring Inventory for Resource Management and Protection
PROJECT MANAGER: Jim Berg
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2014, Chp. 226, Sec. 2, Subd. 05b

APPROPRIATION AMOUNT: $200,000
AMOUNT SPENT: $200,000
AMOUNT REMAINING: $0

Overall Project Outcomes and Results

The purpose of this project was to initiate a systematic inventory of springs statewide. This inventory should help create awareness of and appreciation for this resource so spring flows can be maintained and groundwater-dependent resources can be protected. This phase of the inventory focused on developing protocols and methods for field work and data compilation along with limited field testing of inventory procedures. Major project objectives included the development of 1) a spring inventory guidance document to provide documentation of methods and guidance for other researchers; 2) a spring inventory database built on a web-based geographic information system (GIS) platform that can be used in the field with a computer tablet with GPS and cell phone data capabilities; 3) a web-based reporting application that citizens can use to submit spring locations with smartphones or other mobile devises; and to 4) expand the known set of spring locations through paper and digital records review and a limited amount of fieldwork.

All of these objectives were accomplished. Important sections of the guidance document include a spring classification system and key data to collect in the field. The document also describes data flow/data verification methods for entering data into the database from historical documents, field entry of data with the tablet, and data processing of citizen submittals through the citizen reporting application. The custom GIS database allows the project team to upload data directly to a server from the field with a cell phone data link. Important data include: spring location, estimated flow rate, photos, and physical/chemical information. The citizen reporting application provides similar but more limited capabilities.

To date, the spring inventory team has uploaded approximately 500 locations to the inventory database with the tablet system. Approximately 100 possible spring locations have been submitted through the citizen reporting application and targeted mailings with self-addressed, postal paid postcards. These efforts, in addition to migration of existing data from an older database and extensive document review, have created an inventory that currently contains approximately 6,000 locations.

Project Results Use and Dissemination

The long-term strategy is to establish the Spring Inventory at DNR as an ongoing hydrologic cycle database on the same basis as the existing DNR stream gaging, groundwater level monitoring, climatology, and related hydrologic cycle databases.

This data can be accessed through the following link: http://www.dnr.state.mn.us/waters/groundwater_section/springs/msi.html. Data can be downloaded from the Minnesota Geospatial Commons: https://gisdata.mn.gov/dataset/env-mn-springs-inventory.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2014 Work Plan Final Report

Date of Report: July 14, 2017

Date of Next Status Update Report: Final Report

Date of Work Plan Approval: June 4, 2014

Project Completion Date: June 30, 2017

Does this submission include an amendment request? no

PROJECT TITLE: State Spring Inventory for Resource Management and Protection

Project Manager: Jim Berg

Organization: Minnesota Dept. of Natural Resources

Mailing Address: 500 Lafayette Rd N., Box 32

City/State/Zip Code: St. Paul, MN 55155-4032

Telephone Number: (651) 259-5680

Email Address: jim.a.berg@state.mn.us

Web Address: www.mndnr.gov

Location: Statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$200,000**
	Amount Spent:	**$200,000**
	Balance:	**$0**

Legal Citation: M.L. 2014, Chp. 226, Sec. 2, Subd. 05b

Appropriation Language:
$200,000 the second year is from the trust fund to the commissioner of natural resources to develop necessary protocols, processes, and definitions of springs along with limited field testing of inventory procedures in priority areas to enable a systematic inventory of springs statewide needed to maintain spring flows and protect groundwater-dependent resources. This appropriation is available until June 30, 2017, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: State Spring Inventory for Resource Management and Protection

II. PROJECT STATEMENT:

Springs are critical resources in Minnesota and occur all across the state. They create coldwater (trout streams) and cool water fisheries, sustain base flow in streams, create unique ecological habitats, and help to maintain the integrity of aquatic systems against invasive species. In order to maintain spring flows and protect the groundwater-dependent resources that rely on springs, it is vital to inventory, assess, and monitor springs on a comprehensive, statewide basis. This need was recognized in the December 2008 document, "Managing for Water Sustainability: Report of the EQB Water Availability Project" from the Minnesota Environmental Quality Board which specifically recommends an inventory of the state's springs. A partial inventory exists for research purposes for southeastern Minnesota that is maintained in the Minnesota Karst Features Database (MN KFDB) at the Minnesota Geological Survey. The MN KFDB, although known to be incomplete, is heavily used for project planning by private industry, local governments and state agencies.

This project is in support of a statewide inventory of Minnesota's springs. This project will focus on the development of the protocols, processes, and database necessary to enable a statewide spring inventory. The database will be web-accessible to allow for the entry of spring data from existing sources such as topographic maps, DNR records, local governments, public land survey records, universities, state and federal agencies and local interest groups. Limited field testing of inventory procedures in priority areas will be done to test the protocols, processes, and database design. This project will also develop digital and field mapping methods for springs, including establishing site location and verification criteria, developing field data collection templates and standards. Pilot testing of digital and field methods will be done in selected areas of the state to assess cost-effectiveness of methods. The data acquired during this project will be made web-accessible for use by the MPCA, LGU's, DNR, industry and citizen groups as they identify impaired waters, evaluate TMDL requirements, and target lands for protection, restoration and enhancement. The protocols, methods, criteria and standards resulting from this project will be available to agencies and organizations to support completion of a statewide spring inventory.

III. PROJECT STATUS UPDATES:

Project Status as of 15 January 2015 [project and budget update as of December 31, 2014]

This reporting period concentrating on getting the project established, organizing a technical advisory team to provide technical assistance and direction for the project, and hiring the planned full-time unclassified Research Analysis Specialist for the project. Greg Brick, PhD, joined the project on Dec. 17th as the Research Analysis Specialist. The main focus of planned work for the next reporting period is development of inventory protocols, processes, and database design.

Project Status as of 15 September 2015 [project and budget update as of 15 August 2015]

Considerable progress was made on the project this reporting period. A guidance document describing spring inventory methods and data management is in draft form and being used as a reference as the spring inventory database is developed. Data mining of spring locations from existing data sources was actively pursued resulting more than 1,000 spring locations added to the project database. Additional data will be added to the database from these sources. Limited field testing of locations from existing information sources was conducted. Development of field data collection protocols for use with GPS equipment and an iPad tablet is underway. Additional field testing of assembled data from existing sources and the field data collection equipment is planned.

Project Status as of 15 January 2016

Progress has been made for all of the outcomes during this reporting period. Most of the field data protocols have been established and the various data categories have been assembled into a "data dictionary", loaded into the data collection devices, and set-up in the new database. Additional database enhancements funded with a contract with MNIT have been documented in a detailed work plan. For field collection of spring locations and characteristics, two data collection devises (Apple iPad with ESRI 123 Survey software and Trimble GeoXT GPS collection unit) have been chosen and tested at several locations across the state. We continue to update and revise the guidance document describing spring inventory methods and data management as we gain experience with the inventory. Over one thousand new spring locations have been discovered through review of several different existing data sources during this reporting period.

Project Status as of August 15, 2016

We have had internal meetings to discuss and refine which parameters will be collected during field work and how those parameters will be organized on the two data collection platforms (iPad tablet and Trimble GPS). There are now 1844 springs in the database. The third major draft of the spring inventory guidance document containing the protocol is nearing completion.

Extensive field testing of the data collection tablet took place in the Minnesota River valley with three applications: ESRI Collector, Survey123, and PDF Maps. Most of the field collection from start to finish has been successfully tested. Dr. Carrie Jennings, as part of her FEMA landslide investigations, accompanied a field crew, to study how seepage relates to known landslides in the Minnesota River valley.

Amendment Request (December 15, 2016):

We request that the unspent funds ($3,436) for the budget category: *Professional/Technical/Service Contracts - Support for spring component of Karst Features Database, Minnesota Geological Survey* get moved to the *Database design and specialty programming services - MN.IT service level agreement (SLA).* The MNIT SLA is for creating a GIS database for springs that can be used by any authorized professional through the internet using a pad, laptop, or desktop computer. We are nearly finished with this application but development has taken a little more effort and cost than originally anticipated. In addition, during our testing with non-DNR staff there was a request for enhancements that weren't in the original design. This additional funding will help make this application easier to use for a wider range of data input methods and should increase the use of the application.

Amendment Approved by LCCMR 12/12/2016

Project Status as of December 15, 2016 (early reporting for January 15, 2017)

We developed a citizen science app in conjunction with MNIT for use on smartphones and tablets to enlist public help in locating springs. We are developing a publicity plan to promote the use of the app. In addition a targeted US mail activity is being planned which will send self-addressed postage paid postcards to property owners with possible springs on their property. These contacts will focus on the main spring-hunting corridors.

MNIT is putting the finishing touches on the web interface for recording springs. It is almost ready to connect with the KFD karst database, maintained by the Minnesota Geological Survey.

We drafted an Internal Work Plan that will guide fieldwork on public lands in the main spring-hunting corridors. We have had internal meetings to discuss and refine which parameters will be collected during field work and how those parameters will be organized on the two data collection platforms (iPad tablet and Trimble GPS). Almost 2,000 newly located springs are in the database since the start of this project. The spring inventory guidance document was distributed for external review and should be available by the end of 2016.

We have conducted outreach programs or presentations for several organizations, including Master Naturalists, MASWCD, and MGWA.

We were introduced to an extensive springs data set of Mr. Haugstad (former DNR employee) provided by Ashley Ignatius (MPCA) and developed rules for document evaluation. A cursory review of these files for a sample river basin revealed that 20% of the locations are not in the present database. Therefore we concluded a review of these files will provide some new information about spring locations.

Project Status as of June 30, 2017
Further progress was made on the Minnesota Spring Inventory (MSI) Guidance Document (technical guidance) with additional writing and editing. A job safety analysis (JSA – safety guidance) was developed to help ensure safe procedures for spring searches in remote areas and especially during winter conditions. Additional progress was also made on the web-based spring database system ready for use. Meetings were held with the spring inventory team and information technology staff to decide on final enhancements to the system based on user input and remaining budget. We have continued to make additions to the database from various sources. Field work included surveys for spring locations at approximately 14 areas.

Overall Project Outcomes and Results:
The purpose of this project was to initiate a systematic inventory of springs statewide. This inventory should help create awareness of and appreciation for this resource so spring flows can be maintained and groundwater-dependent resources can be protected. This phase of the inventory focused on developing protocols and methods for field work and data compilation along with limited field testing of inventory procedures. Major project objectives included the development of 1) a spring inventory guidance document to provide documentation of methods and guidance for other researchers; 2) a spring inventory database built on a web-based geographic information system (GIS) platform that can be used in the field with a computer tablet with GPS and cell phone data capabilities; 3) a web-based reporting application that citizens can use to submit spring locations with smartphones or other mobile devises; and to 4) expand the known set of spring locations through paper and digital records review and a limited amount of fieldwork.

All of these objectives were accomplished. Important sections of the guidance document include a spring classification system and key data to collect in the field. The document also describes data flow/data verification methods for entering data into the database from historical documents, field entry of data with the tablet, and data processing of citizen submittals through the citizen reporting application. The custom GIS database allows the project team to upload data directly to a server from the field with a cell phone data link. Important data include: spring location, estimated flow rate, photos, and physical/chemical information. The citizen reporting application provides similar but more limited capabilities.

To date, the spring inventory team has uploaded approximately 500 locations to the inventory database with the tablet system. Approximately 200 possible spring locations have been submitted through the citizen reporting application and targeted mailings with self-addressed, postal paid postcards. These efforts, in addition to migration of existing data from an older database and extensive document review, have created an inventory that currently contains approximately 6,000 locations. These data can be accessed through the following link: **mndnr.gov/MnSpringInventory**. Data can be downloaded from the Minnesota Geospatial Commons: https://gisdata.mn.gov/dataset/env-mn-springs-inventory.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Spring Inventory Database Development and Data Management

Description: Develop the necessary protocols, processes, and database necessary to initiate a statewide spring inventory including limited field testing of protocols to ensure the viability and efficiency of the methods developed. Develop digital and field mapping methods, site verification criteria, field data collection templates, and field data collection standards to allow for statewide user input of spring information. Limited pilot testing in selected areas of the state to develop spring identification and site verification methods and assure efficient inventory procedures.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 200,000
Amount Spent: $ 200,000
Balance: $ 0

Activity Completion Date:

Outcome*	Completion Date	Budget
1. Develop statewide spring inventory protocols, processes, and database.	30 June 2016	$90,000
2. Limited field testing of protocols and process methods.	30 June 2016	$20,000
3. Develop digital and field mapping methods, site criteria, and data standards	30 June 2017	$70,000
4. Limited pilot testing of field methods	30 June 2017	$20,000

***$15,572 of this activity is going towards DNR direct and necessary services. Explanation in section VI. Project Budget summary.*

Activity Status as of 15 January 2015 [project and budget update as of December 31, 2014]

This reporting period concentrating on getting the project established, project budget set up, organizing a technical advisory team to provide technical assistance and direction for the project, and hiring the planned full-time unclassified Research Analysis Specialist for the project. Greg Brick, PhD, joined the project on Dec. 17th as the Research Analysis Specialist. Jeff Green, SE MN karst specialist is funded 15% to assist the project. The project technical advisory team met several times to discuss technical direction and project organization. Main focus of planned work for the next reporting period is work related to Outcome 1, including development of inventory protocols, processes, and database design. In addition, the project will begin to evaluate existing spring and related information from a variety of sources; develop criteria and procedures for compiling those data; and begin compiling existing data on a test basis from identified sources.

Activity Status as of 15 September 2015 [project and budget update as of 15 August 2015]

The project has made progress on all of the project outcomes.

Outcome1 [protocols, processes, and database] -- Reviews of existing databases, spring classification, and field data collection protocols from other states and countries to guide project work have been completed. This information is from other spring inventory projects and has served as valuable references and information sources for this project and has been used to develop a guidance document on spring inventory methods and data management. This document is in draft form and when finalized it will be used for this project and future spring inventory projects and will be made available on the DNR website. Conducted DNR-wide/state-wide request for anyone having further information on springs, polling them on what they would like to see in the database. Received email replies in excess of 120 DNR personnel providing information, which together with follow-up questions and replies were more than 200 emails. Data mining of spring locations from existing data

sources is being actively pursued. U. S. Geological Survey and Minnesota Geological Survey documents have been reviewed and numerous springs have been noted. DNR-Fisheries stream files are being researched and hundreds of potential spring locations have been discovered. During that search, a five foot long hand-drawn, linen map of North Shore trout streams with springs was found. That map was produced in 1922 and is the only copy known. Input data on more than 1,000 springs from the DNR fisheries stream surveys have been added to a spreadsheet for eventual incorporation into the SSI database. A web-accessible database for inventoried spring data is in development with the assistance of MN.IT staff. The database will be designed to link with the existing Karst Features Database housed at the Minnesota Geological Survey. A QGIS data platform was developed and spring locations from DNR-Fisheries stream survey reports were imported into it. QGIS (Quantum GIS) is an open-source Geographic Information System program being used in the project for database development.

Outcome2 [field testing of protocols methods]-- Investigated several field locations including Kasota Prairie SNA, Afton State Park, and the Shingobee Lake area near Walker, MN to ground -proof previous spring reports by others. Met with property owners on Lake Kabekona near Walker, MN, to document lakeshore springs.

Outcome3 [develop field mapping methods] -- After a spreadsheet of more than 1,000 springs from stream surveys by DNR Fisheries had been imported into QGIS, the accuracy of the automatic plotting method was tested in the field at Falls Creek SNA by using a submeter GPS unit to plot the actual locations and then comparing them in a GIS overlay. From this it was found that certain adjustments to the mapping algorithm were necessary.

Outcome4 [pilot testing of field methods]-- The suitability of the use of the current MN KFDB features and attributes field data collection protocol programmed into a Trimble GeoXT GPS unit was assessed at several springs. This field data collection protocol was originally designed for springs in southeastern Minnesota. The field testing of the protocol resulted in development of an improved field data collection protocol and subsequently programmed into the GeoXT instrument. The improved field data collection protocol will also be programmed into a new iPad tablet that will be used in the field in future trials.

Activity Status as of 15 January 2016

Outcome1 [protocols, processes, and database] -- We have had numerous internal meetings to discuss and refine exactly which parameters we will be collecting during field work and how those parameters will be organized on the two data collection devices. Several of these meetings also were used to learn how to use the computer tablet (ipad) data collector and software. We have also had several meetings with the DNR MNIT staff to chart the design of the spring database. A detailed work plan for this part of the project has been created by MNIT staff and is nearly in its final form. Other progress in this category included contacting and examining sources of spring location information including: the U of M Entomology Dept (Prof. Len Ferrington, aquatic biologist); a compilation of noteworthy Minnesota springs (30 pages, so far); DNR wildlife management area (WMA) staff; Minnesota Department of Health public water supply database; MGS and USGS literature; metro watershed districts; all Minnesota county parks; and DNR Fisheries stream surveys (1001 springs).

Outcome2 [field testing of protocols methods] -- Field testing the iPad tablet and ESRI Collector software by mapping springs at the “Platteville Observatory” in Lilydale, North Shore spring locations, and the Falls Creek scientific and natural area. The iPad data were uploaded to a server in the field with a mobile hotspot. These and other tests revealed some characteristics of the system which needed to be adjusted by DNR MNIT staff.

Outcome3 [develop field mapping methods] -- In an effort to evaluate the value of existing thermal imagery for spring locating, visible, thermal, and infrared footage from the 2004 groundwater intrusion overflights by A.W. Research Labs were acquired and examined. Other thermal imaging device evaluations were made by testing the capabilities of a borrowed forward looking infrared (FLIR) handheld thermal unit within the St. Paul area at Swede Hollow, Bruce Vento Nature Sanctuary, and the Lilydale Regional Park claypits. Other possible

field mapping strategies were evaluated by reviewing Wisconsin Department of Natural Resources (WDNR) GIS geodata resources to help analyze spring distribution relative to glacial features in Wisconsin. The second major draft of the spring inventory guidance document (50 pages) was reviewed internally and revised. Arrangements were made (permit application) for evaluating the possible geologic connection between spring locations and landslides at the Minnesota River Valley National Wildlife Refuge. A pipeline permit application (Enbridge) to the DNR to cross a stream in a spring prone area of eastern Cass County provided an opportunity to test our spring mapping protocol with the pipeline company's consultant (Stantec). DNR staff also met with the manager of a nearby DNR fish hatchery (Spire Valley) to discuss how the pipeline could affect his operations. Spring locations at the nearby Lake Shingobee and Lake Kabekona were examined with knowledgeable staff from the U S Geological Survey and the DNR spring mapping protocol was discussed.

Outcome4 [pilot testing of field methods]—Locations along the North Shore of Lake Superior, and especially the Grand Marais area, were explored to evaluate known spring locations from historic records (1922 DNR Surber spring map). Continued to evaluate the iPad with the ESRI Collector software and to record a dozen spring locations. We made contact with numerous personnel who provided further leads for spring locations. We mapped and planned possible exploration corridors for the 2016 field campaigns not only along the North Shore, but also the Minnesota River Valley, St. Croix River valley and Agassiz beachlines.

Activity Status as of August 15, 2016

Outcome1 [protocols, processes, and database]—We have had internal meetings to discuss and refine which parameters will be collected during field work and how those parameters will be organized on the two data collection platforms (iPad tablet and Trimble GPS). Many meetings focused on coordinating how the DNR's SSI would integrate with the existing KFD currently run by MGS. There are now 1844 springs in the database, a large increase since the last status report (1001 springs). The third major draft of the spring inventory guidance document containing the protocol (50 pages) is nearing completion of its internal review at present, and upon revision, will be sent out to three external reviewers who have agreed to critique the document.

Outcome2 [field testing of protocols methods]—Extensive field testing of the tablet took place in the Minnesota River valley with three applications: ESRI Collector, Survey123, and PDF Maps. The strengths and weaknesses of these respective applications were evaluated in the field. The best combination of images was found to be LIDAR and PRIM layers. A Garmin GLO unit was tested to increase accuracy above that of the GPS receiver in the tablet. During this mapping endeavor, the protocol was modified as needed to reflect the actual field conditions. Dr. Carrie Jennings, as part of her FEMA landslide investigations, accompanied a field crew, to study how seepage relates to known landslides in the Minnesota River valley.

Outcome3 [develop field mapping methods]—During the Minnesota River valley mapping, the high proportion of seeps and low-discharge springs was noticed, and the protocol was modified to reflect what was actually possible when collecting water parameters. Strategies were developed for how to most efficiently approach land parcels.

Outcome4 [pilot testing of field methods]— Extensive field testing of the tablet took place during the mapping of nearly 300 springs on public lands in the Minnesota River valley, from the mouth of the river upstream to Mankato. The data was remotely uploaded to the DNR servers. Once back in the office, the candidate springs were double-checked and promoted to the status of verified springs. Most of the field collection from start to finish has been successfully tested. The state was divided up into high-priority areas where it was thought there would be a good return on our efforts. For each of these areas, draft work plans were drawn up to guide the fieldwork and keep it within budget.

Activity Status as of December 15, 2016 (early reporting for January 15, 2017)

Outcome1 [protocols, processes, and database]— We developed a citizen science app in conjunction with MNIT for use on smartphones and tablets to enlist public help in locating springs. The following link provides basic information about the application and the program for citizens:
http://www.dnr.state.mn.us/waters/groundwater_section/springs/msi.html.

MNIT is putting the finishing touches on the web interface for recording springs. It is almost ready to connect with the KFD karst database, maintained by the Minnesota Geological Survey. We drafted an Internal Work Plan that will guide fieldwork on public lands in the main spring-hunting corridors. We have had internal meetings to discuss and refine which parameters will be collected during field work and how those parameters will be organized on the two data collection platforms (iPad tablet and Trimble GPS).

We were introduced to an extensive springs data set of Mr. Haugstad (former DNR employee) provided by Ashley Ignatius (MPCA) and developed rules for document evaluation. A cursory review of these files for a sample river basin revealed that 20% of the locations are not in the present database. Therefore we concluded a review of these files will provide some new information about spring locations.

Outcome2 [field testing of protocols methods]— Field protocols are largely established but continue to evolve according to the changing seasons and additional experience.

Outcome3 [develop field mapping methods]— Field mapping methods are largely established but continue to evolve according to the changing seasons and additional experience.

Outcome4 [pilot testing of field methods]— Additional testing of methods were conducted at Flandreau and Minneopa State Parks

Activity Status as of June 30, 2017

Outcome1 [protocols, processes, and database] Further progress was made on the Minnesota Spring Inventory (MSI) Guidance Document (technical guidance) with additional writing and editing. A job safety analysis (JSA – safety guidance) was developed to help ensure safe procedures for spring searches in remote areas and especially during winter conditions.

Additional progress was also made on the web-based spring database system ready for use. Meetings were held with the spring inventory team and information technology staff to decide on final enhancements to the system based on user input and remaining budget

We have continued to make additions to the database from various sources including: the wildlife manager from the Lac Qui Parle WMA; other DNR staff; and DNR Fisheries files on the Zumbro River Watershed and White Water River Watershed.

Outcome2 [field testing of protocols methods], Outcome3 [develop field mapping methods], and Outcome4 [pilot testing of field methods]— Field methods and protocols are largely established but continue to evolve according to the changing seasons and additional experience.

Field work included surveys for spring locations including: St. Peter area, Seven Mile County Park, Swan Lake WMA, Hindeman Creek AMA, Golden Gate WMA, Beaver Falls County Park, Vicksburg County Park., Upper Sioux Agency State Park, Skalbakken County Park, Cold Springs WMA, Klabunde WMA, Whispering Ridge AMA, and Camp Coldwater/Dogpark

Final Report Summary: August 15, 2017

All of these outcomes were accomplished. Important sections of the guidance document include a spring classification system and key data to collect in the field. The document also describes data flow/data verification methods for entering data into the database from historical documents, field entry of data with the tablet, and data processing of citizen submittals through the citizen reporting application. The custom GIS database allows the project team to upload data directly to a server from the field with a cell phone data link. Important data include: spring location, estimated flow rate, photos, and physical/chemical information. The citizen reporting application provides similar but more limited capabilities.

To date, the spring inventory team has uploaded approximately 500 locations to the inventory database with the tablet system. Approximately 100 possible spring locations have been submitted through the citizen reporting application and targeted mailings with self-addressed, postal paid postcards. These efforts, in addition to migration of existing data from an older database and extensive document review, have created an inventory that currently contains approximately 6,000 locations.

V. DISSEMINATION:

Description:
DNR news releases and web announcements will be used to provide publicity for the project. Local government groups, sporting groups, outdoor recreation groups and other state and federal agencies will be contacted for spring location information in selected areas.

Status as of 15 January 2015 [project and budget update as of December 31, 2014]
Limited information about the project was distributed during the project period, mainly using informal methods such as email. The overall response to even this limited information has been very positive. Technical and other specialists clearly see the benefit of a well-defined statewide spring database that will assemble or link scattered information and are willing to share what they know. Plans are underway to develop web material for the DNR website to better explain the project and act as a point of contact and reporting as the project proceeds.

Status as of 15 September 2015 [project and budget update as of 15 August 2015]
Information on the inventory was printed in the DNR newsletter. Numerous citizens and LGU staff who saw that contacted project staff about their springs. The citizens and LGU staff were very excited to hear that the DNR was undertaking this project. The project was presented to the Inter-agency groundwater taskforce, County Biological Survey staff, and an article on it was prepared for the Minnesota Groundwater Association newsletter. A page on springs, karst and the spring inventory were developed for the DNR website. A pamphlet on lakeshore springs was designed and will be sent via e-mail to lake associations, county zoning staff, and DNR field staff to enlist their assistance in locating this type of spring.

Status as of January 15, 2016
Staff prepared information brochure for lakeshore owners to help locate springs on lakes. Greg Brick prepared: a paper and poster for the Rochester Sinkhole Conference regarding the Minnesota spring inventory; a report on Boiling Springs (Scott County) for the Director of the DNR Ecological and Water Resources Division (Luke Skinner); and an article regarding a pioneering spring mapping effort (Surber) for the Jan-Feb 2016 issue of *MINNESOTA CONSERVATION VOLUNTEER*.

Status as of August 15, 2016
A short story about looking for springs in St Paul was accepted for publication in the 2017 *St. Paul Almanac*, its goal to reach a wider audience to inform them of the DNR's efforts. A lecture, "The Diversity of Minnesota's Springs," has been prepared for delivery at the Master Naturalists meeting at Springbrook Nature Center in

October. A description of the state spring inventory was presented at a meeting of the Southeastern Minnesota Board of Water Resources meeting as part of a general discussion of county geologic atlases and karst.
We were contacted by the president of MGWA and requested to give a talk at their Fall Conference. We are planning to develop through MNIT a citizen app for smartphones that will allow anyone to send in the locations of candidate springs as part of our Citizen Science initiative.

Status as of December 15, 2016 (early reporting for January 15, 2017)
We have conducted outreach programs or presentations for several organizations, including Master Naturalists, Minnesota Association of Soil and Water Conservation Districts (MASWCD), and Minnesota Groundwater Association (MGWA).

DNR is evaluating dissemination of the Citizen App to locate springs through other venues, including:

- Trout Unlimited
- DNR Hunting & Fishing
- St. Croix River Association
- Friends of the Mississippi River
- Minnesota Waters
- Other state agencies & associations

We are developing a publicity plan to promote the use of the app. In addition a targeted US mail activity is being planned which will send self-addressed postage paid postcards to property owners with possible springs on their property. These contacts will focus on the main spring-hunting corridors.

Status as of June 30, 2017
The web page describing the project and the citizen reporting application was finalized in January 2017:
mndnr.gov/MnSpringInventory
https://arcgis.dnr.state.mn.us/gis/CitizenSprings/

On March 8, 2017 a television interview and story aired on KARE11 describing the spring inventory project and the citizen reporting application:
http://www.kare11.com/weather/go-on-the-hunt-for-springs/421220261

An editorial for wildlife publications was prepared describing the project and the citizen reporting application.

A Star Tribune article about the spring inventory project was published on March 14, 2017:
http://www.startribune.com/minnesota-is-the-land-of-15-000-springs-too/415802244/

Final Report Summary: June 30, 2017
These data can be accessed through the following link: **mndnr.gov/MnSpringInventory**. Data can be downloaded from the Minnesota Geospatial Commons: https://gisdata.mn.gov/dataset/env-mn-springs-inventory.

Dissemination included:
- a paper and poster for the National Cave & Karst Research Institute's 2015 Rochester Sinkhole Conference;
- A 2015 DNR newsletter;
- A presentation to the Inter-agency groundwater taskforce and County Biological Survey staff;
- an article in a 2016 Minnesota Groundwater Association newsletter;
- a pamphlet on lakeshore springs was sent to lake associations, county zoning staff, and DNR field staff;

- an article regarding a pioneering spring mapping effort for the Jan-Feb 2016 issue of *MINNESOTA CONSERVATION VOLUNTEER*;
- A lecture, "The Diversity of Minnesota's Springs," at the Master Naturalists meeting at Springbrook Nature Center in October 2016;
- a presentation in 2016 to the Southeastern Minnesota Board of Water Resources;
- a presentation at the 2016 MGWA Fall Conference;
- a presentation to the 2016 Minnesota Association of Soil and Water Conservation Districts (MASWCD) conference;
- a presentation to the Friends of the Root River in December 2016;
- a presentation at the Smithsonian Waterways event in Lanesboro, February 2017;
- a short story about springs in St Paul in the 2017 *St. Paul Almanac;*
- a television interview (March 8, 2017) and story aired on KARE11 describing the spring inventory project and the citizen reporting application: http://www.kare11.com/weather/go-on-the-hunt-for-springs/421220261
- a Star Tribune article about the spring inventory project was published on March 14, 2017: http://www.startribune.com/minnesota-is-the-land-of-15-000-springs-too/415802244/

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Explanation
Personnel:	$ 158,607	Research Analyst Specialist: est. $125,107 (1 unclassified @ 0.8 FTE year 1 (hire Aug or Sept) and 1 FTE for year 2); Hydrologist 3: est. $33,500 (1 classified @ 0.15 FTE for two years)
Professional – Technical Contracts:	$ 20,000	Minn. Geological Survey spring component of Karst Features Database -- est. $6,564; MN.IT for database and specialty programming – est. $13,436
Direct and necessary services* --	$15,572	
Equipment/Tools/Supplies:	$2,150	Field data acquisition devices, such as tablets and GPS equipment; other necessary equipment for field protocol testing
Capital Expenditures over $5,000:	$	
Travel Expenses in MN:	$3,671	Vehicle fleet charges est. $2,621; lodging/meals est. $1,050 for meetings with data holders or users, limited field testing of procedures and pilot testing of field mapping methods
TOTAL ENRTF BUDGET:	$200,000	

*Direct and Necessary expenses include both Department Support Services (Human Resources $2,785, IT Support $4,773, Safety $689, Financial Support $2,138, Communications Support $1,141, Planning Support $704, and Procurement Support $235) and Division Support Services $3,108. The sum of expense detail amounts listed is $15,573, slightly different from $15,572 shown in the budget overview table and project budget due to rounding. Department Support Services are described in the agency Service Level Agreement, and is billed internally to divisions based on rates that have been developed for each area of service. These services are directly related to and necessary for the appropriation. Department leadership services (Commissioner's Office and Regional Directors) are not assessed. Division Support Services include costs associated with Division business offices and clerical support. Those elements of individual projects that put little or no demand on support services such as large single-source contracts, large land acquisitions, and funds that are passed-thru to other entities are not assessed Direct and Necessary costs for

those activities. For this work plan, database development and maintenance activity (Activity 1) with an associated cost of $20,000 has not been assessed Direct and Necessary costs."

Explanation of Use of Classified Staff:

Any classified position paid for with ENRTF funds will either be 1) backfilled with a new position or 2) the work previously done by this position will be delayed, eliminated, or completed by the start of the project.

There is one classified position currently working on a separate ENRTF project to be paid partially by this grant. Including the Hydrologist 3 in the project utilizes existing technical expertise in the subject matter to improve efficiency of the database design and the development of procedures and methods. A portion of the Hydrologist 3 time (0.15 FTE) will be paid by this grant and the remaining portion will be paid by Clean Water Fund or an amended ENRTF project, subject to approval.

Explanation of Capital Expenditures Greater Than $5,000: NA

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 2.1

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: estimated 0.3 FTE

B. Other Funds:

Source of Funds*	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
	$	$	
State			
	$0	$10,000	Funds were used to pay MNIT to fully develop the GIS database with all the functionality requested by users in the DNR, Minnesota Geological Survey and University of Minnesota, department of Earth Sciences.
TOTAL OTHER FUNDS:	**$**	**$10,000**	

*no other funds are planned at this time.

VII. PROJECT STRATEGY:

A. Project Partners: The Minnesota Geological Survey will partner with the DNR to maintain the existing MN Karst Features Database (KFDB) as the repository for karst features and associated spring information as a research database primarily for the southeast Minnesota karst landscape. The State Spring Inventory Database development will be coordinated with the existence and continued use of the KFDB as a research database managed by the Minnesota Geological Survey.

B. Project Impact and Long-term Strategy:
Springs are natural features that return groundwater to surface waters. The groundwater that discharges from springs is critical for maintaining surface stream flow in Minnesota's streams and rivers. The quantity and quality of that water has a direct impact on surface water ecosystems and human use of those rivers and streams. This information is critical for Total Maximum Daily Load (TMDL) implementation strategies, impaired waters remediation, trout stream management, ground water protection and allocation issues, and local land and water management decisions. The state spring inventory is part of a long-term continuing need to identify,

assess, and monitor all parts of the hydrologic cycle so that observed or projected hydrologic system response to change, whether climatic or anthropogenic, can be accurately interpreted.

The long-term strategy is to conduct the inventory, establish the Spring Inventory at DNR as an ongoing hydrologic cycle database on the same basis as the existing DNR stream gaging, groundwater level monitoring, climatology, and related hydrologic cycle databases.

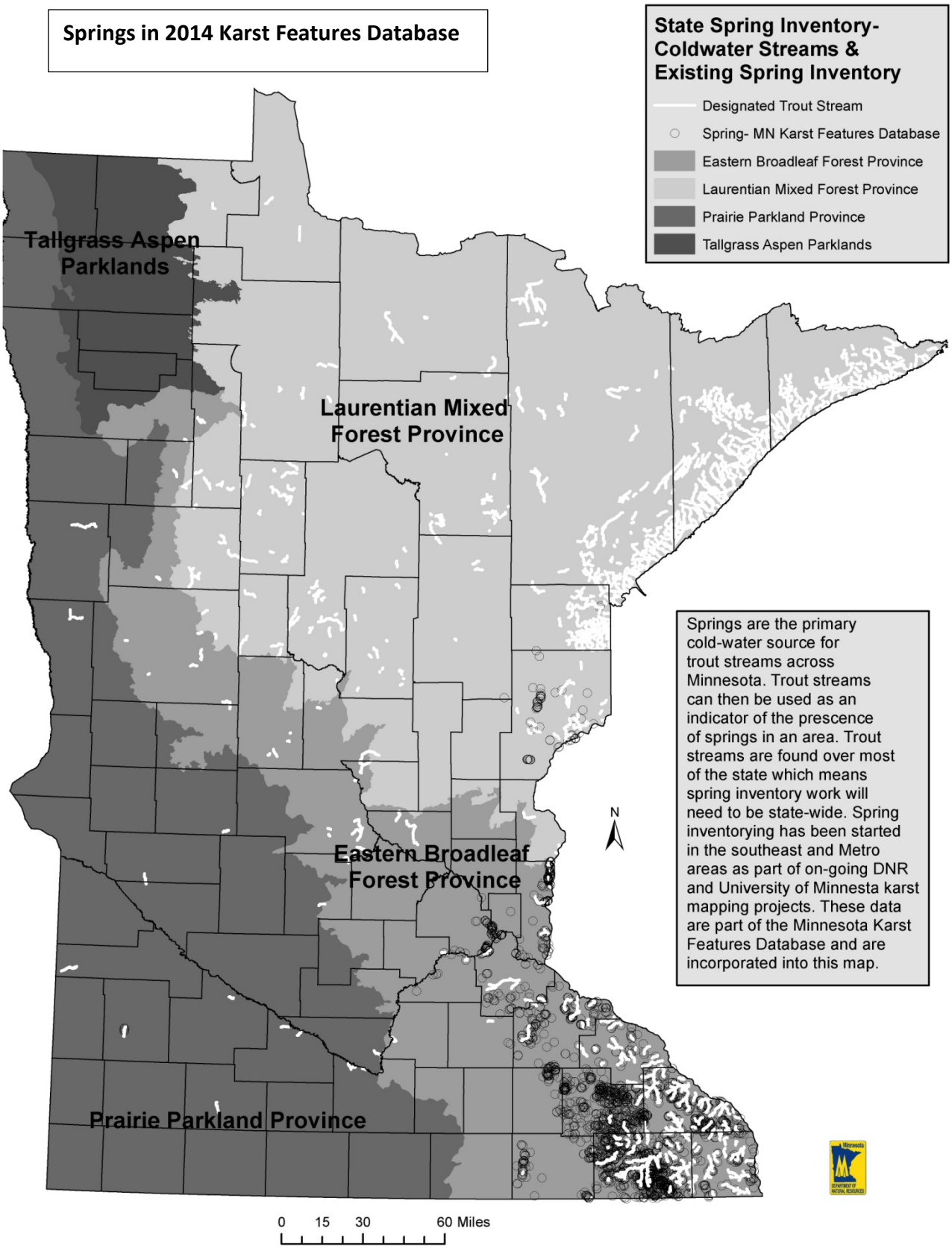
C. Spending History:

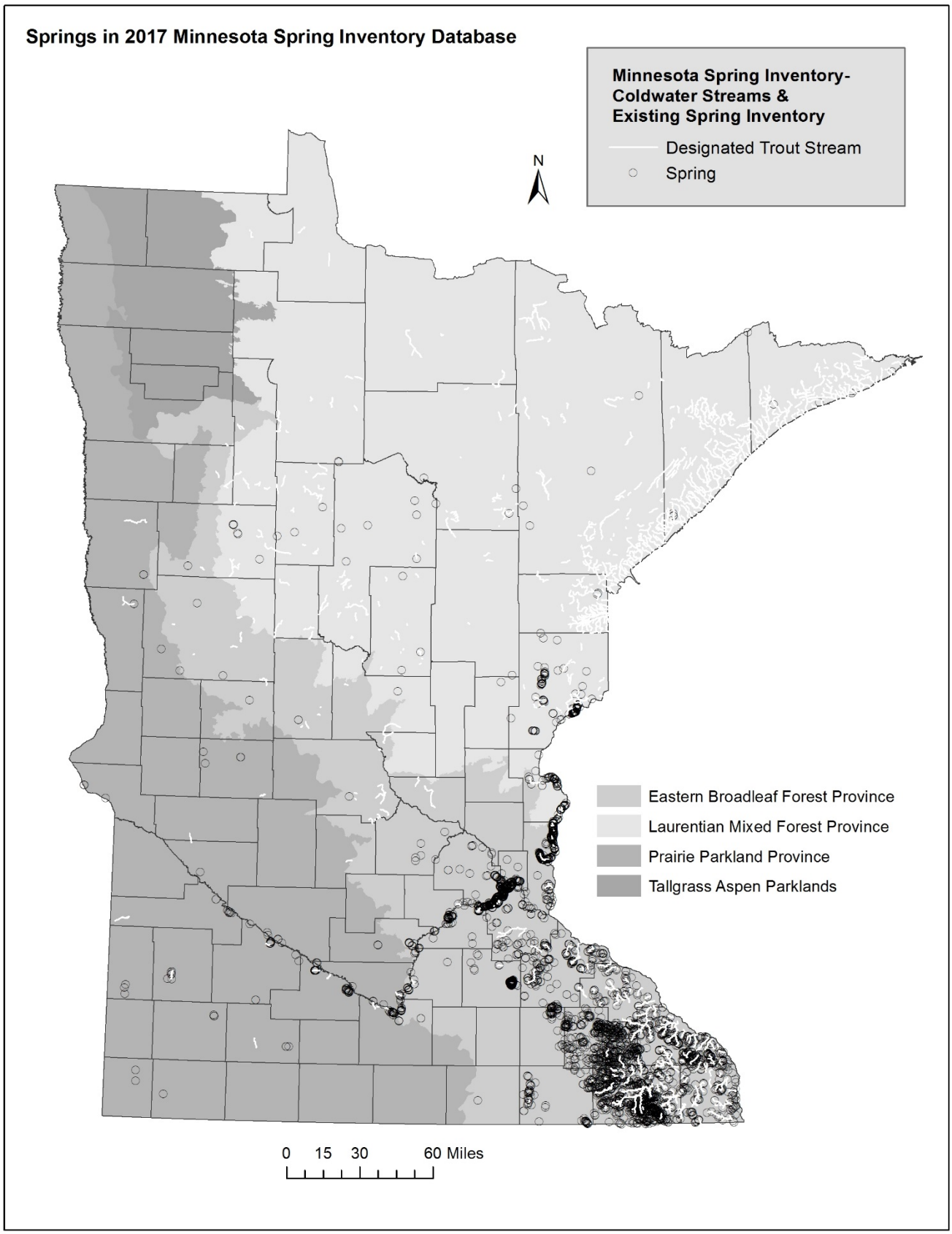
Spring inventory work has been an on-going task in southeast Minnesota for over fifty years. Various groups including private citizens, DNR, U of M, USGS and a multitude of local governments have located springs. Much of this spring information is included within the existing Karst Features Database for southeast MN. In terms of the three ENRTF-supported Springshed Mapping projects, spring inventory has been an integral part of each project and is embedded in the process of dye trace design and springshed characterization. As part of the Springshed Mapping projects, DNR staff estimate they spent approximately 10% of their time on spring inventory while U of M staff estimate they spent approximately 5%. With a total ENRTF allocation of $1,270,000 for the three phases of the projects, those percentages result in an estimated $93,250 spent on spring inventory tasks. The spring information collected as part of the Springshed Mapping work has been incorporated into the Karst Features Database.

Funding Source	M.L. 2007 Springshed mapping funding (inventory)	M.L. 2009 Springshed mapping funding (inventory)	M.L. 2011 Springshed mapping funding (inventory)	Total Project funding (inventory)
ENRTF to DNR	$125,000 ($12,500)	$250,00 ($25,000)	$220,000 ($22,000)	$595,000 ($59,500)
ENRTF to UM	$145,000 ($7,250)	$250,000 ($12,500(	$280,000 ($14,000)	$675,000 ($33,750)
Total	$270,000 ($19,750)	$500,000 ($37,500)	$500,000 ($36,000)	$1,270,000 ($93,250)

VIII. ACQUISITION/RESTORATION LIST: N/A

IX. VISUAL ELEMENT or MAP(S): See inserted map below of existing spring inventory.




Springs in 2017 Minnesota Spring Inventory Database
Minnesota Spring Inventory-
Coldwater Streams &
Existing Spring Inventory
Designated Trout Stream
Spring
N
Eastern Broadleaf Forest Province
Laurentian Mixed Forest Province
Prairie Parkland Province
Tallgrass Aspen Parklands
0 15 30 60 Miles

X. ACQUISITION/RESTORATION REQUIREMENTS WORKSHEET: N/A

XI. RESEARCH ADDENDUM: N/A

XII. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than 15 January 2015, 15 August 2015, 15 January 2016, 15 August 2016 and 15 January 2017. A final report and associated products will be submitted between June 20 and August 15, 2017.

M.L. 2014 Project Budget

Project Title: State Spring Inventory for Resource Management and Protection

Legal Citation: M.L. 2014, Chp. 226, Sec. 2, Subd. 05b

Project Manager: Jim Berg

Organization: Minnesota Department of Natural Resources

M.L. 2014 ENRTF Appropriation: $ 200,000

Project Length and Completion Date: 3 Years; June 30, 2017

Date of Report: July 14, 2017

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM					
Personnel (Wages and Benefits)	$158,607	$158,607	$0	$158,607	$0
two positions, total 2.1 FTE for direct project activities					
Hydrologist 3: est. $33,500 (1 classified @ 0.15 FTE for two years), 64% salary, 36% benefits					
Research Analysis Specialist: est. $125,107 (1 unclassified @ 0.8 FTE for year 1 (hire Aug or Sept) and 1 FTE for year 2), 75% salary, 25% benefits					
Professional/Technical/Service Contracts					
Support for spring component of Karst Features Database. Minnesota Geological Survey	$6,564	$6,564	$0	$6,564	$0
Database design and specialty programming services. MN.IT service level agreement	$13,436	$13,436	$0	$13,436	$0
Direct and Necessary Services for the Appropriation	$15,572	$15,572	$0	$15,572	$0
Equipment/Tools/Supplies					
Data acquisition field equipment to develop and test field procedures: field data tablets, GPS equipment, misc. tools and supplies for field data collection and equipment maintenance.	$2,150	$2,150	$0	$2,150	$0
Travel expenses in Minnesota					
Fleet charges for cars, trucks, minivans, est. $2,621; lodging, meals, mileage as per state contracts, est. $1,050	$3,671	$3,671	$0	$3,671	$0
COLUMN TOTAL	**$200,000**	**$200,000**	**$0**	**$200,000**	**$0**