2017 Project Abstract
For the Period Ending June 30, 2022

PROJECT TITLE: Interactive Water Resource Programs for Planetariums in Minnesota
PROJECT MANAGER: Sally Brummel
AFFILIATION: Bell Museum
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2017, Chp. 96, Sec. 2, Subd. 05c

APPROPRIATION AMOUNT: $500,000
AMOUNT SPENT: $ 488,577.00
AMOUNT REMAINING: $11,423.00

Sound bite of Project Outcomes and Results
Water flows out of Minnesota in three directions, and our personal and public choices have impacts far beyond our borders. With *Minnesota Water Stories,* citizens tour Minnesota in planetariums across the state, to learn about issues in each region and understand what they can do to protect this natural resource.

Overall Project Outcome and Results
The planetarium dome is an ideal place to provide an immersive venue for citizens to understand complex topics such as time, scale, and geographic perspective as they relate to water. The shape of a dome fills our peripheral vision and mirrors the way our eyes see the world around us, which allows the audience to feel they are part of the story, connected to the decisions made by themselves and others. A skilled presenter can tailor the show to the needs of the audience, so each experience is unique. *Minnesota Water Stories* includes a mixture of animation and live-action video from a dozen locations around the state including Park Rapids, Halstad, Breckenridge, Redwood Falls, Waseca, Wabasha, and Tofte.

The outcomes for citizens attending *Minnesota Water Stories* were to increase awareness of challenges facing our waters, understand the challenges' relations to the larger system, and becoming aware of community resources to work toward addressing these problems. Due to the pandemic, we were not able to do a full-scale evaluation of the show in planetariums around the state. We created an online version with similar content as the planetarium show to measure how it meets these outcomes. According to the evaluation report, "general audience and student participants increased their understanding of challenges facing Minnesota waters."

Almost 1,000 Minnesotans saw the interactive and audience participatory experience of *Minnesota Water Stories* in its initial run at the Bell Museum's Whitney and Elizabeth MacMillan Planetarium, and 231 students and public reviewed the web-based version. Over the next few years *Minnesota Water Stories* will show to thousands of people at planetariums in Baxter, Duluth, Hibbing, Mankato, Marshall, Moorhead, Rochester, St. Cloud, and St. Paul.

Project Results Use and Dissemination
This project produced a planetarium show and an online StoryMap that all Minnesotans can access. To date, over 900 Minnesotans have seen the show at the Bell Museum. In fall 2022 it will be available for audiences in planetariums in nine cities around the state and can travel to any region with the University of Minnesota's portable planetarium system. In the years to come, thousands of Minnesotans will view *Minnesota Water Stories*.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2017 LCCMR Work Plan Final Report

Date of Submission: November 18, 2022

Final Report

Date of Work Plan Approval: June 7, 2017

Project Completion Date: June 30, 2022

PROJECT TITLE:
Interactive Water Resource Programs for Planetariums in Minnesota

Project Manager: Sally Brummel

Organization: Bell Museum

Mailing Address: 2088 Larpenteur Ave. W

City/State/Zip Code: St. Paul, MN 55113

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Web Address: bellmuseum.umn.edu

Location: Statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$500,000**
	Amount Spent:	**$488,577**
	Balance:	**$11,423**

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 05c

Appropriation Language:
$500,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota, Bell Museum of Natural History, to create an interactive planetarium program on water resources, reaching approximately 400,000 citizens statewide through the Bell Museum Planetarium, St. Paul Public Schools, Anoka-Hennepin Public Schools, Mayo High School, Mankato East High School, Southwest Minnesota State University, Minnesota State University Moorhead, and University of Minnesota Duluth. This appropriation is available until June 30, 2022, by which time the project must be completed and final products delivered.

I. PROJECT TITLE:
Interactive Water Resource Programs for Planetariums in Minnesota

II. PROJECT STATEMENT:

Minnesota's official state natural history museum, the Bell Museum + Planetarium, with statewide partners, will create a planetarium program on water resources that will reach over 300,000 students and 100,000 adults in 5 years. *Minnesota Water Stories* will be uniquely designed as an interactive and audience participatory experience in an immersive, dome environment, featured at the Marshall W. Alworth Planetarium (University of Minnesota Duluth), Como Planetarium (St. Paul Schools), Jackson Middle School Observatory (Anoka-Hennepin Schools), Mankato East High School Planetarium, Mayo High School Planetarium (Rochester Schools), Minnesota State University Moorhead Planetarium, Southwest Minnesota State University Planetarium (Marshall), at the new state funded Bell Museum Planetarium opening in St. Paul in 2018 and throughout Minnesota via the two portable planetariums in the University of Minnesota system. Scientists from the University of Minnesota's Water Resources Center, Institute on the Environment, and Large Lakes Observatory will provide science advisement. The University of Minnesota Center for Applied Research and Educational Improvement (CAREI) will perform formative and summative evaluation of the planetarium program to determine its effectiveness in meeting its intended learning outcomes.

Water flows out of Minnesota in three directions and our personal and public choices have impacts far beyond our borders. Understanding these impacts from a local to global perspective is necessary in order to address Minnesota's water challenges of the present and future. Under a planetarium dome is the ideal place--the shape of the dome fills our peripheral vision mirroring the way our eyes see the world around us. Research shows programs on Earth science presented in the immersive environment of the planetarium makes it easier to understand complex topics such as time, scale, and geographic perspective, and allows the audience to feel as they are part of the story, connected to the decisions made by others and themselves.

The Bell Museum and partners will produce a live program to share through an existing network of planetariums and via two portable dome systems that can travel anywhere in the state. The production team will combine media, current and historic satellite data, and science results in these live presentations under the dome to support a statewide dialogue around water. The presentation is easily adjusted by a skilled planetarium presenter to accommodate the specific needs of the audience. Using compelling stories that partners produce, presenters will guide citizens through a visual experience that transports them from outer space to inside a water molecule and all scales in between. In year one, the planetariums in St. Paul, Moorhead, and Duluth will present a pilot program. CAREI will perform formative evaluation on the pilot presentations, to inform production of the final program during year two. In year three, the program will debut in the Bell Museum Planetarium and delivered in planetariums across the state. CAREI will perform summative evaluation to determine that the program met the outcomes for planetarium professionals and audience members, including understanding relationships of ecological issues to larger systems (e.g., the cosmic, global, regional, and local impacts) and building relationships with community partners.

III. OVERALL PROJECT STATUS UPDATES:

Amendment Request (10/4/2017)
I request a move of $8,000 from the budget item Fulldome Production team under the Professional/Technical/Service Contracts category to the personnel category. This amount will fund Patrick O'Leary, Production Coordinator of the pilot program from September 2017-January 2018. The pay will be retroactive to September 18, 2017. The intent was to hire a person or team on contract for this position, but the person identified is a University of Minnesota employee. Per University regulations, we cannot pay a current

employee as a contractor, so we are creating a position on the payroll. This requires the move of the funding to the personnel category. The pay will be retroactive to September 18, 2017. The change is within Activity 1 only.
Amendment Approved by LCCMR 10/31/2017

Project Status as of January 15, 2018*:*
Not submitted per instructions of LCCMR staff

Project Status as of July 15, 2018*:*
The organization name and mailing address changed as of January 2018 and is reflected on the cover page.

We developed the pilot planetarium program *Minnesota Water Stories* and presented it for school and public audiences in three Minnesota planetariums. At the Marshall W. Alworth Planetarium, University of Minnesota Duluth, the program focus was research conducted by the UMD Large Lakes Observatory on Lake Superior and other Minnesota lakes, as well as the importance of water in the Lake Superior region for Dakota and Ojibwe Indians. We set up the Bell Museum's portable planetarium at Valley View Middle School in Bloomington, and we focused on ways to improve water quality the Minnesota River, Lower Mississippi, Upper Mississippi river basins. At the Minnesota State University Moorhead Planetarium we focused on the issues facing the Red River of the North, including flooding, droughts, and lake water clarity. A total of 329 students and 59 adults participated in the program. The Center for Applied Research and Educational Improvement (CAREI) performed a formative assessment by administering a paper survey to all audience members, and conducing focus groups with 4-7 adults in each planetarium. The results of the assessment are pending.

Amendment Request (07/30/2018)
I request a move of $71,000 from the budget item Fulldome Production team under the Professional/Technical/Service Contracts category to the personnel category. This amount will fund Patrick O'Leary, who will be the Production Coordinator of the pilot program from August 2018-June 2020. Mr. O'Leary served as the interim Production Coordinator for the pilot program from September 2017-January 2018, and we have decided to hire him as the permanent Production Coordinator at 40% FTE. We will hire him as a University employee, not as a contractor, so we are required to include him in the personnel category. The change is within Activity 3 only.
Amendment Approved: 08/07/2018

Project Status as of January 15, 2019*:*
The project evaluation team from the Center for Applied Research and Educational Improvement (CAREI) submitted the formative assessment in September 2018, and the Project Manager and CAREI discussed the results and how they will inform the development of the final production.
The production team began development of the final production, focusing on refinement of the scripts for each region of Minnesota.

Project Status as of July 15, 2019:
The production team continued development of the final production, including acquiring and testing equipment for photography and videography for fulldome planetarium formats.

Amendment Request (11/12/2019)
Regarding the Professional/Technical/Service Contracts budget category: we did not spend any funds for the Fulldome production team in Activity 1, the pilot production. The production funds we allotted for Activity 1 were intended to hire professionals to create assets such as animations and provide services such as video editing. We ended up being able to produce the pilot using existing assets, and it was done entirely by project personnel. For the final production, Activity 3, we would like to use the funds we did not spend to ensure we have the funds to hire skilled professionals to produce a high quality final production. We are requesting to shift $92,000 from the Activity 1 budget to the Activity 3 budget.

Regarding the budget for 4 days videography on board LLO Blue Heron: The initial budget had $10,000 allotted for Activity 1, the pilot planetarium production, and $10,000 allotted for Activity 3, the final planetarium production. We did all of the videography for Activity 3. In addition, we spent 5 days on the Blue Heron to realize our video needs, and the cost will come to $21,000. I am requesting a shift of the $10,000 for the Blue Heron videography in Activity 1 to Activity 3. The additional $1,000 to cover the Blue Heron costs will come from the Activity 2 travel budget, because we do not anticipate using that entire amount.

Regarding the Equipment/Tools/Supplies budget category: Because Activity 1 has concluded, the remaining funds will be spent on equipment needed for Activity 3. We request a shift of the balance of $21,246 from Activity 1 to Activity 3. In addition, we require a different selection of equipment for fulldome production than listed in the submitted budget. Some items we are not purchasing, some items are coming in at a different price, and we have need for equipment not initially included such as camera accessories and sound equipment. The funding needed to cover these items still falls within the Equipment/Tools/Supplies budget. There is a new line in the budget describing the equipment we need.

We are changing the delivery dates of the outcomes in Activity 3. The final production has taken longer than expected, so the dates are reflected in the Activity 3 section. We will still finish the project by the initial completion date.

AMENDMENT APPROVED by LCCMR 11/20/2019

Project Status as of January 15, 2020:

This was an exciting period for the *Minnesota Water Stories* production! We spent 5 days on Lake Superior, shooting fulldome photography and videography on the Blue Heron, and shot in the corn fields of the Southern Research & Outreach Center (Waseca, MN) for the science story. We also did fulldome photography in Rochester, Moorhead, and other locations around the state. We are now beginning final production stages.

We worked with the evaluation team on the summative assessment tool, and scheduled the premier dates of *Minnesota Water Stories* at the Bell Museum and around the state for April and May 2020.

AMENDMENT REQUEST May 29, 2020

The following requests are made in order to complete the outcomes in Activities 2 and 3 that were postponed due to the University of Minnesota and state of Minnesota closedowns during the COVID-19 outbreak.

- An extension of the project completion date to June 30, 2021. Outcomes 4 and 5 in Activity 2 are dependent on being able to present *Minnesota Water Stories* in planetariums around the state and gather information for summative evaluation. At the time of this submission, it is known that we cannot present in the planetariums until fall 2020 at the earliest. We are concerned that social distancing guidelines will not allow the planetariums yet to open in the fall and would like to have the possibility of doing the presentations in the spring 2021 and finish at the end of school year 2020-2021.
- An addition to Activity 3 of a 6th Outcome , production of digital and flat screen assets of *Minnesota Water Stories.* The evaluation and extended presentation period depend on reaching a set number of students and public. To achieve this there must be audiences in the planetarium. If schools and the public are not allowed or choose not to attend planetariums in the upcoming months we will fail to reach those numbers. To reach audiences outside the planetarium walls, we will create a version of *Minnesota Water Stories* that can be presented in a variety of digital formats. This will use assets already produced for the planetarium program

- A move of $119,650 from the budget item Fulldome Production team under the Professional/Technical/Service Contracts category and $5000 from the Equipment/Tools/Supplies category to the personnel category. This amount will add wages and benefits for the noted existing personnel and add additional personnel, in order to complete the planetarium program and develop the digital assets.
- As a result, Activity 2 budget will change from $98,000 to $91,000 and Activity 3 budget will change from $338,246 to $345,246.

AMENDMENT APPROVED by LCCMR 8/20/2020

Project Status as of July 15, 2020:
Between January and March 2020 we continued the production of the final show and scheduled the presentations around the state, at planetariums in Mankato, Marshall, Rochester, St. Paul, Duluth, Moorhead, and Bloomington. The premiere at the Bell Museum was scheduled for April 11, 2020 as part of a Spotlight Science event, with two showings of *Minnesota Water Stories* and presentations from University of Minnesota scientists and researchers working to understand and protect the state's waters. Unfortunately, the pandemic and state shutdown required us to postpone production and cancel all scheduled presentations. Working from home as of March 18, 2020, we continued working on aspects of the production we were able to do without access to the planetarium and devised new project timelines, pending when the Bell Museum and planetariums around the state open again.

Project Status as of January 15, 2021:

Between July and December 2020 we continued with the production of the planetarium show without a known premier date. The Bell Museum was open with capacity reduced to 25% between July and November, and closed again with opening date unknown at the time of this submission. All other planetariums around the state have remained closed since March 2020 and are expected to remain so through at least June 2021.

The production team has been working on an online version of *Minnesota Water Stories* for school and public audiences, to premier in spring 2021.

AMENDMENT REQUEST April 27, 2021

Minnesota planetariums will not be open for school and public audiences before the end of the project period. Therefore we will not be able to train the Minnesota planetarium professionals directors to present Minnesota Water Stories (Activity 3, Outcome 4). Instead we will provide training for them to use the online version for their virtual audiences. Outcome 4 is updated to reflect this change.

Due to this conflict, the evaluation will cannot be done on the planetarium production (Activity 2, Outcome 4). Instead we will have students and community members from in all three regions experience the online digital production and take an online evaluation. The evaluation questions intend to measure the same outcomes as proposed outcomes for the planetarium production. Outcome 4 is updated to reflect this change.

The debut of Minnesota Water Stories in the Bell Museum planetarium is scheduled for June 11, 2021. Activity 3 outcome completion dates are updated to reflect this change.

I request to add two new budget items to the Professional/Technical/Service Contracts category.

- We are having Minnesota educators review the new digital and flat screen production for use with students, and request an honorarium for 8 teachers of $250 each, for a total of $2,000.
- We would like to schedule 2 additional days of videography on the Large Lakes Observatory Research Vessel Blue Heron in May 2021. We will film researchers that were not able to participate in the summer 2019 videography. This is a total of $10,400.
- The amount of $12,400 will be reduced from the Fulldome production team budget to cover these costs. All of these budget items are in the same category, so there is no change in either the Professional/Technical/Service Contracts category or the Activity 3 budget.

Amendment Approved by LCCMR 4/12/2021

Project Status as of July 15, 2021:
This project period we debuted the work of the past four years to audiences in Minnesota. In April and May we ran an evaluation of the online version of Minnesota Water Stories to Bell Museum members, visitors, and social media followers; as well as to almost 200 students in all three major water basins around Minnesota. The planetarium program premiered at the Bell Museum on June 11 and continues on our weekly schedule through summer 2021. In the upcoming year we will deliver Minnesota Water Stories to planetariums around Minnesota to share with their audiences.

Project Status as of January 15, 2022:
The primary activity in this project period was that *Minnesota Water Stories* ran in the Bell Museum's planetarium weekly schedule from June 11-September 3, 2021. 670 visitors saw the show. We continued production for a re-release in spring 2022, as well as continued the production for planetariums statewide.

AMENDMENT REQUEST April 15, 2022
We request to move $11,600 from Professional/Technical/Service Contracts to Personnel. We have found it more efficient and cost-effective to use in house staff to finish up the production instead of hiring professional services. Our staff now has production capabilities that we did not anticipate when we submitted the original budget. Both of these are within Activity 3 so there is no overall change to that budget or any change to the budget of the other activities.

Amendment Approved by LCCMR 4/21/2022

Final Report Status:
Overall Project Outcomes and Results:
The planetarium dome is an ideal place to provide an immersive venue for citizens to understand complex topics such as time, scale, and geographic perspective as they relate to water. The shape of a dome fills our peripheral vision and mirrors the way our eyes see the world around us, which allows the audience to feel as they are part of the story, connected to the decisions made by themselves and others. A skilled presenter can tailor the show to the needs of the audience, so each experience is unique. *Minnesota Water Stories* includes a mixture of animation and live-action video from a dozen locations around the state including Park rapids, Halstad, Breckenridge, Redwood Falls, Waseca, Wabasha, and Tofte.

The outcomes for citizens attending *Minnesota Water Stories* were to increase awareness of challenges facing our waters, understand the challenges' relations to the larger system, and be aware of community resources to work toward addressing these problems. Due to the pandemic, we were not able to do a full-scale evaluation of the show in planetariums around the state. We created an online version with similar content as the planetarium show

to measure how it meets these outcomes. According to the evaluation report, "general audience and student participants increased their understanding of challenges facing Minnesota waters."

Almost 1,000 Minnesotans saw the interactive and audience participatory experience of *Minnesota Water Stories* in its initial run at the Bell Museum's Whitney and Elizabeth MacMillan Planetarium, and 231 students and public reviewed the web-based version. Over the next few years *Minnesota Water Stories* will show to thousands of people at planetariums in Baxter, Duluth, Hibbing, Mankato, Marshall, Moorhead, Rochester, St. Cloud, and St Paul.

AMENDMENT REQUEST November 18, 2022
We request to move $8,727 from Professional/Technical/Service Contracts to Personnel. Some of the production that was anticipated to be done by service contracts was handled by Bell Museum personnel, and salaries went up beyond what we originally budgeted.

Amendment approved by LCCMR 12/2/22

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Program Production
Description:
For the production of *Minnesota Water Stories*, the production team will write a script, collect and integrate data, film and produce segments, and create the technical structure that will allow presenters to interactively deliver the program. This includes collecting existing satellite and ground based data, creating necessary animations, and filming with a fulldome camera at featured locations around the state. The Bell Museum production team will collaborate with University researchers and partners to include the latest science-based results and data.

The production team will test a prototype version of *Minnesota Water Stories* with selected audiences in the first year of the activity period. The purpose of the prototype is to determine its effectiveness in meeting intended learning outcomes defined in Activity 2 and refine the script as necessary. The production will take place from July 2017 through January 2018. The team will begin with writing a summary outline of the script, including consultation with the project science advisors to incorporate the latest science-based results and data. The science will greatly drive the content in the script, so this consultation will inform the direction and schedule of completing the subsequent tasks of data collection and integration, creating new animations, and filming relevant sequences around the state.

The sections of the script are separated into content areas that represent our understanding of water at a variety of scales.
Cosmic: By taking a flight through the universe using a 3D digital atlas of astronomical data, the audience will learn about the distribution of water in our solar system, that it is mostly trapped in ice on various types of worlds, and the special characteristics of Earth that allow water to be in liquid form on the surface and thus be the only planet we know to support life. Water is not created or destroyed on planets like Earth. We have a fixed amount, and we must manage it wisely.
Global: The audience will see a satellite view of the distribution of water across the planet and examples of how changing natural and human forces impact where people live. We will also discuss the water cycle, and how water can move long distances in the atmosphere but it often stays closer to home, when it lands on Earth's surface as liquid water.
Regional: Impacts specific to each of the basins that trisect Minnesota and drain into three major bodies of water.
1. The Minnesota River, Lower Mississippi, Upper Mississippi, and St. Croix River basins, where water drains into the Gulf of Mexico.

Nitrogen coming from human activities upstream causes hypoxia, or a depletion of oxygen, causing dead zones which can no longer support living organisms, which is revealed by satellite ocean color remote sensing. One source of excess nutrients are farms, and farmers are using precision agriculture to make sure they most efficiently use nitrogen fertilizer, which both maximizes their crop yield and benefits the environment. One method is to use NASA and the U.S. Geological Survey's Landsat satellites to pinpoint where nitrogen is depleted, so farmers can use it only where it is necessary. This program segment will include a visualization of the process, including a view from the satellites to an aerial flight over their field, illustrations of how nitrogen enhances planet growth and can be carried downstream, an animation of the hydrological cycle, and a discussion with a farmer about how they use this for crop management.

2. Lake Superior and its basin, the headwaters of all of the Great Lakes.
Lake Superior holds 10% of Earth's accessible freshwater. It is one of the most rapidly warming lakes on Earth, and there are long-term changes to the ecosystem that might be resulting from this stressor. The production team will combine satellite views with footage of researchers exploring different facets of this ecosystem to illustrate issues affecting the Great Lakes such as invasive species, seasonally fluctuating lake levels, and ice cover. With a virtual flight over the deck of the University of Minnesota Duluth research vessel Blue Heron, audiences will meet researchers and dive underwater to view fish populations, invasive species, and the role of seasonal ice. The Minnesota Pollution Control Agency has identified key principles of management of the Lake Superior basin, focusing on water resource priorities, environmental outcomes, customer/public involvement, and integrating pollution reduction strategies for point and nonpoint sources. The program in Duluth will include a conversation about these principles.

3. The Red River of the North and Rainy River basins, which drain to Lake Winnipeg.
The increasing eutrophication (nutrient enrichment) of lakes across Minnesota due to excess phosphorus causes algal blooms which can produce toxins harmful to life, both human and aquatic. The program will include a visualization of how phosphorus is carried into rivers and lakes in sediment from urban and rural practices. Satellite views show us the seasonal algal blooms and water lake clarity. Citizens monitor lakes on a local scale with secchi disk readings, which scientists use to calibrate satellite imagery and make statewide monitoring more efficient. Assessing the water quality in the region is essential for effective environmental planning and management, and audiences in Moorhead will discuss these methods. The use of historic satellite data from back to the 1970s combined with existing data collection efforts and satellite land-use data can help determine the impacts different land-use practices have on lake conditions on a comprehensive regional scale.

Local: Audiences will see what specific issues are impacting their communities, how their local businesses and fellow citizens are taking action, and how they can join in. For example,

- Students building a rain garden
- Road builders using porous asphalt
- Businesses implementing zero discharge 100% wastewater recycling systems

The outcomes for this activity are the successful completion of each of the items listed 1-4.

Milestone dates for completing each of these tasks are listed in the outcomes table.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 63,754
Amount Spent: $ 62,454
Balance: $ 1,300

Outcome	Completion Date
1. Summary outline and schedule for production and data collection complete	September 15, 2017

2. Schedule for shooting fulldome stories and creating animations complete	October 15, 2017
3. Script complete	November 15, 2017
4. Initial version for testing with selected audiences complete	January 15, 2018

Activity 1 Status as of January 15, 2018*:*
Not submitted per instructions of LCCMR staff

Activity 1 Status as of July 15, 2018*:*
Outcomes 1, 3, and 4 for Activity 1 were accomplished with slight delays in the completion date, but not significant enough to delay the completion of the activity. Outcome 2 was determined not to be needed within the scope of this activity.

Over the period of September 2017-April 2018, the Project Manager Sally Brummel and Production Coordinator Pat O'Leary developed the summary outline, script, and prototype planetarium programs for each region: the Upper and Lower Mississippi and Minnesota rivers, the Red River of the North, and Lake Superior.

- The story and visuals for the Lake Superior story were developed in conjunction with project team members Dr. Robert Sterner of the Large Lakes Observatory and Jim Rock of the Marshall W. Alworth Planetarium in Duluth. Dr. Sterner wrote about the mission of the Large Lakes Observatory and some of their scientific research. Mr. Rock is a Dakota Indian and his portion of the story focused on the meaning of water in the Lake Superior region for Dakota and Ojibwe Indians. Mr. Rock and Dr. Sterner presented the story to the Duluth audiences.
- The Project Manager developed the story for the versions presented in the Twin Cities and Moorhead. Scientific review was done by Dr. Kate Brauman, Director of the Global Water Initiative UMM and participant in this project; Dr. George Weiblen, Bell Museum Science Director; Dr. Holly Menninger, Bell Museum Director of Public Engagement and Science Learning; and Dr. David Mulla, Professor & Larson Endowed Chair in Soil and Water Resources, Co-Director of Graduate Studies in the Department of Soil, Water, and Climate at the University of Minnesota. The story focused on the quality of water in the Red River, the Mississippi River, and the Minnesota River; and what researchers, farmers, and citizens are doing to improve the quality.

Activity 1 Status as of January 15, 2019*:*
The outcomes of Activity 1 were completed before this status update period. Funds were used to purchase production equipment and software.

Activity 1 Status as of July 15, 2019:
The outcomes of Activity 1 were completed before this status update period. Funds were used to purchase production equipment and software.

Activity 1 Status as of January 15, 2020:
The outcomes of Activity 1 were completed before this status update period.

Activity 1 Status as of July 15, 2020:
The outcomes of Activity 1 were completed before this status update period.

Activity 1 Status as of January 15, 2021:
The outcomes of Activity 1 were completed before this status update period.

Activity 1 Status as of July 15, 2021:

The outcomes of Activity 1 were completed before this status update period.

Activity 1 Status as of January 15, 2022:
The outcomes of Activity 1 were completed before this status update period.

Final Report Summary:
For activity 1 we created the pilot production of *Minnesota Water Stories* and presented it in 2018 to audiences in three cities around the state. Each city saw the same overall show except for versions tailored to the water issues in each region. Audiences in the Minnesota and Mississippi River basin learned about precision agriculture and its use to improve water quality, in the Lake Superior basin they learned indigenous connections to Minnesota's waters and how scientists are studying the ecosystems of Minnesota's large and inland lakes, and they learned about flooding in the Red River basin. This pilot testing informed the creation of the final production.

ACTIVITY 2: Audience Testing and Evaluation

Description: Evaluate prototype program and final production with planetarium professionals and community and school groups. This program is intentionally designed to be modified and updated as needed. This will allow the presenters to adapt to address audience needs, and current events. This process will be iteratively refined based on formative and summative feedback provided by the UMN Center for Applied Research and Educational Improvement (CAREI).

The intended outcomes for planetarium professionals are:
- Building knowledge of social-ecological issues;
- Building ability to deliver a presentation about Minnesota's waters;
- Viewing domes as a tool for communicating about social-ecological issues and systems (not just space science);
- Increasing programming about Minnesota's water in planetariums;
- Building relationships with community partners and external advisors.

For public attendees, school and community groups, the intended outcomes include:
- Increase in awareness of challenges facing Minnesota's waters;
- Have a positive affective/emotional response (i.e., awe, inspiration, amazement);
- Understand new relationship(s) of ecological problems to larger systems (e.g., the cosmic, global, regional, and local impacts);
- Have awareness of community resources / opportunities to work toward addressing the social-ecological problems.

The first round of evaluation—Phase 1-- will gather information about the prototype program presented in planetariums located in each of Minnesota's three drainage basins: Twin Cities, Duluth, and Moorhead. CAREI will interview planetarium professionals (3 total), will survey and hold focus groups with program participants from the general public (up to 150 for the survey and 24 for the focus groups), and will survey students from classrooms (approximately 225.)

The formative evaluation from Phase 1 will inform the production of the final program. The summative evaluation will be done with the online version. Approximately 450 community members who have visited a Minnesota planetarium in the past, and 225 students from the three major basins are expected to take the survey. The survey will be refined to gather objective, summative data from program participants about the affect program participation had on: a) changes in their awareness of the challenges facing Minnesota's waters;

b) their emotional response and interest in issues facing Minnesota's waters; c) their awareness of resources and opportunities available to address social-ecological issues, particularly issues related to Minnesota's waters.

During all stages of the evaluation, CAREI staff will work closely with Bell Museum project staff to design and refine all interview, focus group, and survey questions. CAREI will provide project staff with relevant formative and summative feedback in a timely manner.

Summary Budget Information for Activity 2:

ENRTF Budget: $91,000
Amount Spent: $86.667
Balance: $4,333

Outcome	Completion Date
1. Prototype testing with focus groups and surveys at each site	May 31, 2018
2. Interviews with planetarium professionals at each site	June 30, 2018
3. Deliver formative evaluation report to project staff	September 1, 2018
4. Final digital production testing at each site	May 31, 2021
5. Deliver summative evaluation report to project staff	June 30, 2021

Activity 2 Status as of January 15, 2018*:*
Not submitted per instructions of LCCMR staff

Activity 2 Status as of July 15, 2018*:*
Outcomes 1 and 2 were accomplished on time. Outcomes 3-5 will take place in years 2-3 of the project.

The prototype program was presented in Duluth, Bloomington, and Moorhead in April-May 2018. In each city there was one presentation for a public audience, and multiple presentations for school classes of grades 4-8.

The evaluation team from the Center for Applied Research and Educational Improvement (CAREI) worked with Project Manager Sally Brummel to develop the assessment tools for the prototype program in Duluth, Moorhead, and the Twin Cities. The tools included a written survey for all students and public attendees, focus group questions at each site with 5-7 adults, and interviews with each of the planetarium presenters. The tools were identical for each city. CAREI is taking the results of the surveys to provide a formative assessment by September 1, 2018.

In the Marshal W. Alworth Planetarium (MWAP), University of Minnesota Duluth, 97 5th, 7th, and 8th grade students in two classes saw the presentations and took the written survey, 43 people saw the public presentation and took the written survey, and seven adults from the public audience participated in the focus group. MWAP Program Director Jim Rock and Dr. Robert Sterner of the Large Lakes Observatory co-presented the story to the Duluth audiences.

In the Minnesota State University Moorhead Planetarium (MSUM), 117 8th grade students in three classes saw the presentations and took the written survey, four adults saw the public presentation and took the written survey, and the same four adults from the public audience participated in the focus group. Project Manager Sally Brummel and MSUM Planetarium Director Sara Schultz co-presented the story to the Moorhead audiences.

In the Bell Museum ExploraDome at Valley View Middle School in Bloomington, 115 6th-8thgrade students in five classes saw the presentations and took the written survey, 12 people saw the public presentation and took the written survey, and five adults from the public audience participated in the focus group. Project Manager Sally Brummel presented the story to the Bloomington audiences.

Activity 2 Status as of January 15, 2019*:*
Outcome 3 was met. The evaluation team from CAREI submitted the formative assessment of the pilot program in September, 2018. They reported on strengths and recommendations of the program.
Strengths

- There was a positive response from public and school audiences
- Audiences valued local perspective about Minnesota water issues
- The program led to increased knowledge and awareness of social-ecological issues around water
- Audiences learned about geography and history of the lakes
- Audiences gained scientific knowledge
- Audiences learned about global water issues
- Planetarium domes served as useful way to convey the information/connect with audience

Recommendations for improvement

- Include more content to mobilize people toward action to conserve water or to be an advocate for water
- Allow time for questions during the presentation
- Connect Minnesota's water challenges to global concerns
- Improve the quality of the images and better utilize the planetarium through more movement.

The most valuable finding was that the audience wanted ways to mobilize. After learning about the water challenges in the region, they wanted to know what they could do to help. We will put more of a focus on that in the final production.

The production team and evaluation team discussed the scope and format of the summative evaluation. The next step will be to prepare the tool in fall of 2019.

Activity 2 Status as of July 15, 2019:
There was no work for Activity 2 scheduled for this status update period.

Activity 2 Status as of January 15, 2020:
We met with the evaluation team to prepare the summative assessment tool.

Activity 2 Status as of July 15, 2020:
The summative assessment tool was prepared and ready for the presentations of *Minnesota Water Stories* in April and May 2020. When the Bell Museum closed and the presentations were cancelled, we met with the evaluation team to discuss what changes in the evaluation plan will be necessary. We intend to survey 225 students around the state, but at this point it is unlikely that school districts will allow students to visit planetariums. As described in the Activity 3 status update, we will produce a version of the show for access online, and will adjust the evaluation plan accordingly.

Activity 2 Status as of January 15, 2021:
There were no additional evaluation activities in this period.

Activity 2 Status as of July 15, 2021:
By January 2021, it was apparent that planetariums around the state would not be open in the 2020-2021 school year, and the Bell Museum would not be able to host any special events before the summer. We decided to switch our evaluation activities to the digital format. With the evaluation team we determined that we would be able to use the same survey questions we had intended to use for the planetarium production, to assess how the digital production meets the original intended outcomes described in this activity.

We recruited teachers from schools in each of the three water basins:

- Crosslake International School and Harbor City High School, Duluth (Lake Superior
- Horizon Middle School, Moorhead (Red River)
- Mankato Middle School and Walker-Hackensack-Akeley Schools, Mississippi River

A total of 197 students across five schools participated in the program and completed the survey. Over 90% of students were in middle school (i.e., 6th – 8th grade) with the remaining students in high school (i.e., 9th – 12th grade).

The Bell Museum conducted outreach efforts using their member and subscriber listserv, and Facebook. Email communication promoting participation and feedback on the web-based program was sent in April to the Bell Museum's 1,396 members. In May, an email communication promoting participation and feedback on the web-based program was shared with the Bell Museum's full listserv of 35,618 subscribers. The April communication to members resulted in 56 recipients clicking the link to the web-based program and the May communication to all subscribers resulted in 63 recipients clicking the link. Moreover, a Facebook posting was also used in May to promote participation and feedback for interested community members. Facebook campaign metrics noted that the posting reached 6,353 people, indicating that these individuals saw the posting in some shape or form (e.g., newsfeed). The engagement metric was 409, indicating that 409 individuals actively engaged with the posting (e.g., liked, shared, or commented on the posting). In all, there were 35 total general audience survey responses generated through these outreach strategies.

Overall, survey results from general audience community members, student participants and teachers indicate that the program accomplished its intended goals and helped to facilitate awareness and new learning regarding Minnesota waters and social-ecological concerns. Participants appeared to enjoy the web-based program and teachers reported that the program was easy for students to navigate and that they would consider using it again in the future. Recommendations from participants include: integrating more American Indian perspectives, more content on invasive species and the wildlife and plants that are dependent on Minnesota waters, identifying a deeper connection between Minnesotans and water, adjusting the format of hyperlinks to further support student navigation, and adding text-to-speech capabilities to be inclusive of all ability levels.

Activity 2 Status as of January 15, 2022:
There were no evaluation activities in this period.

Final Report Summary:
This project met its outcomes, though in a different way than we had intended. In phase 1 of the evaluation, where we showed the pilot *Minnesota Water Stories* (activity 1) to 338 people in Bloomington, Duluth, and Moorhead, we learned that audience members desired a call to action—how can they act on the issues that we presented, to improve the water quality in Minnesota and throughout the region? We focused on that for the final production (activity 3). The phase 1 evaluation is attached.

Phase 2 of the evaluation was to present Minnesota Water Stories to 450 community members and 225 students from the three major basins during April-June 2020, in their regions' planetariums. Due to the pandemic, there were no visitors in those planetariums at that time, and many of them had no visitors through the 2020-2021 school year. Instead of delaying the evaluation until an unknown time when the planetariums could reopen, we produced an online version of the planetarium show and developed a process to survey a similar number of people and determine if the content could meet the original outcomes in this alternate form. We were able to meet the outcomes as described in the attached phase 2 evaluation.

The intended outcomes for planetarium professionals are still to be determined. Five planetarium educators presented Minnesota Water Stories at the Bell Museum in 2021-2022. All have backgrounds and expertise in

astronomy, so confidently presenting a show on social-ecological issues and systems was a new opportunity for them. What provided the best development for their ability to use the dome to communicate these issues was the interaction with the audience. The production team and planetarium educators can determine how to create and present a show, but until they have spent some time presenting it to live audiences, they cannot anticipate how people will react. The questions that the Bell Museum presenters received and the water stories that some audience members chose to share helped refine how they will present the show for future audiences. This will continue for audiences around the state when *Minnesota Water Stories* shows in additional planetariums beginning fall 2022.

ACTIVITY 3: Final Production and Implementation State-wide

Description:
Informed by the results of the program testing, the production team will complete the script and finish post-production of final data and media elements in preparation for launch and promotion of program at each site and via the portable domes.

CAREI will complete the analysis of the data collected from the prototype production testing by September 1, 2018, and the production team will use these results to refine the script as necessary. The team will also customize the script for each region of the state, with consultation from the regional planetarium directors and members of their communities. The script revision will be complete by November 15, 2019.

Concurrent with the script revision, the production team will continue to gather new footage, animations, and data, and will complete the final production by October 1, 2020. Shooting of fulldome season specific footage occurs through summer 2019 to ensure two full seasonal cycles.

Minnesota Water Stories will premier to public audiences in the Bell Museum Planetarium in November 2019. The presentation will include a dialogue with the scientists who contributed to the production, as well as representatives of the community who are finding solutions to Minnesota's water issues. After the premier, the program will be available at the Bell Museum Planetarium for school and public audiences.

The Bell Museum production and education staff will hold training for the online program delivery with the regional planetarium professionals by June 2021.

In June 2021, the program will be available to audiences across Minnesota, through the eight planetariums in the network, as well as in the two portable planetariums that can travel anywhere in the state. The Bell Museum planetarium staff will continue to work with the regional planetarium directors to keep the content up to date with new science results and community solutions that are unique to their regions. This is a part of the sustainability of the program, as the Bell is committed to maintaining programmatic partnerships with the members of the network on a continuing basis. The planetariums will be able to use *Minnesota Water Stories* as intended when their theaters reopen.

Summary Budget Information for Activity 3:

ENRTF Budget: $345,246
Amount Spent: $339,456
Balance: $5,790

Outcome	Completion Date
1. Use evaluation results to refine script and customize it for each region	November 15, 2019
2. Complete final production	May 1, 2021
3. Final production premieres at Bell Museum Planetarium	June 11, 2021
4. Digital flat screen program delivery training for planetarium professionals	June 30, 2021

5. Planetarium and digital and flat screen program available for use at regional planetarium sites and via portable systems	June 30, 2021
6. Complete digital and flat screen production scene for use outside of the planetarium.	April 2021

Activity 3 Status as of January 15, 2018*:*
Not submitted per instructions of LCCMR staff

Activity 3 Status as of July 15, 2018*:*
No effort was necessary on Activity 3 in this reporting period.

Activity 3 Status as of January 15, 2019*:*
The Project Manager, Production Coordinator, and other project partners worked toward the completion of Outcome 1, the refinement of the pilot production script. This included using the results of the evaluation to determine what parts of the production need revision, and what new content to include.

The final production will include more emphasis on mobilizing the audience to action on water issues. This will be done in part by working with managers of Minnesota watershed districts and other similar organizations to include possible activities in each specific region of the state. The production team made contact with such organizations at the Minnesota Water Resources Conference in October, 2018.

The Production Coordinator tested cameras to use for fulldome photography and videography and made a purchase.

Activity 3 Status as of July 15, 2019:
The Project Manager, Production Coordinator, and other project partners continued to work toward the refinement of script for the final production.

The Production Coordinator began testing and acquiring photographs and videos with the fulldome camera to be used in the final production. The Project Manager and Production Coordinator ("production team").

The production team planned the schedule for when additional services will be needed for the final production; e.g., animation, sound editing, and video editing, and began looking for contractors.

The production team worked with project partners at the Large Lakes Observatory to plan photography and videography of the research vessel Blue Heron in July and August 2019.

The Project Manager and project partner Jim Rock presented a version of the pilot program at the University of Minnesota Duluth planetarium to students at the Lake Superior Youth Symposium on May 17, 2019.

Activity 3 Status as of January 15, 2020:
This was a very busy activity 3 period. The production team spent five days on Lake Superior onboard the Large Lakes Observatory's Research Vessel Blue Heron. We interviewed scientists and filmed them doing research using equipment on the boat. The topics we covered were climate change and the physics of Lake Superior, cyanobacteria turning Lake Superior and other lakes green, invasive species, and fish populations.

We also went to the University of Minnesota's Southern Research and Outreach Center, Waseca, MN to film scientists working on Precision Agriculture. We filmed the differing corn yields based on nitrogen fertilizer application, and how they are using drones to monitor the fields.

We are now producing the final elements of *Minnesota Water Stories*.

We have scheduled the premier of *Minnesota Water Stories* at the Bell Museum in April 2020, as part of a Saturday Spotlight Science with events related to water issues around the museum, and have scheduled presentations at planetariums around the state for April and May 2020.

Activity 3 Status as of July 15, 2020:
January-March 2020 was spent finalizing the production of *Minnesota Water Stories.* This included refinement of the script and assembling and editing the video and audio we recorded. We were four weeks away from the premier when we had to close the museum due to the pandemic and put production on hold. We continued what production work we could do with our home computers, but putting together the final production requires using the equipment in the planetarium, which we couldn't access for two months. As the closedown continued, we realized that even after the Bell Museum and the school and university planetariums open again, we do not expect to have the breadth of audience members see the show as we had planned. We made a new plan to produce some of the elements of the show for schools to access online.

We have gotten limited access to the planetarium as of June 2020 to continue the production work. We still do not have regular access and continue to do most of our work from home. We are tentatively planning on a premier of *Minnesota Water Stories* in June 2021.

Activity 3 Status as of January 15, 2021:

We have begun work on the online version of the planetarium show, with new additions to the production team that include a museum educator and web designer. We continue to work with the research partners who contributed to the planetarium show development. The online version is scheduled to launch in spring 2021.

Activity 3 Status as of July 15, 2021:
In this project period we completed outcomes 2, 3, and 6: completed the digital flat screen version for use online (outside of the planetarium) in April 2021, and completed the final planetarium production and premiered it at the Bell Museum in June 2021.

The statewide planetariums continue to be closed for public events until fall of 2021 at the earliest, so we have not yet completed the planetarium production for their sites or trained them to deliver the presentations. We will revisit the timeline for this once we know the planetariums' status.

Activity 3 Status as of January 15, 2022:
Minnesota Water Stories ran in the Bell Museum's planetarium weekly schedule from June 11-September 3, 2021. 670 visitors saw the show.

In September 2021 we started working on production revisions based on feedback from audiences and stakeholders. That includes the production or the statewide production. The show will return to the Bell Museum's schedule in March 2022. We still do not know the status of the statewide planetariums' opening and capacities, so we have not scheduled presentations at their sites.

Final Report Summary:
Activity 3 was the most significant and time intensive part of this project. Projects always turn out different than you expect, especially when one concludes more than six years after its initial conception. New people with different perspectives joined the project. The type and cost of equipment required for the state-of-the-art 360 production changed. And of course, the primary objective was "interaction in a planetarium." Due to the pandemic, that was not possible for the better part of the over two years of the project period.

From 2018-2022, the production team traveled across lakes, farmlands, and flood plains to capture how people are carrying out their passion for preserving this greatest of Minnesota's natural resources, water.. Scientists use drones to survey corn fields. They do complex data analysis. They deploy equipment deep into Lake Superior to monitor its temperature. They quantify the status of large lake ecosystems, from mussels to fish to the extent of algae blooms. And the indigenous inhabitants of this land we now call Minnesota have knowledge about how water has flowed on this land for thousands of years. We are able to take audience members on this journey, as if they were doing the discovery themselves.

We were still able to show *Minnesota Water Stories* to almost 1,000 people in the Whitney and Elizabeth MacMillian planetarium at the Bell Museum. Each time a presenter is in front of the audience, we get different reactions, different questions. This allows for an ongoing evaluation of the show. This type of planetarium production is not like a movie. It does not result in a recorded show that can never be modified again. Despite this project having concluded, we intend to continue to make changes as the need arises. We look forward to hearing from planetarium directors around the state about how their audiences interact with it, and what kind of changes or new content will better suit the desires of the people who see it.

V. DISSEMINATION:

Description:

The Project Manager and project partners will present the results of this project at regional and national planetarium and education conferences, such as the Minnesota Conference on Science Education and the Great Lakes Planetarium Association, and National Science Teachers Association.

The team will write an article to be submitted to the journal *The Planetarian*.

University of Minnesota Relations will provide press releases at key milestones of the project, such as the premiere of *Minnesota Water Stories* at the Bell Museum Planetarium in November 2019.

The program production will be available for planetariums beyond those participating in the project to use, in whole or in part, for their institutions. This will be sent as a digital file, upon request.

Status updates will be provided through social media sites

- Facebook www.facebook.com/BellMuseum
- Twitter @bellmuseum

Status as of January 15, 2018*:*

Not submitted per instructions of LCCMR staff

Status as of July 15, 2018*:*

Dissemination is not applicable for this reporting period.

Status as of January 15, 2019*:*

The Project Manager and evaluation team from CAREI presented the project at the Minnesota Water Resources Conference on October 17, 2018.

Status as of July 15, 2019:

Dissemination is not applicable for this reporting period.

Status as of January 15, 2020:

Dissemination is not applicable for this reporting period.

Status as of July 15, 2020:

Not submitted pending amendment request.

Status as of January 15, 2021:

Dissemination is not applicable for this reporting period.

Activity 2 Status as of January 15, 2022:
The Project Manager presented the project as a poster at the Minnesota Water Resources Conference on October 19, 2021.

Final Report Summary:
The project team shared the process of the production at various conferences through methods described above. The ultimate dissemination is sharing *Minnesota Water Stories* with citizens around the state. In fall 2022 it will be available for the first time for school visitors to the Bell Museum, and to show in additional planetariums in Moorhead, St. Paul, St. Cloud, Rochester, Mankato, Marshall, Hibbing, Duluth. Over the next five years, we expect tens of thousands of people to interact with the show.

VI. PROJECT BUDGET SUMMARY:
A. Preliminary ENRTF Budget Overview:
***This section represents an overview of the preliminary budget at the start of the project. It will be reconciled with actual expenditures at the time of the final report.**

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $5,000: N/A

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 4.3

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
University of Minnesota in-kind	$6,812	$8,974	Dr. Robert Sterner, Director - UMD Large Lakes Observatory - (75% salary, 25% benefits) 1% time FTE - Science content and data advisor
University of Minnesota in-kind	$41,317	$46,693	Jessica Herrington, Planetarium Director ~~Dr. Marc Seigar, Professor and Department Head -~~ UMD Dept. Physics and Astronomy - (80% salary, 20% benefits) 10% time FTE - Program design and implementation
University of Minnesota in-kind	$4,875	$0	Dr. George Weiblen, Scientific Director-UMN Bell Museum of Natural History - (75% salary, 25% benefits) 1% time FTE - Science advisor
State			
	$0	$55,667	
TOTAL OTHER FUNDS:	**$53,000**	**$55,667**	

VII. PROJECT STRATEGY:
A. Project Partners:

Partners receiving ENRTF funding

- Sally Brummel, Planetarium Program Manager, Bell Museum of Natural History, $78,000, Project Manager
- Dr. Kate Brauman, Lead Scientist, Global Water Initiative, Institute on the Environment, University of Minnesota, $17,000, Science content and data advisor
- Sarah Komperud, Planetarium Educator, Bell Museum of Natural history, $25,250, Program design and implementation
- James Rock, Instructor and Planetarium Program Director, University of Minnesota Duluth Department of Physics and Astronomy, $30,150, Program design and implementation
- Lisa Sundberg, Outreach Coordinator, University of Minnesota Duluth Large Lakes Observatory, $15,000, program design, implementation, and management
- Patrick O'Leary, Production Coordinator, Bell Museum of Natural History, $156,650, Production Coordination
- Thaddeus LaCoursiere, Planetarium Educator, Bell Museum, $26,590, visual prodcution

Partners NOT receiving ENRTF funding

Regional Planetarium Directors:

- Dave Burgess, Planetarium Director, Mankato East High School
- John Iverson, Planetarium Director, Como Planetarium
- Paul Larson, Planetarium Director, Mayo High School
- Ken Murphy, Planetarium Director, Southwest Minnesota State Universty Planetarium
- Ronald Schmit, Observatory Coordinator, Jackson Middle School
- Sara Schultz, Planetarium Coordinator, Minnesota State University Moorhead Planetarium
- Brian Wallace, Planetarium Director, Forestview Middle School
- Kevin Milani, Planetarium Director, Palucci Space Theater

B. Project Impact and Long-term Strategy:

Part of the Bell Museum's mission is to explore our connections to nature and the universe and create a better future for our evolving world. This compliments one of the purposes of the Environment and Natural Resources Trust Fund, to "protect, conserve, preserve, and enhance Minnesota's air, water, land, fish, and other natural resources for the benefit of current citizens and future generations." Citizens who see *Minnesota Water Stories* will increase awareness of challenges facing Minnesota's waters and gain awareness of community resources and opportunities to work toward addressing the social-ecological problems. When the new Bell Museum and Planetarium opens in 2018, annual attendance is projected to more than double, and combining that with the reach of this program across the planetarium network, the population of citizens who understand water challenges and will be inspired to act will increase by the thousands. *Minnesota Water Stories* will be available for school and public audiences statewide beyond the funding period.

This project presents the opportunity to build on the NASA-Funded "Immersive Earth" project, where five teams of planetarium professionals and middle school educators worked together to create Earth science lessons for the classroom and planetarium. While *Minnesota Water Stories* is not written explicitly for middle school audiences, the educators can utilize the script, data, and animations, in part or in whole, in combination with other resources, to create a program that would fit into a middle school curriculum. Planetarium professionals and educators are already skilled at creating new programs from existing materials, and so *Minnesota Water Stories* will provide a new set of resources.

Bell Museum stakeholders have concerns about water conservation issues and we will seek their partnership to sustain the programming effort, whether it be reaching new audiences and/or production of new content.

C. Funding History: N/A

VIII. REPORTING REQUIREMENTS:

- The project is for 4 years, will begin on 07/01/17, and end on 06/30/21.
- Periodic project status update reports will be submitted January 15 and July 15 of each year.
- A final report and associated products will be submitted between June 30 and August 15, 2021.

IX. VISUAL COMPONENT or MAP(S):

See attached graphic

X. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: Not applicable

Environment and Natural Resources Trust Fund
M.L. 2017 Project Budget-Final

Project Title: Interactive Water Resource Programs for Planetariums in Minnesota
Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 05c
Project Manager: Sally Brummel
Organization: University of Minnesota - Bell Museum
M.L. 2017 ENRTF Appropriation: $500,000
Project Length and Completion Date: 5 Years, June 30, 2022
Date of Report: November 18, 2022

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Revised Activity 3 budget November 18,	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL SPENT	TOTAL BALANCE
BUDGET ITEM												
Personnel (Wages and Benefits)	**$49,000**	**$49,000**	**$0**	**$23,000**	**$23,000**	**$0**	**$269,977**	**$269,977**	**$0**	**$341,977**	**$341,977**	**$0**
Dr. Kate Brauman, Lead Scientist Global Water Initiative - UMN Institute on the Environment (75% salary, 25% benefits) 5% time FTE each year for 3 years- Science content and data advisor ($17,000)												
Sally Brummel, Planetarium Manager - UMN Bell Museum of Natural History(75% salary, 25% benefits) 20%time FTE Yr 1 and 10% time FTE Yr 2-3 Project implementation and management ($30,000) 30% time FTE Yr4 ($26,200)												
Sarah Komperud, Planetarium Educator- UMN Bell Museum of Natural History (80% salary, 20% benefits) 10% time FTE each year for 3 years - Program design and implementation ($15,000), 15% time FTE Yr 4 (75% salary, 25% benefits) ($10,250)												
Patrick O'Leary, Production Coordinator - (09/15/2017) UMN Bell Museum of Natural History (75% salary, 25% benefits) 10% FTE September 18 2017-January 7 2018 ($8000); 40% FTE August 6 2018-June 30 2020 ($71,000), 55% Time FTE Yr 4 ($53,000)												
Thaddeus LaCoursiere, Planetarium Educator – UMN Bell Museum (75% salary, 25% benefits) 25% time FTE Yr 4- Planetarium Program Production ($13,500)												
Kaitlin Ehert, Planetarium Outreach Educator – UMN Bell Museum (75% salary, 25% benefits) 10% time FTE Yr 4- Program Implementation ($5,200)												
Mila Velimirovich ,-Museum Educator – UMN Bell Museum (75% salary, 25% benefits) 15% time FTE Yr 4-Online Program Development ($8,500)												
Adrienne Wiseman, Director of Business & Marketing– UMN Bell Museum (75% salary, 25% benefits) 10% time FTE Yr 4- Program Marketing and Web Design ($13,000)												
James Rock, Instructor and Planetarium Program Director - UMD Dept. Physics and Astronomy (80% salary, 20% benefits) 10% time FTE each year for 3 years - Program design and implementation ($24,000); 5% time FTE Yr 4 ($4,000)												
Lisa Sundberg, Outreach Coordinator - UMD Large Lakes Observatory (80% salary, 20% benefits) 10% time FTE Yr 1,3 20% time FTE Yr 2 - Program design, implementation and management ($15,000)												
UMNUndergraduate student presenters/workers 3 students at 150 hrs each for Yr 4 Program implementation ($5000)												
Professional/Technical/Service Contracts	**$0**	**$0**	**$0**	**$61,000**	**$60,684**	**$316**	**$56,023**	**$50,921**	**$5,102**	**$117,023**	**$111,605**	**$5,418**
Fulldome production team, $246,000 over 3 years	$0						$31,350	$21,447		$31,350	$21,447	
CAREI, Evaluation				$61,000	$60,684	$316				$61,000	$60,684	
4 days videography on board LLO Blue Heron	$0						$21,000	$20,963		$21,000	$20,963	
2 days videography on board LLO Blue Heron							$10,400	$5,584		$10,400	$5,584	
Honoraria for teacher education activity review							$2,000	$1,350		$2,000	$1,350	
Equipment/Tools/Supplies	**$8,754**	**$8,754**	**$0**	**$0**	**$0**	**$0**	**$16,246**	**$15,561**	**$685**	**$25,000**	**$24,315**	**$685**
Media and music rights ($6,000)												
Production Software ($2,000)												
Production Computers (2) (4,000)												
Data storage- ($1,000)												
Fulldome Video Camera--Insta360 Pro ($2,300)												
50MP DSLR Camera ($3,500)												

Fisheye lens ($1,000)												
Aerial drone octocopter ($2,000)												
Camera mount ($3,000)												
Sound equipment, camera accessories, and batteries ($2,700)												
Printing	**$0**	$0	**$0**	**$1,000**	$222	**$778**		$0	**$0**	$1,000	**$222**	**$778**
Printing at $0.12/page ($1,000)												
Travel expenses in Minnesota	**$6,000**	$4,700	**$1,300**	**$6,000**	**$2,761**	**$3,239**	**$3,000**	$2,997	**$3**	**$15,000**	**$10,459**	**$4,541**
Travel: 35 3 day/2 night trips at $350/trip based on UMN travel reimbursement policy Directly related to production: $4,200 (6 trips for 2 travelers - e.g. visits to farm site-visit, northwoods citizen monito), rural business and school site) Directly related to evaluation: $4,900 (7 trips for 2 travelers to partner sites - Moorhead and Duluth--2 trips each, Mankato, Marshall and Rochester--1 trip each) Directly related to program testing: $1,400 (2 trips for 2 travelers to partner sites for initial community program - Moorhead and Duluth); Directly related to program implementation: $1,750 (5 trips for 1 traveler to partner sites - Moorhead, Duluth, Mankato, Rochester and Marshall) Rental car, 60 days at $50/day $3000 Gas 1200	$6,000	$4,700	$1,300		$1,947		$3,000	$2,997		$9,000	$9,645	
Other										**$0**	**$0**	**$0**
COLUMN TOTAL	**$63,754**	**$62,454**	**$1,300**	**$91,000**	**$86,667**	**$4,333**	**$345,246**	**$339,456**	**$5,790**	**$500,000**	**$488,577**	**$11,423**

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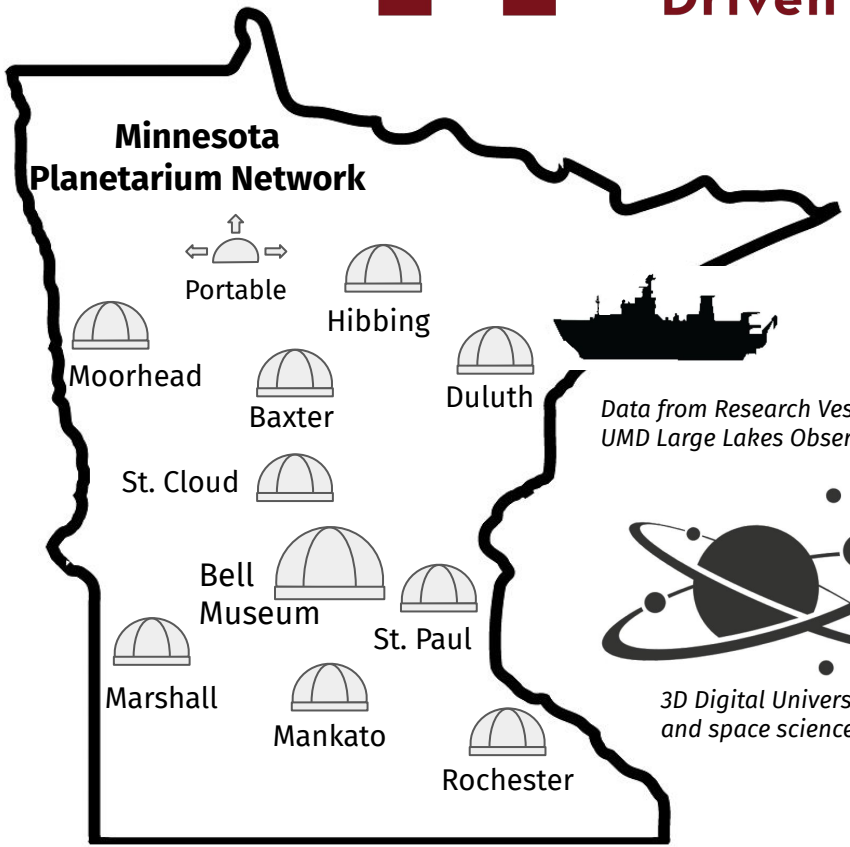

Data from Research Vessel Blue Heron
UMD Large Lakes Observatory

3D Digital Universe Atlas Earth
and space science data

Minnesota Water Stories (local, regional, global) produced for interactive use in digital planetarium theaters around the state fostering important dialogue on water issues.

The Bell Museum is part of the University of Minnesota's College of Food, Agriculture and Natural Resource Sciences (CFANS)