

PRIORITIZE, TARGET, AND MEASURE APPLICATION NEEDS ASSESSMENT

A Master Plan for the Future

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Acronyms and Common Terms

1W1P = One Watershed One Plan

BMP = Best Management Practice

BWSR = Board of Water and Soil Resources

EPA = Environmental Protection Agency

ESRI = Environmental Science and Research Institute

GIS = Geographic Information Systems

HUC = Hydrologic Unit Code

IWI = International Water Institute

LGU = Local Government Unit

MnGEO = Minnesota Geospatial Information Office

MNIT@BWSR = Minnesota IT Services at the Board of Water and Soil Resources

PTMApp = Prioritize, Target, and Measure Application

PTMApp – Desktop = Prioritize, Target, and Measure Application for Desktop

PTMApp – Web = Prioritize, Target, and Measure Application for Web

RRWMB = Red River Watershed Management Board

RUSLE = Revised Universal Soil Loss Equation

SSURGO = Soil Survey Geographic Database

TN = Total Nitrogen

TP = Total Phosphorus

TSA = Technical Service Area

WQDSA = Water Quality Decision Support Application

WRAPS = Watershed Restoration and Protection Strategies

Executive Summary

The Prioritize, Target, and Measure Application (PTMApp) is a decision support tool used by local government staff to prioritize locations within a watershed to target conservation work, identify opportunities where conservation may be best implemented, and estimate the benefit of that conservation towards meeting one or more water quality goals. The application was originally developed in 2012 as the Water Quality Decision Support Application (WQDSA) by the International Water Institute (IWI) and Houston Engineering, Inc. (HEI) with funding from the MN Board of Water and Soil Resources (BWSR) Accelerated Implementation Grant program (via the Clean Water Fund) and the Red River Watershed Management Board (RRWMB). A second Clean Water Fund was awarded in 2014 to develop the PTMApp prototype. As a result of the project, PTMApp became available both as a desktop application (PTMApp – Desktop) compatible with Environmental Science and Research Institute (ESRI) ArcGIS Desktop software as well as in a web environment (PTMApp – Web). PTMApp data was intended to be developed in PTMApp – Desktop and accessed and used in PTMApp – Web to meet daily local government business needs. In 2016, BWSR adopted the program and funded additional enhancements, maintenance, and technical support. A second contract was signed in September 2018, effective through June 30, 2020, for additional development and technical support.

The principal goal of this contract period is to bring the PTMApp prototype to a production application. To direct this process, a Needs Assessment was proposed to guide future enhancements, maintenance, technical support, and software and hardware needs both for the near term and future. This Needs Assessment is intended to serve as the road map for PTMApp through the immediate contract period (ending June 30, 2020) and will provide some planning recommendations through the 5-year planning horizon (ending December 31, 2023). Assessing PTMApp needs 5 years into the future is challenging as software and hardware technology are changing rapidly. However, a 5-year vision for PTMApp seems warranted considering the potential fiscal and resource investment by BWSR.

The first step in defining priorities for this contract period is re-establishing the business needs of PTMApp users. Business needs were originally established as part of the Blue Ribbon Panel, convened during PTMApp prototype development. The panel consisted of LGU and state agency staff who were expected to use the application and its products regularly. Business needs were translated into standard information products to support local water quality decisions for short term and long-term watershed planning. These products have been updated and expanded to now also consider field-scale implementation and landowner engagement (**Figure 1**). To better reach, communicate to, and train PTMApp users, targeted user groups were defined based on expected use and skill level (**Figures 2 and 3**). Users in groups A, B, and D are the intended audience of training materials developed during the contract period as they are the expected users most qualified to create and use products to meet local government business needs. Users in group E, made up of policymakers and the general public, are not expected to interact with either PTMApp – Desktop or PTMApp – Web, but should be trained in how to understand and communicate information developed within PTMApp. The Business Needs will be finalized during discussion with the BWSR Internal PTMApp Team and the External PTMApp Committee. The former is made up solely of BWSR staff and will comment on the specific business needs from BWSR's perspective. The latter is made up of a diverse audience outside of BWSR to provide perspective of potential users.

The long-term vision for the use of PTMApp products address and integrate BWSR's life cycle for water quality business decisions; i.e. from planning, to implementation decisions, through tracking constructed projects and quantifying measurable outcomes of completed projects. The long-term vision for PTMApp – Web is to create a bridge between PTMApp and the application BWSR uses to track funded projects (i.e., eLINK). This vision will not be realized during this contract period, but steps can be made to initiate that progress, beginning with working towards the original vision that PTMApp-Web meet at least 80% of BWSR's and the LGU's daily water quality business needs. Specifically, this means improving existing functionality and adding new features that improve LGU staff's ability to prioritize areas in need of conservation, target areas where opportunities exist to implement, and measure benefit and progress toward reaching water quality goals. This was started with functions such as the Interactive Map and Targeted BMP Action Report (i.e. Action Report). These existing functions will be enhanced and others added based on user feedback to work towards achieving the 80% business need vision. **Table 1** lists the specific enhancements which will be completed for PTMApp – Web during the contract period. The immediate priority, which is already under way, is achieving a robust, stable, and scalable web application which users can trust to host their data and be accessible and usable for years to come.

The PTMApp – Desktop investment decisions are directly related to the overall business model that most user need (>80%) will be met by using PTMApp – Web. Following this model, the number of PTMApp – Desktop users should be relatively small and the user's skill level higher as compared to typical web users. Proposed investment in PTMApp – Desktop improvements focuses on (1) reducing processing bottlenecks, and (2) improving product creation on PTMApp – Desktop to better meet user need on PTMApp – Web. This is done through three specific tasks to bolster existing data and functionality and to modify BMP Suitability and Benefit Analysis to estimate conservation benefit based on NRCS practice type (as opposed to treatment group) (**Table 1**). Two technical memorandums will also be drafted to explore feasibility of future enhancements to the toolbar (**Table 1**)

Finally, a primary focus of this contract period is to improve user understanding of PTMApp and increase overall adoption of the platform, specifically PTMApp – Web. To accomplish this, a three-prong approach is recommended:

- **Communication and Outreach Campaign:** Develop a strategy and materials to better inform LGU and state agency staff about the platform and its capabilities.
- **Training:** Once (potential) new users are aware of the program, and to better inform our existing users, develop resources specifically targeted to their unique needs which may ease their use and improve their experience. This will be based on user groups and skill levels shown in **Figures 2** and **3**.
- **Input Creation:** Consider developing and formatting common PTMApp-Desktop inputs which may shorten the learning curve, allowing users to more quickly and easily develop output products.

This approach both improves the experience of existing users while also increasing the pool of potential new users. It is also important state agency and policymakers are aware of and understand PTMApp so that they may aide in communicating the benefit of the application to local government staff which see them as a resource.

Table 1. Summary of actions to be completed for each task and (where available) subtask as listed under the Prioritize, Target, and Measure Application (PTMApp) contract (Swift contract number 146576). A more detailed description of each action is provided in the text of this Needs Assessment.

Task and Subtask Descriptions	Summary of Actions to be Completed
Task 1: Project Kickoff and PTMApp User Needs Assessment	
Complete PTMApp User Needs Assessment and Establish Technical Direction	<ul style="list-style-type: none"> • Development of a Needs Assessment setting "road map" for future BWSR planning and investment • Establishment of a BWSR Internal Team and External Committee to review Needs Assessment and comment on direction, business needs, and overall future priorities.
Task 2A: PTMApp - Web Application	
2Ai: Development Server Hosting	Continued maintenance and support of a development instance of the PTMApp - Web application.
2Aii: System Maintenance	General program upgrades to maintain system functionality.
2Aiii: MNIT and MNGEO Support	System hosting and technical support for MN IT Services (MNIT) and the Minnesota Geospatial Office (MNGEO).
2Aiv: Application Testing	Test new system functionality and maintenance items in the development instance.
2Av: New PTMApp-Web Enhancements	<p>Complete the following enhancements to improve functionality, performance, and scalability of the PTMApp - Web application:</p> <ul style="list-style-type: none"> • Scalability and performance improvements to PTMApp - Web code structure to support current and future watersheds. • Enhancements to the administrative user interface and supporting code to improve the user experience and ease of services publishing. • Improvements to Targeted Conservation Portfolio (i.e. Action Report) based on user feedback. • Align Interactive Map and Action Report with Natural Resource Conservation Services (NRCS) practice types. • Support display of select rasters on Interactive Map which are used often for planning and implementation. • Development of the Watershed Implementation Scenario Report (i.e. Scenario Builder) to allow for rapid generation of action plans.
Task 2B: PTMApp - Desktop Application	
2Bi: System Maintenance and Version Upgrades	Provide necessary system maintenance and support for PTMApp - Desktop for ESRI ArcGIS Desktop version 10.6 and for ArcPro.
2Bii: User Support and Access	Provide technical support and other resources for PTMApp - Desktop users.
2Biii: Increase System Support and Performance	<p>Continue to pursue avenues for ensuring consistent functionality and performance for PTMApp - Desktop users. Complete development, testing, and deployment of the following items to reduce known performance bottlenecks:</p> <ul style="list-style-type: none"> • Limited parallel processing on tools from the ESRI Hydrology Toolset • Optimized Internal Table Writing

Task and Subtask Descriptions	Summary of Actions to be Completed
2Biv: New PTMApp Desktop Enhancements	<p>Complete the following enhancements to improve functionality of PTMApp - Desktop:</p> <ul style="list-style-type: none"> • Estimation of best management practice (BMP) benefits for individual NRCS BMP types in lieu of treatment groups. • Testing and upgrades to the Integrated Agricultural Conservation Planning Framework (ACPF) – PTMApp (IAPA) for consistency with updates to ACPF. • Updated Base catalog. <p>Draft two technical memorandums to explore the feasibility of incorporating additional enhancements in the future:</p> <ul style="list-style-type: none"> • Nutrient and sediment sources from streambank and bluff erosion. • Hydrologic routing and altered hydrology.
Task 2C: PTMApp Training	
2Ci: In-person workshops: PTMApp - Desktop and PTMApp - Web	Development of user-focused (Figure 2) workshop modules designed for select user skill levels (Figure 3).
2Cii: Interactive and Remote Training Modules	Development of video training sessions based on in-person modules and content.
2Ciii: Outreach Campaign	Creation of an outreach campaign to target potential new users and provide resources to engage them.
Task 2D: Statewide Adoption of PTMApp Needs Assessment	
Seek to increase user adoption by developing statewide datasets.	Explore options for providing statewide data to users which may decrease the "learning curve".

Figure 1. Graphic showing the “standard information products” created using Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) and provided through PTMApp – Web for planning (top) and implementation (bottom).

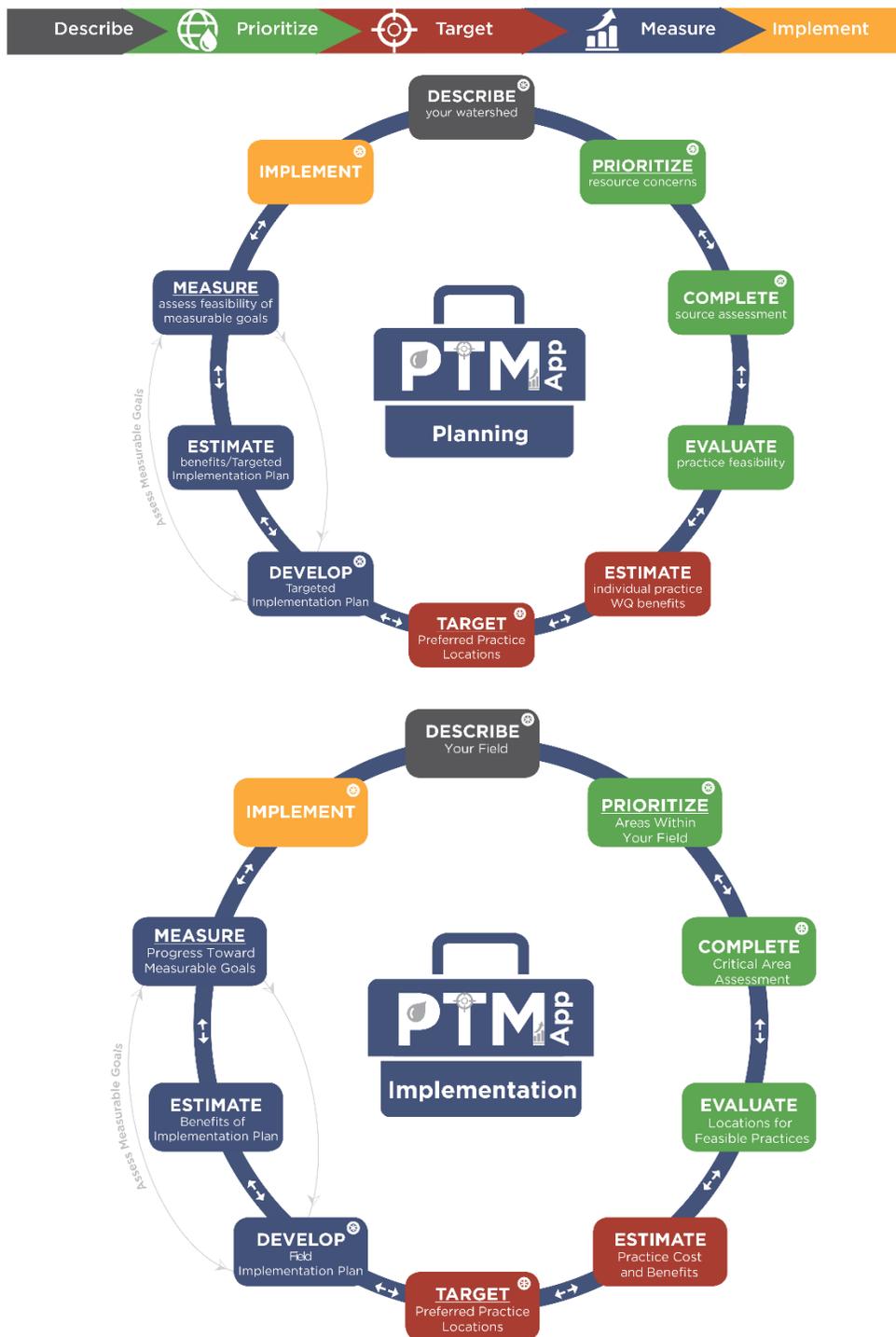


Figure 2. Relationship between the water quality business need, type of decision maker using PTMApp products, and expected minimum skill level associated with the business need.

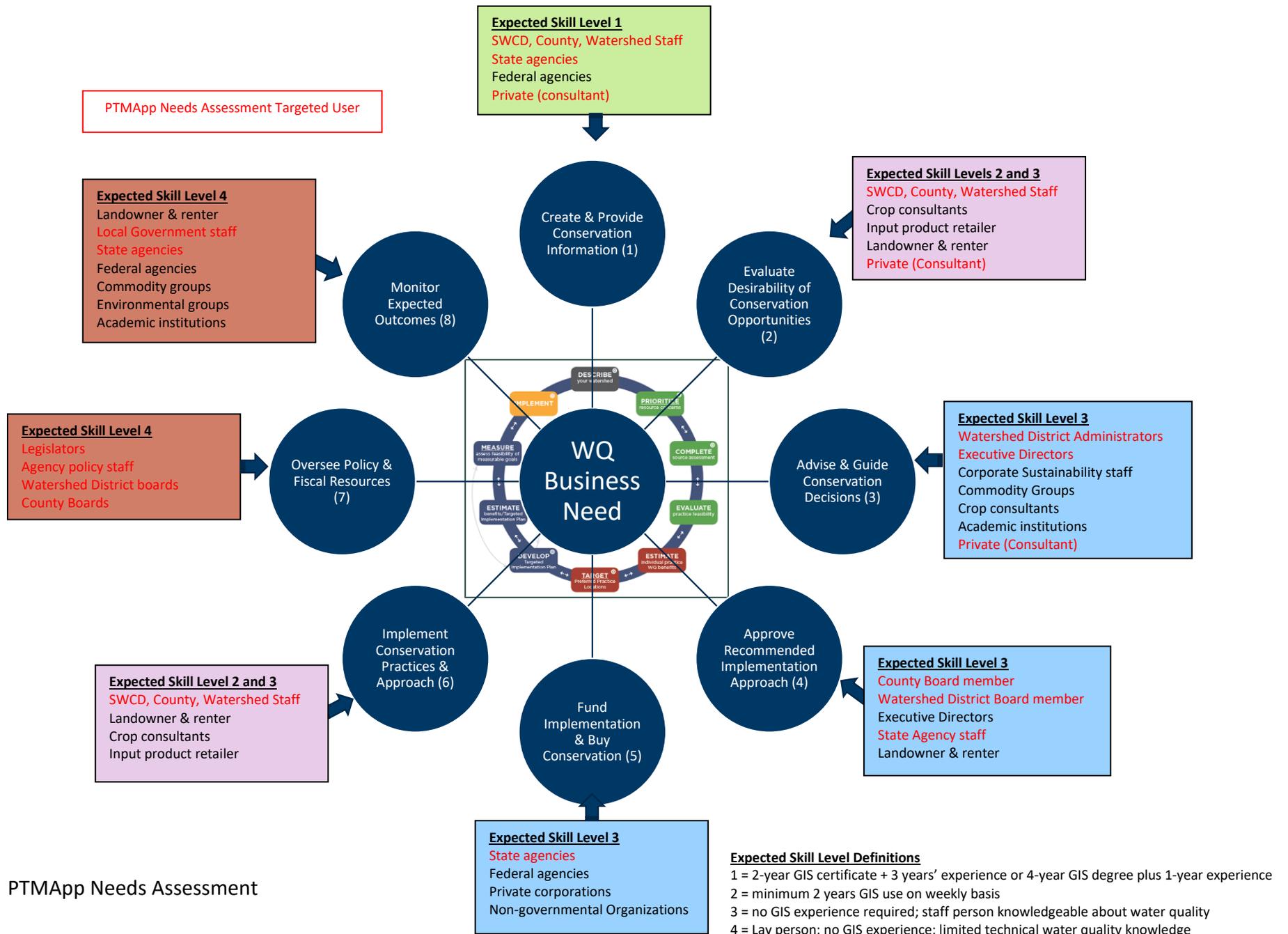
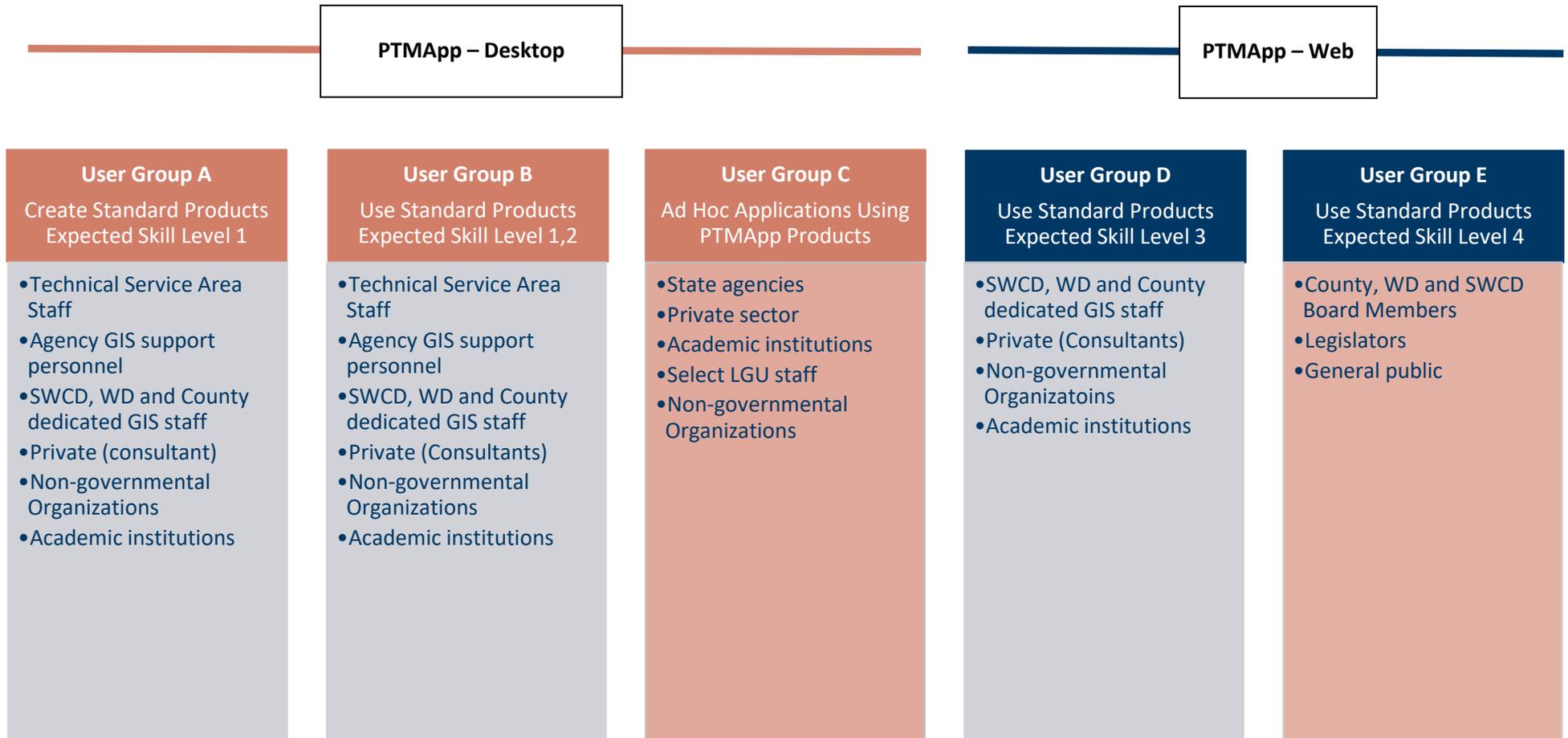


Figure 3. Prioritize, Target, and Measure Application (PTMApp) user groups, Geographic Information System (GIS) expected skill levels, and user type.



Immediate Focus is Needs of These User Groups

Expected Skill Level Definitions

- 1 = 2-year GIS certificate + 3 years' experience or 4-year GIS degree plus 1-year experience
- 2 = minimum 2 years GIS use on weekly basis
- 3 = no GIS experience required; staff person knowledgeable about water quality
- 4 = Lay person; no GIS experience; limited technical water quality knowledge

Introduction

Background

The concept for what is now PTMApp originated from discussions with Minnesota Local Units of Government (LGUs) about their need for “better” data for making water quality decisions. LGU staff, from counties, soil and water conservation districts, and watershed districts search for information needed to make water quality decision including: 1) identifying opportunities for implementing conservation practices on a specific field when the agricultural producer walks through the door seeking assistance; 2) determining whether a conservation practice has water quality value; 3) understanding whether the amount of money paid for a conservation practices falls within a reasonable range; 4) assembling many practices within a watershed into a plan to achieve water quality goals; and 5) assessing whether water quality goals are fiscally and technically feasible. Although there are an abundance of watershed and water quality models, data generated from them can rarely be conveniently accessed and presented in an understandable manner that aligns with LGUs staff decision-making processes. PTMApp was developed to address this need for better information products which are readily available to LGU staff.

The IWI recognized the need for better and more accessible information in early 2012 through their interaction with LGU staff. The IWI along with HEI, initially developed the WQDSA with funding from the BWSR Accelerated Implementation Grant program (via the Clean Water Fund) and the RRWMB. The WQDSA focused on developing and demonstrating an approach to estimate the amount of sediment, total phosphorus (TP) and total nitrogen (TN) transported off urban and rural lands and conveyed downstream by surface water runoff. The WQDSA included two pilot watersheds within the Minnesota portion of the Red River Basin to estimate the load reduction value of agricultural structural best management practices (BMPs) and target locations for identifying and obtaining funding to implement the “best” structural BMPs to protect Lake Emily in Pope County, Minnesota.

A second (2014) IWI Clean Water Fund award led to the current PTMApp prototype application. The IWI and HEI convened a “Blue Ribbon Panel” comprised of water quality practitioners from LGUs to guide information product development. Water quality information products believed valuable in making water quality decisions were developed and ranked by the Blue Ribbon Panel to determine their value for decision making.

The notion of “standard PTMApp information products” to support local water quality decisions (see **Figure 1**) came from the work of the Blue Ribbon Panel. The IWI and HEI developed the desktop application (PTMApp – Desktop) to create an extensive water quality geodatabase using ESRI technology which is ported to a web application (PTMApp – Web) to create a suite of standard information products for use. Accessing the standard information products through the web was expected to meet LGU staff needs to efficiently access information

without the need to be literate in Geographic Information Systems (GIS) or confer with external technical resources. Although many PTMApp – Web architecture ideas were conceived by the Blue Ribbon Panel, funding limitations allowed only a few to be implemented.

The fully functioning PTMApp – Desktop was used to develop a comprehensive watershed plan through the One Water One Plan (1W1P) Program for the Root River Watershed in southeast Minnesota. Recognizing the value of PTMApp, and because of similar business needs, BWSR funded additional enhancements, maintenance, and technical support of PTMApp and formally adopted the platform in 2016. This prompted dedicated funding to support further development and maintenance of PTMApp into the future.

The Minnesota Geospatial Information Office (MnGEO) joined the PTMApp team in late 2017 and soon after assumed responsibility of hosting PTMApp – Web from the IWI and HEI. BWSR initiated training sessions focused on using both PTMApp – Desktop and PTMApp – Web for LGU and BWSR staff. Several PTMApp – Desktop¹ enhancements were developed, tested, and incorporated to identify potential agricultural structural BMP locations based on Natural Resource Conservation Service (NRCS) design criteria.

Use of PTMApp within Minnesota is increasing. Standard information products are used for completing watershed plans through 1W1P and to identify the best structural practices to improve water quality for specific lakes, streams, and rivers. Use within North Dakota and Iowa also began in 2016.

Most recent efforts for improving PTMApp (Web and Desktop) have focused on generating and obtaining the standard information products. Notably, the recent development of the Action Report tool on PTMApp – Web, allows users to rapidly develop lists of “preferred” practices for implementation based on their desired ranking criteria.

In 2018, BWSR selected the team comprised of HEI and the IWI to enhance, support, and maintain PTMApp for a 2-year period. A central component of the HEI / IWI proposal focused on developing a Needs Assessment to serve as a master plan for guiding enhancements, maintenance, support, and funding needs for project partners into the future.

¹ PTMApp -Desktop is publicly available without fee and is now being used to develop standard information products within Minnesota, North Dakota, Iowa, and Manitoba.

Document Purpose

As PTMApp moves from prototype to production, a process outlining future enhancements, maintenance, technical support, and software and hardware needs both for the near term and future is needed. This Needs Assessment is intended to serve as the road map for PTMApp through the immediate contract period (ending June 30, 2020) and will provide some planning recommendations through the 5-year planning horizon (ending December 31, 2023). Assessing PTMApp needs 5 years into the future is challenging as software and hardware technology are changing rapidly. However, a 5-year vision for PTMApp seems warranted considering the potential fiscal and resource investment by BWSR.

Project Team: Members, Expectations, and Processes

Project Team Members

The project team consists of a public, private, and non-profit partnership led by BWSR and supported by the Minnesota IT Services (MNIT@BWSR). Team members include BWSR, MNIT@BWSR, MnGEO, and the consultant team of HEI / IWI. Project team guidance and direction is provided by BWSR and MNIT@BWSR. Lead technical roles can be placed into the categories: 1) application enhancement; 2) operation; 3) maintenance; 4) training; and 5) education and communication. **Table 2** provides a description of each category and the entity with the lead technical role.

The project team has developed an expectation for: 1) supporting and enhancing PTMApp – Web and PTMApp – Desktop in the most cost-effective manner; 2) an intuitive, efficient, and positive user experience; 3) timely response to the growing user community; and 4) an application which effectively meets the business needs of LGUs and BWSR for making water quality decisions.

Table 2. Team role categories, category descriptions, and team member(s) with the lead technical responsibility for supporting the Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) and for Web (PTMApp – Web), as directed by Board of Water and Soil Resources (BWSR) and Minnesota IT Services (MNIT@BWSR) staff.

Category	Description	Responsibility
PTMApp – Web		
Application Enhancement	Add new functionality to the web application. Conceptualize, program, and test enhancements on the development site.	Houston Engineering, Inc. (HEI) / International Water Institute (IWI)

Category	Description	Responsibility
Operation	Application hosting and support on a daily basis in the production environment. Primary emphasis for support is related to Amazon Web Service hosting and performance issues.	Minnesota Geospatial Services (MnGEO)
Maintenance	Respond and resolve non-hosting related application run time errors, “bug fixes”, and problems.	HEI / MnGEO
Training	Development of instructional materials and the delivery of on-line and in-person user training sessions.	HEI / IWI
Education and Communication	Communication with users and development of video training materials.	HEI / IWI
PTMApp – Desktop		
Application Enhancement	Add new functionality to the desktop toolbar. Conceptualize, program, and test enhancements prior to public release.	HEI / IWI
Operation	Application support on a daily basis.	HEI / IWI
Maintenance	Respond and resolve user support requests, “bug fixes”, and problems.	HEI / IWI
Training	Development of instructional materials and the delivery of on-line and in-person user training sessions.	HEI / IWI
Education and Communication	Communication with users and development of video training materials.	HEI / IWI

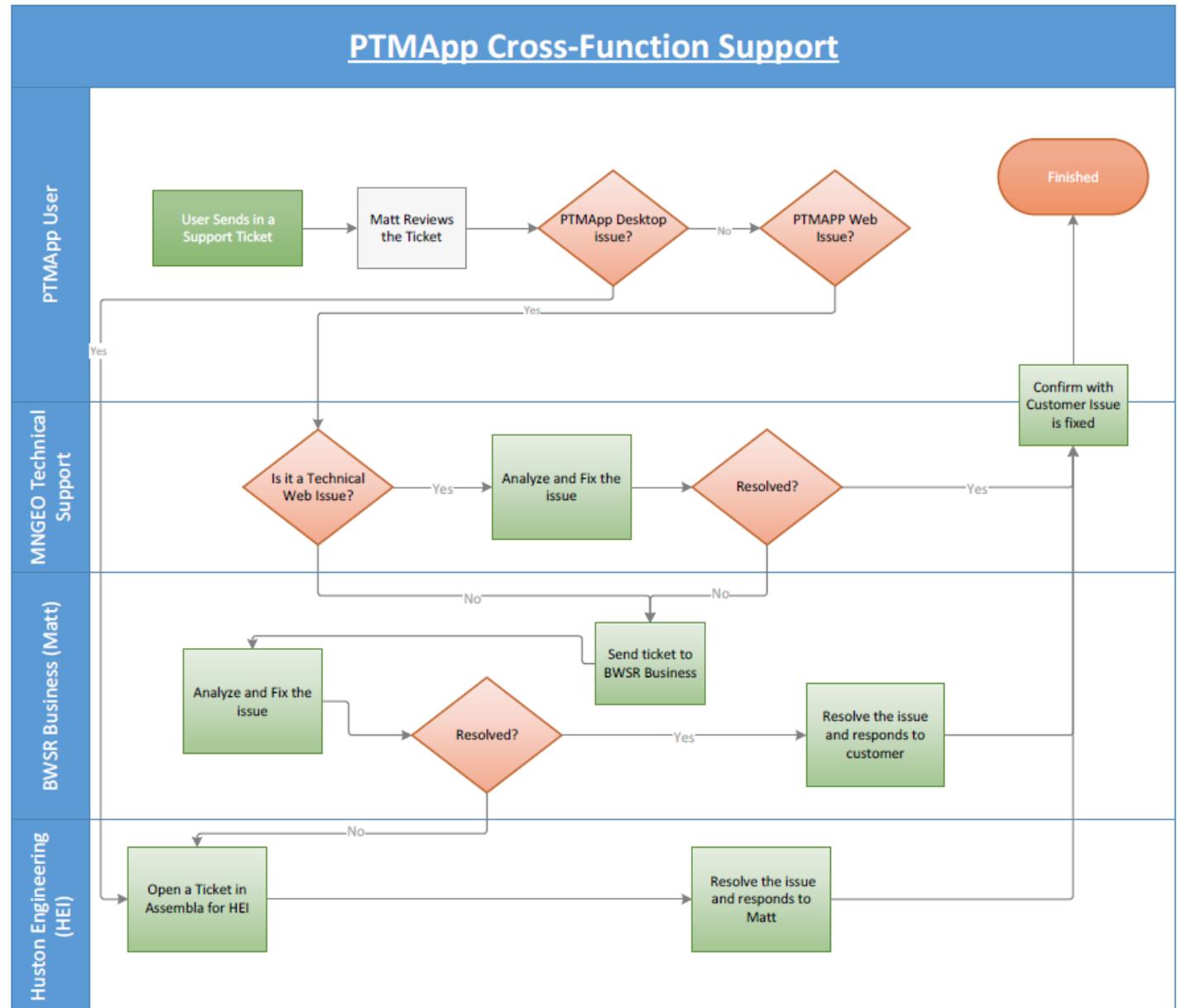
Role Expectations

The current PTMApp operation, maintenance, and enhancement structure is expected to remain consistent into the future. Identification and prioritization of the application’s business needs rests with BWSR and MNIT@BWSR. Technical guidance is provided through MNIT@BWSR with web application operation by MnGEO. Contractual services are used for application enhancements and to support team members.

Technical Support Process

The process for supporting PTMApp – Web and PTMApp – Desktop is led and managed by the BWSR Measures and Outcomes Coordinator. Work orders are identified by the project team, entered into Assembla, prioritized by the BWSR Measures and Outcomes Coordinator based on user need and the available fiscal resources, and executed by the technical lead (see **Table 2**). A flow chart of the technical support process is shown in **Figure 4**. Various documents describing the technical support process are periodically updated and can be accessed via the Assembla project site, which is used to track contract deliverables and work orders. Details relative to technical support can be found within **Appendix A (Tables A1 and A2)** and will not be discussed further within this assessment.

Figure 4. Flow chart representing decision making process for supporting users of the Prioritize, Target, and Measure Application (PTMApp), including roles for the Board of Water and Soil Resources (BWSR) through its Measures and Outcomes Coordinator, Minnesota Geospatial Office (MnGEO) staff, and Houston Engineering, Inc. (HEI) staff.



PTMApp Business Needs

Previous Input and Direction to Meet Local Business Need

Prior to PTMApp prototype development in 2014, several “goals” were established through the Blue Ribbon Panel. These goals were entirely focused on the business needs surrounding water quality decisions by local water quality practitioners to fill current information gaps:

1. Empowering local government staff to make water quality related decisions by providing understandable and valuable information products, which meet their daily business needs;
2. Enhancing workload capacity and increasing decision certainty and accountability when making water quality decisions, by improving information quality and ease of access;
3. Increasing the efficiency and effectiveness of water quality decisions made by local government staff, by providing real-time access to information products; and
4. Achieving self-reliance for making water quality decisions by improving access to quality information, thereby reducing the need for external technical advisors for routine business decisions.

Completing a series of workshops led to identifying, refining, and establishing a set of standard (geospatial) information products which attempted to meet the majority of the local needs identified at the time, including;

1. Assessing the magnitude of nutrient and sediment loads and yields at the field scale, the small watershed scale, and large watershed scale, including the ability to “trace” the amount of load reaching downstream water resources (i.e., identify sources). Use this information to identify preferred locations for conservation practices where nutrient and sediment sources are largest;
2. Identifying technically feasible locations for implementing conservation practices based on the application of landscape, design, or other criteria (including social criteria). Rapidly create a list of the preferred locations as a working list to begin identifying implementation opportunities. Use this list to develop watershed plans and work with landowners to implement conservation. Have the ability to rank the practice locations from “best” to “worst” based on user-specified criteria including practice cost effectiveness (i.e., \$ / mass reduction), practice total cost, or the amount of load reduction. Use this list to apply for grants to funding entities;
3. Identifying and describing the general level of effort (i.e., numbers and types of conservation practices) and probable cost range needed to achieve water quality load reduction goals to protect or restore a water resource;
4. Facilitating discussions with landowners and renters about their interest in implementing conservation practices during one-on-one discussions;
5. Responding to landowner’s and renter’s expressions of interest about implementing conservation practices; and
6. Establishing expectations around the magnitude of the fiscal investment to improve water quality and amount of progress toward achieving water quality goals.

The standard information products can be assembled in a variety of ways to meet local needs and additional ways to package and use the standard information products are continually being developed. Information can be developed simply by assembling the standard information products in a logical and deliberate manner to inform watershed plans at nearly any spatial scale, develop strategies for improving water quality for a specific lake or stream/river reach, and create outreach information packets for landowners.

Although the business needs for developing PTMApp were explicitly defined, users and their skill sets were only generally defined during prototype development (**Table 3**). The minimum GIS skills were defined generally for use of PTMApp – Desktop. Users with a “novice” GIS skill set were identified for the use of PTMApp – Web.

Table 3. User definitions developed during the Blue Ribbon Panel process (2014).

What (Task)	Step in Development of the Plan	Type and Level of Skill
Person capable of gathering the data needed to run the desktop application	Early	Moderate Geographic Information System (GIS) skills
GIS base data creation capability for Time of Travel, Curve Number, and other inputs	Early	Moderate GIS skills
ESRI ArcGIS (9.X or >) with a spatial analyst license for processing the data for the desktop toolbar.	Early	N/A
Load GIS products following generation of the desktop process to a GIS server and turn on web services.	Towards end of plan development	Advanced GIS/technical skills
Person(s) capable of running the web application once it is set up.	Post Plan (Tailoring)	Novice

The use of PTMApp – Desktop as initially envisioned requires moderate GIS skills, primarily because of the need to develop the required input data. PTMApp – Desktop use initially focused on developing information for BWSR’s 1W1P program. Technical Service Area (TSA) or county staff were expected to be the primary PTMApp – Desktop user. Once the information products were created by TSA or county staff, they would continue to serve as a technical resource to the 1W1P group. Users with no GIS skills (or limited skills) were expected to access and use the products through PTMApp – Web. As originally conceived PTMApp – Web was intended to serve up to 80% of the daily business of local practitioners and be the primary portal with which most users would access PTMApp data.

The value of the information products created using PTMApp – Desktop has been successfully demonstrated. These products have been used as components within Watershed Restoration and Protection Strategies (WRAPS), 1W1Ps, and specific lake and stream improvement plans. However, achieving the initial larger vision for the use of PTMApp remained unrealized for several reasons. These reasons² include:

1. Since completion of the Root River Watershed 1W1P, standard information products³ have been incorporated into several additional watershed plans resulting in improved plans which clearly demonstrated the value for identifying the types and numbers of conservation practices and the likely cost needed to achieve sediment and nutrient reduction goals. However, the expectation that local regional technical resources⁴ will use PTMApp – Desktop to create the standard information products remains largely unrealized. The lack of GIS training and skills to create the necessary input products have been the primary barriers to local use;
2. Even though step-by-step instructions for creating each of the standard information products on the desktop and web environments are available on the PTMApp website, few users have the necessary GIS skills or take time to review and use the materials. The preferred means of technical support comes from the submission of trouble tickets. The majority of trouble tickets received during the previous two-year contract period are related to questions about how to create inputs, user runtime errors caused by user error, or others related to result interpretation.; and
3. The vision for PTMApp – Web remains unrealized; i.e., most of the local business need fulfilled by using solely the web application. The amount of funding for the enhancement of PTMApp – Web to meet the daily business needs of local water quality staff has been limited. More training is one means of addressing this issue.

Reaching the vision for PTMApp use is necessary within the immediate future.

Meeting the Future Local and State Business Need

Confirming the future vision for PTMApp is essential to successfully achieve the business needs of LGUs and BWSR. Since BWSR has committed to support, enhance, and use PTMApp, consideration of their unique

² In general, there is considerably unnecessary confusion surrounding the topic of application selection for addressing water quality concerns. Describing the water quality problem(s), goals, and objectives should be the first topic when deciding which application should be used.

³ Currently more than 30 PTMApp datasets have or are being developed covering more than a quarter of the agricultural area within MN. These have traditionally been developed as part of a BWSR Accelerated Implementation Grant or 1W1P. Once created, these datasets can be used to address other water quality issues within the area.

⁴ Some exceptions exist. For example the IWI, the Red Lake Watershed District, Wright County Soil and Water Conservation District, and the Province of Manitoba (among others), have successfully used PTMApp – Desktop.

business interests, in addition to those of local government, is critical. Both local and BWSR business needs are discussed within this section of the Needs Assessment.

PTMApp Users and Their Business Need

User Groups Defined

A prerequisite to confirming the future vision for PTMApp is describing and agreeing upon the relationship between the water quality business need, who will use PTMApp into the future, and the minimum user skill set to use the application. **Figure 2** shows the relationship between both BWSR and local water quality business needs, the required minimum user skill level, and the User Group. **Figure 3** places the types of PTMApp users into five user groups based on the minimum required skill level; i.e., Group A (moderate to high GIS skill level; expected primary use in Desktop), Group B (moderate GIS skill level; expected primary use in Desktop) Group D (no GIS skills, technical staff; expected primary use in Web); and Group E (no GIS skills; lay person; expected primary use in Web). A separate, fifth user group (Group C) was added to address a potential need for users to apply PTMApp data within other applications. Establishing and agreeing upon the User Groups is essential for several reasons including:

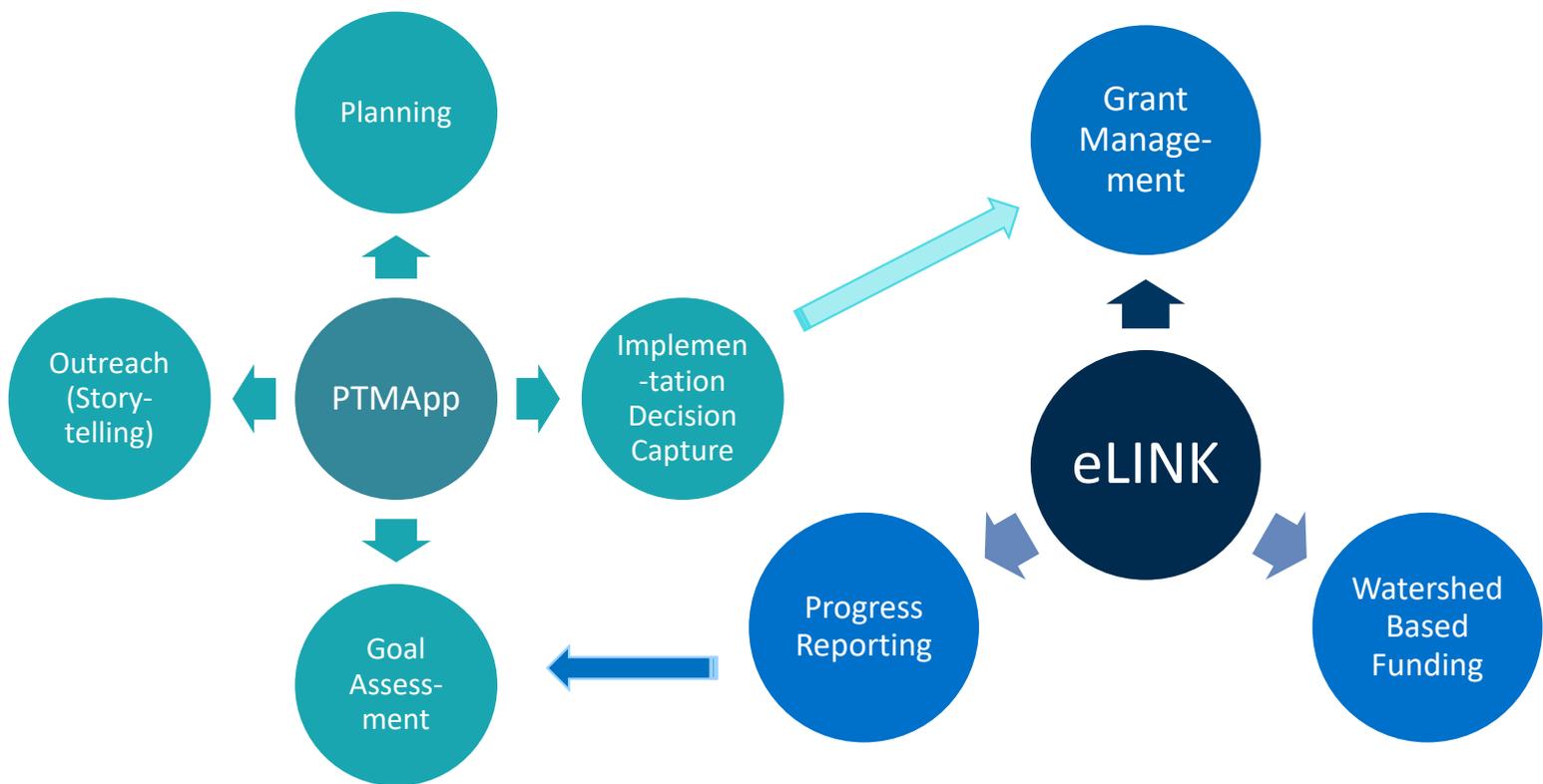
- The current business model is creating the standard information products using PTMApp – Desktop by a “reasonably sophisticated” GIS user (on behalf of a local government), with product use largely through PTMApp – Web. The current PTMApp business model contemplates up to 80% of the daily water quality business needs served by PTMApp – Web. Altering this business model means adjusting the proportion of resources between PTMApp – Desktop and PTMApp – Web;
- How PTMApp standard products and reports are used, understood, and communicated to others varies considerably among the User Groups. How information is packaged and communicated also differs markedly among the User Groups, in part because of differing levels of technical understanding. Enhancements to PTMApp – Web in particular should be prioritized based on the User Groups preferentially served by the application. This approach aids in establishing and communicating expectations with regard to PTMApp functionality and use internal and external to BWSR and the PTMApp user community; and
- Training and workshop materials and efforts should be prioritized and focused to each User Group. The current PTMApp business model is predicated on the idea that “some” centralized staff resource within a geographic region with moderate to high GIS skill creates PTMApp products within the desktop environment. These products once created are served through the web application to meet the majority of the water quality business need.

This needs assessment is focused on the business needs of User Groups A, B and D. Recommendations for the future enhancements, support, operations, and maintenance are predicated on preferentially addressing the needs of these User Groups. The business needs of User Groups C and E can also be supported through the use of PTMApp. However, addressing the business needs for User Groups C and E would be accomplished by using the PTMApp data to meet specific reporting obligations or legislative initiatives.

PTMApp – Web User Needs

The long-term vision for the use of PTMApp products address and integrate BWSR’s life cycle for water quality business decisions; i.e. from planning, to implementation decisions, through tracking constructed projects and quantifying measurable outcomes of completed projects. The long-term vision for PTMApp – Web is to create a bridge between PTMApp and the application BWSR uses to track funded projects (i.e., eLINK) (Figure 5). Conceptually, this means that reports generated within PTMApp – Web could be saved, edited, and attached to an eLINK account. Select attributes within these reports and eLINK could be used to estimate load reductions using PTMApp. These same reports could be used to document implementation decisions (i.e., why or why not a practice is implemented). The vision is achieving a minimum of 80% of BWSR’s and the LGU’s daily water quality business needs (Figure 2) using PTMApp – Web.

Figure 5. Conceptual diagram showing the possible future relationships between the integration of the Prioritize, Target, and Measure Application (PTMApp) and eLINK.



The immediate priority for PTMApp – Web is achieving a robust, stable, and scalable web application. Scalability needs to consider the likely number of future concurrent users and number of datasets. Achieving a robust, stable, and scalable web application requires some nominal amount of redesign, which is currently under development.

The majority of the future business need is expected to be achieved by developing and deploying enhancements to PTMApp – Web. These enhancements consist of improved functionality within the PTMApp – Web production environment, allowing the user to easily and rapidly work through a series of decisions and then generate, save, download, and print digital and hard copy reports. **Table 4** shows a preliminary list of enhancements to PTMApp – Web, identifies the specific water quality business need fulfilled, provides a functional description of the information products, and identifies the possibility of a future eLINK connection (where practical).

Considerable thought about the implication of the web enhancements is warranted. A priority rank and determination of the level of effort (ease of implementation) is provided within **Table 4**. The level of effort (ease of implementation) category is based in part on several factors including: 1) whether the PTMApp – Desktop data are currently extracted and provided to the web application; 2) probability of experiencing web related performance issues; 3) the anticipated complexity of queries needed to provide the report to the user; and 4) the likely amount of web programming. In terms of investment, a ‘low’ level of effort is defined as any enhancements costing \$10,000 or less (2019 dollars). Enhancements estimated between \$10,000 - \$25,000 to complete are assigned a ‘medium’ level of effort. Enhancements estimated to cost more than \$25,000 are assigned a ‘high’ level of effort. Future enhancements may also have impacts to web hosting costs, MnGEO staff workload, and BWSR and MNIT@BWSR resource needs, which are also factored into consideration.

PTMApp – Desktop User Needs

The PTMApp – Desktop user needs are again directly related to the business model; i.e., most user need will be met by using PTMApp – Web. The number of PTMApp – Desktop users should be relatively small and the user’s skill level nominal as compared to typical web users. **Table 5** provides a list of the possible desktop enhancements. Desktop enhancements are placed into one of two categories; operational and technical. Operational enhancements are defined as modifications related to the mechanics of using the ArcGIS toolbar to create the PTMApp products using the desktop application. Technical enhancements are defined as modifications to add or improve existing hydrology or biogeochemical processes within PTMApp – Desktop. Level of effort to complete PTMApp – Desktop enhancements (**Table 5**) was defined similarly to PTMApp – Web enhancements (**Table 4**).

The preliminary recommendations are ranked within **Table 5**. Their rank is qualitative, based on whether the enhancement is likely to result in “improved” conservation decision recommendations. Several of the desktop enhancements have programming implications for using the information and are also related to the stability, performance, and scalability within PTMApp – Web. An example desktop enhancement having web implications is the NRCS Practice Code BMP Suitability enhancement. Implementing this enhancement within the desktop environment requires the ability to show opportunities for the placement of structural conservation practices on the web. This specific PTMApp – Desktop enhancement would require structural changes to the PTMApp – Web environment in order to be implemented.

To fully incorporate these new data types into the web environment, additional programming to incorporate functionality into the current map interface and other tools (e.g. Action Report) would be required. Scalability and performance would both potentially be affected as increasing the number of web services would be necessary. Assuming the use of PTMApp – Desktop is focused on User Group A consistent with the current business need, several of the enhancements are better accomplished through training. In particular, training is needed to reinforce the relationship between the quality of the hDEM and the use of PTMApp products (**Figure 6**). By addressing these items through training fewer requests for technical support are likely.

Table 4. Functional description of current and future Prioritize, Target, and Measure Application for Web (PTMApp – Web) information products intended to satisfy the reasonably foreseeable water quality business needs for User Group D. Text shown in red reference a potential future connection of PTMApp results with eLINK. Enhancements with a Priority Rank of 1 have the highest priority, 2 have a moderate priority, and 3 have a low priority.

Information Product and/or Enhancement Name	Description	Priority Rank	Current Contract	Level of Effort	Water Quality Business Need (see Fig. 3)
Scalability and Performance Enhancements	Modify structure of database tables to reduce the number of web services and modify image rendering to improve application response time. Increase the stability and scalability of the web application. Create and print standard information products. Describe watershed condition, identify resources, complete source assessment, evaluate practice feasibility, estimate individual practice water quality benefits, and target preferred practice locations. This enhancement included an upgrade in the Javascript API from 3.x to 4.x.	In Progress	Yes	High	All
Enhancements to Admin User Interface	Program enhancements for ease of administering the web application including: <ul style="list-style-type: none"> • Develop automated process for preparing web services • Add pagination to the data grids (tables) in all the tabs (Current Users, New Account Requests, Watershed Requests, All Users, Comments); • Add a search bar in Current Users and All Users tab; • Track user’s last logged in time; • Notifications to users; • Management of watershed assignment by admin 	In Progress	Yes	Moderate	Not applicable
Improvements to Targeted Conservation Portfolio (i.e., Action Report)	Select a lake, stream or other resource location (identified in PTMApp desktop), enter user decision criteria for query-based selection of the “best” structural and management practices. Generate, print and save a report with a map of selected locations and a table ranking the practices from most to least preferred based on user decision criteria and estimated load reduction value, cost, and cost effectiveness at the selected resource and edge of field. Send the report to eLINK as a grant request. This enhancement will also include recent requests provided by users. Improve scaling and best management practice (BMP) display information	1	Yes	Low	1,2,3,4,5,8

Information Product and/or Enhancement Name	Description	Priority Rank	Current Contract	Level of Effort	Water Quality Business Need (see Fig. 3)
	on interactive map and enhance Action Report to improve mapping functionality and print a shapefile of proposed BMPs.				
Align Interactive Map and Action Report with Natural Resource Conservation Service (NRCS) Practices	The PTMApp – Desktop enhancement to align PTMApp output with NRCS Practice Code (thereby removing treatment groups) will lead to considerable PTMApp – Web changes to both the Interactive Map and Generate Report.	1	Yes	Low	1,2,3,4,5,8
Rasters to Interactive Map	Provide on the Interactive Map raster information typically used for planning and implementation purposes, including fac_total (as flowlines), Stream Power Index (as flowlines), and sediment, total phosphorus (TP), and total nitrogen (TN) delivery to the flowline. This enhancement will require additional performance measures from the AWS environment and will require additional hosting costs.	1	Yes	Low	1,2,3,4,5,8
Watershed Implementation Scenario Report (i.e. Scenario Builder)	Build upon Targeted Conservation Portfolio. Add functionality to interactively (graphically on a map) select (remove) specific treatment group polygons types and locations, save the implementation scenario, and evaluate the water quality outcome at the selected resource and edge of field. Print and download a report. Send the report to eLINK as a grant request. Save in eLINK for future use.	1	Yes	High	1,2,3,4,5,8
Watershed Implementation Scenario Comparison Report	Build upon Watershed Implementation Scenario Report. Add functionality to compare cost, cost effectiveness, and load reduction value of two or more saved implementation scenarios.	2	No (Only completed if additional dollars allocated)	High	1,2,3,4,5,8
Landowner Information Packet	Select a specific field or parcel (using common land use boundaries) by using either a name / address text query; parcel identification number query; query by township, section range; or interactive map interface (select field or catchment boundary). Display the landowner contact information for the selected field or parcel. Generate a field / parcel report for describing existing conditions with regard to hydrology, sediment loss, land slopes, potential erosion hotspots, runoff potential. Print and download a report.	2	No (Only completed if additional dollars allocated)	Moderate	1,2,3,6

Information Product and/or Enhancement Name	Description	Priority Rank	Current Contract	Level of Effort	Water Quality Business Need (see Fig. 3)
Interactive Map (PTMApp – Web)	Create and print additional desktop information products. Identify field-scale erosion hotspot, potential gully formation, areas with high runoff potential, practice cost effectiveness curves, and priority areas for management practices	2	No (Only completed if additional dollars allocated)	Moderate	1,3,5,6
Practice Treatment Group Concept Design Report	Select a geographic area based on the catchment (priority resource or complete watershed scale). Enter user decision criteria for query-based selection of structural and management practices. Save the query for reuse. Show the functional design features (e.g., surface area, drainage area, volume of water treated, cost, landowner name) of the selected practices. Print and download a report.	2	No	Moderate	1,3,5,6
Load Reduction Goal Assessment Report	Build upon the Targeted Conservation Portfolio and the Watershed Implementation Scenario Reports. Retrieve user defined nutrient and sediment load reduction goals from the web user interface (or in p_res_catchment table in desktop). Generate cost-effectiveness graphs for nutrients and sediment showing the relationship between the cumulative cost and load reduction. Generate a table showing fiscal investment and load reduction ordinates of the graph. Print and download a report.	3	No	High	1,2,6,7,8
Landowner Automated Mailing List	Select an area using a text query or interactive map interface (e.g., catchment, drainage area to a point). Generate a table showing the landowner contact information. Download and print the report. Generate mailing labels.	3	No	High	1,2,3,6
Conservation Practice Tracker Report	Build upon the Targeted Conservation Portfolio and the Watershed Implementation Scenario Reports. Edit the table (connected to eLINK) of the practices selected by the user, by entering information about: 1) rationale for practice selection decision; 2) implementation stage (rejected; withdrawn; design; construction; completed); 3) construction cost; 4) total cost; 5) load reductions realized (automated from PTMApp); 6) physical features; and 7) cost effectiveness. This report, like other reports with potential eLINK connections, would likely be integrated into the Next Generation eLINK system and not the current system that is near the end of its development cycle (maybe this should be a footnote).	3	No	High	1,5,6,7,8

Information Product and/or Enhancement Name	Description	Priority Rank	Current Contract	Level of Effort	Water Quality Business Need (see Fig. 3)
Table Generator	In conversations with local partners and PTMApp development staff, it is recommendation to disable the functionality of this module within the system and put resources dedicate to Table Generator into other more robust reporting functions.	5	Yes	Low	None

Table 5. Functional description of future Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) enhancements for the reasonably foreseeable water quality business needs for User Groups A, B, and D. Enhancements with a Priority Rank of 1 have the highest priority, 2 have a moderate priority, and 3 have a low priority.

Enhancement Name	Description	Rationale	Priority Rank	Current Contract	Level of Effort	PTMApp – Web Implications
Hydro-conditioning integration	<p>This enhancement would consist of creation of a new toolbar module which would incorporate the hydro-conditioning steps into PTMApp – Desktop making them seamless.</p> <p>PTMApp - Desktop can be used with any quality of hydro-conditioned digital elevation model (hDEM). Quality ranges from the National Elevation Dataset and National Hydrography Dataset Plus (low) to H3DEM Plus (high) conditioned by the user. Use of the PTMApp products to meet the water quality business needs is a function of the quality of conditioning. For example, PTMApp products created for the purpose of developing watershed plans using an hDEM conditioned to a low-quality will not be appropriate for making field-scale implementation decisions. Hydro-conditioning currently occurs outside of PTMApp – Desktop and inconsistencies in the inputs used by PTMApp are a common source of trouble ticket requests.</p>	Can be accomplished through training. Assumes the current business model for PTMApp use and user groups are adopted.	Training	Yes	Only Through Training	Maybe. Depends upon implementation approach. Could automate the retrieval of the flow direction and flow accumulation raster from local drive or another server location.
Staged and bundled PTMApp input data	<p>The enhancement would consist of creating statewide inputs for PTMApp – Desktop and bundling these within the downloadable “input database”.</p> <p>Creating the PTMApp products requires the user to pre-process certain geographic information system (GIS) data in a specific format. The source of these data is public (e.g., soils data) but need to be</p>	Can be accomplished through training. Assumes the current business model for PTMApp use and user groups are adopted.	Training	Yes	Only Through Training	Yes – the base file geodatabase would need to include these data increasing the storage requirements on the server.

Enhancement Name	Description	Rationale	Priority Rank	Current Contract	Level of Effort	PTMApp – Web Implications
	processed into a specific format corresponding to the watershed boundary. Although some inputs are provided to the user, creating select inputs occurs outside of PTMApp – Desktop and inconsistencies in the inputs used by PTMApp are a common source of trouble ticket requests. (Note: one of the required inputs is a water travel time raster, which is site specific to the watershed, and would be challenging to create on a statewide basis because it is watershed specific).					Also could affect bandwidths as this geodatabase is downloaded from the server.
Streamlined PTMApp Data Re-Creation	For cases in which PTMApp data has already been created (e.g. for a major watershed for One Watershed One Plan), users may want to quickly clip down data and re-run for a smaller watershed. This may be to add additional resource points, run the data at a finer grid-scale, or to run the data after new toolbar functionality has been added. This enhancement would streamline the process by clipping the watershed to a user-defined boundary and re-running inputs related to travel time by employing the Minnesota Department of Natural Resources (MNDNR) travel time tool.	Can be accomplished through training. Assumes the current business model for PTMApp use and user groups are adopted.	Training	Yes	Only Through Training	May lead to users uploading additional subwatersheds within a larger watershed already on the site.
Natural Resource Conservation Service (NRCS) Practice Code BMP Suitability	<p>This enhancement consists applying the treatment group equations to the practice codes and thereby changing the PTMApp language for structural practices to be consistent with the NRCS.</p> <p>PTMApp – Desktop currently uses various criteria to evaluate the technical feasibility of structural conservations practices using “treatment groups.” Practices within a treatment group (e.g., storage) remove sediment and nutrients in a similar manner (by settling). Specific equations are applied to estimate sediment and nutrient removal for each treatment</p>	The vernacular used to describe structural practices would be consistent with that of the NRCS, BWSR and others.	1	Yes	High	Yes. Affects both scalability and functionality.

Enhancement Name	Description	Rationale	Priority Rank	Current Contract	Level of Effort	PTMApp – Web Implications
	group. PTMApp – Desktop also uses various criteria to evaluate the technical feasibility of structural practices as classified by the Natural Resource Conservation Service (i.e., Practice Codes).					
Integrated Agricultural Conservation Planning Framework (ACPF) – PTMApp (IAPA)	PTMApp – Desktop currently has the functionality of being able to “ingest” or “bring – in” conservation practice polygons created using the US Department of Agriculture – Agricultural Research Service (USDA-ARS) ACPF enhance these polygons. The polygons are enhanced using PTMApp data in the background, to assign water quality information to the polygons, including their load reduction value. ACPF was recently upgraded to version 3.0 and testing and likely updates are necessary to ensure compatibility with PTMApp – Desktop.	Maintains the previously made investment and meets the need within MN where ACPF is currently being used.	1	Yes	Low	None
Updated Base Catalog	The base catalog, used for processing in PTMApp – Desktop toolbar modules and for qualitative review of products created in the toolbar, has not been updated since the original development of PTMApp. This enhancement would include a review of current catalog layers, consideration for additional (qualitative) layers, and an update of current layers. Note: As requested by PTMApp External Committee members, Base Catalog layers which are used for processing in PTMApp will be extended to the hydrologic boundary of major watersheds in Minnesota.	The Base catalog hasn’t been updated since development. We should review to determine which are still necessary and update them.	1	Yes	Low	None (any change to inputs would not lead to change in PTMApp – Desktop outputs)

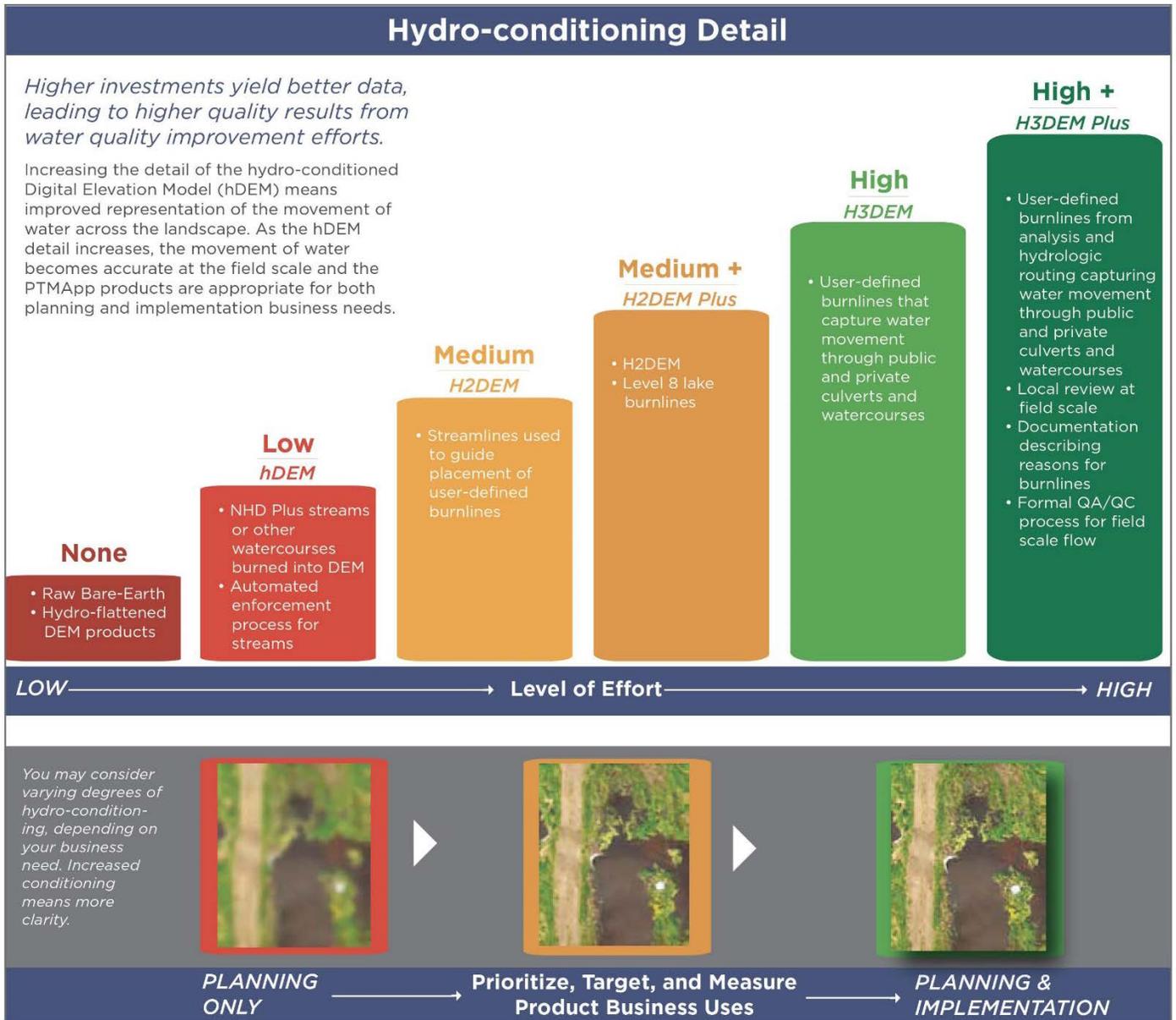
Enhancement Name	Description	Rationale	Priority Rank	Current Contract	Level of Effort	PTMApp – Web Implications
Technical Memorandum to Determine Feasibility of Estimating Streambank Sediment and Nutrient Sources	This enhancement consists of exploring the technical feasibility of implementing methods to estimate sediment and nutrient annual loads from streambanks and bluffs. Sediment and nutrient sources from surface water runoff are currently estimated by PTMApp – Desktop. Streambanks and bluffs can be an important source of sediment and nutrients. The methods to address sediment and nutrients originating from streambank and bluffs can differ from surface water runoff and thus the feasibility to quantitatively estimate these would have to be determined before considering implementation.	Streambank erosion is a significant source of sediment in many landscapes (often eclipsing surface erosion) and knowing the proportion from each source may change where conservation investments are made.	2	Yes	Low	None at this time. May have implications in the future if included in the toolbar as functionality would be required to present information from streambank and bluff erosion. Larger file sizes would be extracted to the web.
Technical Memorandum to Determine Feasibility of Incorporating Hydrologic Routing and Altered Hydrology	This enhancement consists of exploring the technical feasibility of incorporating hydrology into PTMApp, including the ability to generate hydrographs, route the hydrographs downstream, and estimate the runoff volume and peak reduction associated with the structural and management practices. Peak discharge rates for user specified precipitation depths and runoff volumes is currently implemented within PTMApp – Desktop, but this memorandum would explore the necessary functionality to accomplish hydrologic routing consistent with the methods used within the U.S. Army Corps of Engineer’s HEC-HMS model.	BMPs can help to detain, retain, and even infiltrate water and can have a significant impact on downstream hydrographs. This enhancement would provide users with information on how to better reach storage goals and mitigate for flooding and/or altered hydrology.	2	Yes	Low	None at this time. May have implications in the future if included in the toolbar as functionality would be required to present hydrologic information. Larger file sizes would be extracted to the web.

Enhancement Name	Description	Rationale	Priority Rank	Current Contract	Level of Effort	PTMApp – Web Implications
Technical Memorandum to Determine Feasibility of Transitioning to NRCS' Water Erosion Prediction Project (WEPP)	The USDA-NRCS had been using RUSLE (and later RUSLE2) for sediment erosion estimation until recently, when it began transitioning to WEPP. For consistency with NRCS, PTMApp should explore the necessity and feasibility of transitioning to WEPP for sediment erosion estimation.	WEPP may soon become the standard for sediment estimation but is not yet commonplace and NRCS has experience technical issues during its rollout. May be worth delaying this work.	2	No (Only completed if additional dollars allocated)	Low	None
Formatted MXD with Standard PTMApp Output Products	Many Desktop users admit their biggest problem with using PTMApp – Desktop is understanding the various layers and attributes within each layer. To reduce that learning curve, a button could be added to the toolbar to generate an MXD with pre-defined layers (and specific attributes within the layers) identified as important to watershed planning and project implementation. This enhancement would also include development of aliases for layer attributes.	Can be accomplished through training but many new and novice users found this would shorten the “learning curve” and increase user adoption. Since increasing user adoption is a program focus this was considered more than just a training exercise.	2	No (Only completed if additional dollars allocated)	Only Through Training	None
Field-scale Agricultural Management Practices	This enhancement consists of developing additional functionality to define the sediment and nutrient reductions occurring within a field as a resource of management and operational practices. The practices may include fertilizer application, conservation tillage, and permanent cover including cover crops. PTMApp – Desktop currently used the “source reduction” treatment group to represent field management and operational practices.	Modify to better reflect actual agricultural operations.	2	No (Only completed if additional dollars allocated)	High	Yes. Additional BMP types added resulting in larger file sizes extracted to web.

Enhancement Name	Description	Rationale	Priority Rank	Current Contract	Level of Effort	PTMApp – Web Implications
Nutrient Yield	<p>This enhancement consists of estimating annual yields based on the estimated depth of runoff from each cell and a land use event mean concentration.</p> <p>The spatial scale for estimating annual nutrient yields (total phosphorus and total nitrogen) resulting from surface water runoff are currently limited by the spatial scale of the input data. The annual nutrient yield estimates within PTMApp – Desktop are computed for each cell within the hDEM raster. However, these vary little across a field, because they are based on land use polygons from the National Land Cover Dataset, which are much larger than the cells in the raster.</p>	Although intellectually attractive, enhancement likely has little effect on conservation decisions made compared to the current desktop version.	3	No	Moderate	None
Annual Infiltration, Interflow, and Groundwater Volumes	<p>This enhancement consists of using the current PTMApp – Desktop equations but capturing the estimated infiltration, interflow, and groundwater volumes, and modifying the estimated water volumes treated by each structural BMP type (i.e., treatment group or NRCS practice code).</p> <p>Although PTMApp – Desktop uses annual precipitation depth to estimate annual runoff and infiltration depths, the infiltration depth within the upstream drainage area is not converted to annual infiltration, interflow volume, or groundwater volume. Surface water runoff volumes are used to adjust the reduction amount in subsurface structural conservation practices like bioreactors.</p>	Intellectually attractive. However, the current methods used to estimate load reductions associated with the treatment groups are reasonable because they are constrained by literature values. Would result in better separation of practice type by landscape setting.	3	No	Moderate	Yes, modification to existing PTMApp – Web functionality (at least in Interactive Map) to display these attributes. Larger file sizes extracted to the web.
Nutrient Routing	This enhancement is dependent upon the above enhancement (Annual Infiltration, Interflow, and Groundwater Volumes) and consists of estimating interflow and groundwater loads to BMPs.	Intellectually attractive. However, the current methods used to estimate load reductions associated with the treatment	3	No	Low	Same as enhancement above

Enhancement Name	Description	Rationale	Priority Rank	Current Contract	Level of Effort	PTMApp – Web Implications
		groups are reasonable because they are constrained by literature values. Would result in better separation of practice type by landscape setting.				
Nutrient Speciation	This enhancement consists of separating Total Phosphorus and Total Nitrogen into the various substances that comprise them, and modifying the routing equations within PTMApp. Total Phosphorus (P) would be simulated as dissolved phosphorus, particulate P and Total P. Total Nitrogen (N) would be simulated as dissolved N, organic N and Total N.	Also intellectually attractive but may not result in changes to BMP planning processes needed to justify investment.	3	No	High	Yes, would need to display loading, yields, and BMP benefits in various species (Sediment, Total Dissolved P, Particulate P, Total N, Inorganic N; Organic N). Larger file sizes uploaded to the Web.
Sediment Loss Estimation Modification	This “enhancement” consists of modifying the methods used to estimate the Crop Management Factor “C” based on mulch level and tillage practice. The estimated sediment loss is estimated using the Revised Universal Soil Loss Equation (RUSLE) for each cell in the hDEM raster, a delivery ratio applied and summarized by catchment. External data which affect RULSE parameters like the amount of mulch or tillage practice, are do not vary spatially in PTMApp.	Can be accomplished through training. Assumes the current business model for PTMApp use and user groups are adopted.	Training	Only Upon Request	Low	None

Figure 6. Relationship between quality of digital elevation model (DEM) hydro-conditioning detail and appropriate use of products created in the Priorize, Target, and Measure Application (PTMApp).



Process to Confirm Business Needs

Two “teams” have been established to provide guidance to ensure the water quality business needs of BWSR and the LGUs are being met. One team is focused on the water quality business needs of BWSR and is comprised entirely of BWSR staff with differing internal responsibilities. The second team is focused on the water quality business needs of LGU staff and is comprised of a broad group of varying backgrounds.

BWSR Internal PTMApp Team

The BWSR Internal PTMApp Team is comprised entirely of BWSR staff and is expected to meet biannually. Members participating on this team represent the Senior Management Team, Board Conservationists, Section Heads, and program staff. BWSR Internal PTMApp Team members have the following roles as shown in **Table 6**. An initial draft of this Needs Assessment was provided to BWSR Internal PTMApp Team members in February 2019 and the current document reflects recommendations from the team.

Table 6. Description of roles for the Board of Water and Soil Resources (BWSR) Internal Prioritize, Target, and Measure Application (PTMApp) Team.

Team Member Role	Description
Identify BWSR Business Need	Identify and describe the water quality business need based on their role within BWSR.
Enhancement Concept Design	Review design concepts for enhancing PTMApp – Desktop and PTMApp – Web relative to their business need. Recommend modifications to the design concepts.
Prioritize Enhancements	Prioritize execution of the design concepts based on the availability of funding.
Communication and Messaging Internal to BWSR	Serve as a knowledgeable resource within and external to BWSR. Deliver consistent communication and messaging relative to PTMApp branding, use, and functionality.
Increase Adoption and Use	<p>Identify, describe, and communicate potential opportunities for PTMApp use to achieve BWSR water quality business needs.</p> <p>Deliver consistent communication and messaging relative to PTMApp branding, use, and functionality external to BWSR.</p> <p>Provide guidance relative to the appropriate use of PTMApp when addressing local and BWSR water quality business needs.</p>

External PTMApp Committee

The External PTMApp Committee is comprised of a diverse group representing different organizations including members from academic institutions, state and federal agencies, LGUs, non-governmental organizations, and the private sector. The External PTMApp Committee meets no more than quarterly, either in person or by teleconference, during periods when enhancements are being developed. External PTMApp Committee members have the roles identified in **Table 7**. An initial draft of this Needs Assessment was provided to External PTMApp Committee members in February 2019 and the current document reflects recommendations from the team provided before, following, and during the committee’s inaugural meeting on March 28th, 2019. A summary of discussions and decisions from this meeting is included in **Appendix B**.

Table 7. Description of External Priorize, Target, and Measure Application (PTMApp) Committee member roles.

Team Member Role	Description
Identify Local Government Business Need	Identify and describe the water quality business need based on their role within a Soil and Water Conservation District, County, or Watershed District.
Enhancement Concept Design	Review design concepts for enhancing PTMApp – Desktop and PTMApp – Web relative to their business need. Recommend modifications to the design concepts.
Prioritize Enhancements	Prioritize execution of the design concepts based on the availability of funding.
Communication and Messaging External to the Board of Water and Soil Resources (BWSR)	Serve as a knowledgeable resource within their organization and external to the BWSR. Deliver consistent communication and messaging relative to PTMApp branding, use, and functionality.
Research	Identify research needs to improve PTMApp. Consider the use of PTMApp for applied research projects. Use PTMApp as an example to identify student education needs.
Increase Adoption and Use	<p>Identify, describe, and communicate potential opportunities for PTMApp use to achieve local government water quality business needs.</p> <p>Deliver consistent communication and messaging relative to PTMApp branding, use, and functionality internal to their organization.</p> <p>Provide guidance relative to the appropriate use of PTMApp when addressing local water quality business needs.</p>

Planned Use

The planned future use for PTMApp – Web is serving as the primary application to deliver products to BWSR and LGUs to achieve the majority of their water quality business needs (see **Figure 2**). Through existing functionality and planned enhancements, 80% of the daily water quality business need of BWSR and LGU staff will be achieved through the use of PTMApp – Web. PTMApp – Web is the primary repository for the standard information products created through PTMApp – Desktop. The planned uses for the PTMApp standard information products include not only the business needs shown in **Figure 2**, but more broadly providing information to inform the following processes:

- Watershed planning including the development of many elements comprising an Environmental Protection Agency (EPA) nine element plan and described by the “Handbook for Developing Water Plans to Restore and Protect Our Waters”; BWSR 1W1P; and components of a WRAPS, specifically informing the action plan at a broad range of watershed sizes (i.e., 12-digit Hydrologic Unit Code (HUC), 10-digit HUC; 8-digit HUC);
- Implementation strategies (i.e., Action Plan or similar document) developed to protect or restore the water quality of specific water resources (i.e., a specific stream or lake) to achieve a previously developed load reduction goal. An implementation strategy consists of a specific list of management and structural BMPs considered “best” for achieving the load reduction goal;
- Communication programs focused on contacting a large number of landowners and renters within a specific watershed;
- Landowner engagement facilitated by the ability to generate field specific information about water quality, opportunities for implementing conservation, the water quality value of management and structural practices, and the probable cost;
- Policy development related to water quality issues. Example policy discussions which can be informed by the PTMApp standard information products include the fiscal investment needed to achieve state-wide or regional load reduction goals, the practicability of various load reduction goals, identifying “preferred” conservation practice types for implementation, and establishing a cost-effectiveness range (\$ / lb) for conservation practice cost sharing;
- Accountability reporting by estimating the water quality load reduction value of existing and planned management and structural practices; and
- Fiscal planning for water quality protection and restoration including the magnitude of implementation block grants needed to improve water quality, creating the opportunity for private investment to support sustainability claims, and NGO investment to specific environmental outcomes.

Grants awarded by BWSR for the creation of data using PTMApp – Desktop should include receipt of the final data products, especially if those products were uploaded to PTMApp – Web.

Prototype to Production Application

An application is considered a “production” application when the software and hardware is installed and relied upon to meet the daily business needs of its end users. A production application meets all of the requirements identified by the State of Minnesota, including accessibility requirements.

BWSR@MNIT currently defines PTMApp – Web as a prototype application. **Table 8** identifies the six characteristics which need to be satisfied to define PTMApp – Web as a production application. Five of the six criteria are expected to be met by the end of August 2019.

A fully scalable, functioning application for routine use achieving the first five criteria is expected by August 31, 2019. Achieving the accessibility assessment criterion (number 6) is expected by the end of the contract period: June 30, 2020.

Ensuring Functionality for Users

Projected Use

The projected use for PTMApp – Web can be summarized by describing the functional requirements for the application. The functional requirements for the application as currently designed, for the short-term and long-term timeframes, are shown in **Table 8**. The short-term timeframe is defined as June 30, 2020, which corresponds with the completion of the current 2-year contract period. The long-term timeframe is defined as the end of December 2023, which roughly corresponds to a 5-year time period. Because of rapidly changing technology (i.e., hardware, software, programming languages) using a planning horizon exceeding five years is speculative and should be subject to periodic review and revision.

The number of registered PTMApp – Web users is currently 258. However, only a small number of users are presently active. The number of users for the short-term and long-term timeframes is primarily based on the number of watersheds created using PTMApp – Desktop and expected to be uploaded to PTMApp – Web. PTMApp – Web currently houses 12 watershed datasets (**Table 8**). An additional 24 watersheds are currently being processed and are expected to be uploaded to PTMApp – Web in the near future. Some of the future 1W1Ps could use PTMApp during the planning process. Assuming 8 1W1Ps are completed per year and approximately ½ use PTMApp during the planning process, approximately 40 watersheds are likely to be uploaded to the web during the short-term timeframe. Most watersheds accessed through PTMApp – Web are an 8-digit HUC (~ +/- 2,000 sq. mi. in size) including portions or all of 3 to 5 counties, suggesting multiple users per watershed. Assuming a minimum of one user per county means an estimated 4 users per watershed.

Table 8. Characteristics defining Priorize, Target, and Measure Application for Web (PTMApp – Web) as a production application.

Criterion No.	Characteristic	Description	Status
1	Placed into service for daily business needs of users	Robust and stable web application is available to provide standard information products for planning and implementation with a 99% up time for use by BWSR and LGU staff.	Place into service by August 31, 2019 with enhancements, additional watershed datasets (~ 25), and Action Report functionality.
2	Consistent periodic releases	Release known bug fixes on a quarterly basis.	Begin after December 10, 2018. Scheduled non-enhancement releases March (2019), August, October, January (2020), April, and June, as shown in Table 11 .
3	Routine testing protocol	Written protocol followed for completing quality assurance review of programming enhancements and bug fixes, using one or more test watershed datasets.	Implemented.
4	Routine performance and scalability testing protocol	Written protocol followed for completing quality assurance review of programming enhancements and bug fixes, using one or more test watershed datasets.	In process. Implemented by August 31, 2019.
5	Security requirements assessment	Complete scan to assess, prioritize, and complete program modifications to comply with State of MN requirements.	Implemented.
6	Accessibility assessment	Complete scan to assess, prioritize, and complete program modifications to comply with State of MN accessibility requirements.	Prototype enhancements consider accessibility requirements during development. Use Wave.webaim.org (or similar software) to assess compliance and resolve where feasible. Use keyboard only to navigate application pages. Evaluate color contrast. Implement by June 30, 2020.

Table 9. Status of watersheds either currently available or expected to be available in the near future through the Prioritize, Target, and Measure Application for Web (PTMApp – Web).

Watersheds	PTMApp – Web Status
Adley Creek	Currently on PTMApp – Web (21 total)
Apple Lake (Becker/Otter Tail Co.)	
Ashley Creek	
Cannon River	
Chippewa River (Becker/Otter Tail Co.)	
Crow Wing River (Becker/Otter Tail Co.)	
Hoboken Creek	
Lake of the Woods 1W1P	
Long Prairie River (Becker/Otter Tail Co.)	
Missouri River 1W1P	
Nicollet County	
North Fork Crow River	
Otter Tail River (Becker/Otter Tail Co.)	
Red Eye River (Becker/Otter Tail Co.)	
Pomme de Terre	
Green Meadow (Marsh River Watershed)	
Root River	
Sugar Lake	
Red Lake River	
Roseau (old version, updating)	
Wild Rice River (Becker/Otter Tail Co.)	
Buffalo River - Red River of the North	Needs to be Uploaded - Desktop products completed (18 total)
Blue Earth River	
Bois de Sioux River	
Carver County	
Cottonwood River	
Laq Qui Parle River	
Le Sueur River	
Marsh River	
Mustinka River	
North Fork Crow JD1	
Red Lake	
Redwood River	
Sandhill River	
Thief River	
Two Rivers/Joe River	
South-Washington Watershed District - Lower St. Croix River	

Watersheds	PTMApp – Web Status
Upper Minnesota River Headwaters	Needs to be Uploaded - Desktop products under development but nearing completion (3 total)
Watonwan River	
Buffalo-Red River	
Heron Lake	
Wild Rice River	

The estimated number of users for PTMApp – Web shown in **Table 10** is similar to the number of current eLINK users. The number of watersheds and users is expected to increase during the long-term timeframe assuming the completion of additional 1W1Ps and the development of water resource specific action plans.

The current configuration of PTMApp – Web requires considerable RAM, in part because of the number of ArcSocs. An ArcSoc can be thought of as a web service, which provides data to the web application. PTMApp – Web is already being modified to reduce the number of ArcSocs to decrease the response time, thereby reducing the amount of web server RAM. The estimated RAM shown in **Table 10** assumes 30 concurrent users accessing the application during a training workshop. Previous stress testing showed RAM needs of approximately 2 GB per user during simultaneous application use. The estimated web server RAM needed is likely high, because the revised configuration of the application has reduced the number of ArcSocs.

Process

Ensuring functionality requires an application which meets the user business needs, is readily accessible, and whose use is intuitive, easy, and efficient. A process is needed to continue to refine and describe the business needs and provide guidance on whether the application is intuitive and easy to use. BWSR intends to convene and use the Internal PTMApp Team and External PTMApp Committee to guide application development, enhancement, and deployment to the production environment. The process used by BWSR to ensure functionality is shown in **Figure 7**.

The BWSR Measures and Outcomes Coordinator has the (final) responsibility for making recommendations to the BWSR Executive Director.

Training

Effective training is needed to ensure functionality for users. Training is expected to occur through both in-person workshops and online video modules. A description of the training program is described in the Increase Adoption and Use section.

Table 10. Functional requirements for Prioritize, Target, and Measure Application for Web (PTMApp – Web) planning.

Timeframe	#. of Watersheds *	Users			Desktop Geodatabase Size (TB) †	Web Storage Needs (TB) ‡	ArcSocs Needs §		Web Server RAM (GB)
		Active **	Peak Per Day	Concurrent			Current Configuration	Revised Configuration	
Current	12	44	5	30	0.54	0.04	72	12	60
Short Term (June 2020)	40	160	18	30	1.80	0.24	NA	40	60
Long Term (Dec. 2023)	68	272	31	30	3.06	0.41	NA	68	60

* No. of watershed estimated based on the number of known projects using PTMApp either through One Watershed One Plan or specific BWSR grants.

** No. of active users estimated from eLINK Google Analytics. Present number of PTMApp web users registered is 258. Assumes 4 active users per watershed (assumed to be 8-digit HUC). Active user means use on a weekly basis. Number of concurrent users is based on workshop maximum attendance.

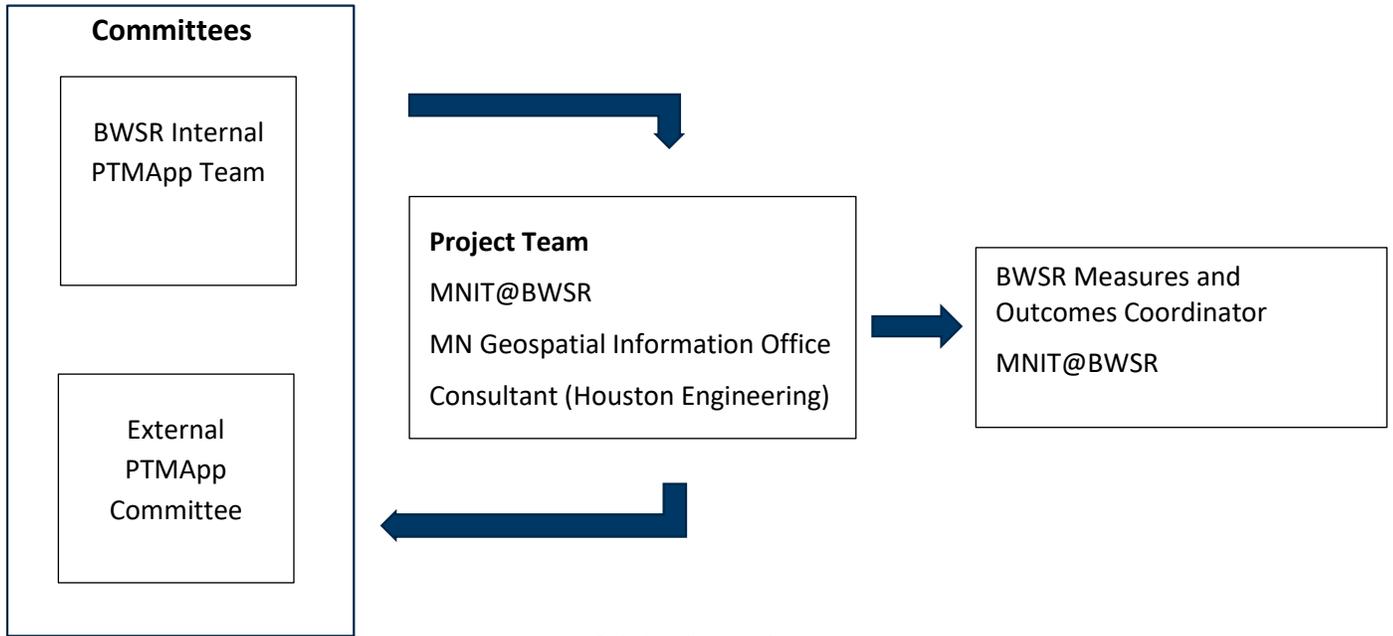
† Desktop geodatabase size based on 45 GB per database created using PTMApp – Desktop. Data are the source of information extracted to the web.

‡ Web storage needs based on current maximum file geodatabase size of 3 GB (for North Fork Crow 8-digit HUC) and an additional 3 GB (6 GB total) for future web enhancements including 6 raster datasets.

§ Current ArcSocs needs ('Current Configuration') are 6 per watershed and 1 for other services. Future needs ('Revised Configuration') assume scalability and performance revisions reducing needs to 1 per watershed.

Web server RAM needs based on stress test results for current application configuration summarized by Technical Memorandum to M. Drewitz (dated December 31, 2017) (~ 2 GB per user). Requirements based on number of concurrent users. These needs may change following scheduled scalability and performance improvements

Figure 7. Process used to ensure Prioritize, Target, and Measure Application (PTMAApp) functionality for the Board of Water and Soil Resources (BWSR), Minnesota IT Services (MNIT@BWSR), and their partners.



Responsibilities for Each Group

Committees	Project Team	BWSR Measures and Outcomes Coordinator
Define business needs	Develop ideas	Recommendations to BWSR Senior Management Team
Develop ideas	Refine business needs	Manage fiscal resources
Vet enhancement concepts	Develop enhancement concepts	Schedule enhancements
Prioritize enhancements	Prioritize enhancements	
Test enhancements	Test enhancements	
Recommend modification	Modify concepts	
Communicate value	Estimate cost and budget	

Technical Considerations

Supported Browsers

Three browsers are supported for PTMApp – Web on a desktop computer: Google Chrome, Mozilla Firefox, and Internet Explorer. The current design is not responsive, meaning it may not work on a range of mobile devices.

Scheduled Releases

To achieve status as a production application, regularly scheduled releases are essential to ensure the application is updated consistently enough that users can anticipate full functionality to meet business needs. Scheduled releases will include critical/non-critical bug fixes and any enhancements which have completed testing within a reasonable time of the scheduled release. **Table 11** outlines a release schedule for PTMApp – Web through the contract period.

Table 11. Prioritize, Target, and Measure Application for Web (PTMApp – Web) scheduled release dates and anticipated content/functionality.

Date	Release Content
Aug. 2019	<ul style="list-style-type: none">• Scalability and Performance Improvements• Addressed non-critical tickets
Oct. 2019	<ul style="list-style-type: none">• Enhancements to Admin User Interface• Improvements to Targeted Conservation Portfolio (i.e. Action Report)• Addressed non-critical tickets
Jan. 2020	<ul style="list-style-type: none">• Raster deployment on Interactive Map• Addressed non-critical tickets
Apr. 2020	<ul style="list-style-type: none">• Align Interactive Map and Action Report with NRCS Practices• Addressed non-critical tickets
Jun. 2020	<ul style="list-style-type: none">• Watershed Implementation Scenario Comparison Report (i.e. Scenario Builder)• Addressed non-critical tickets

Application Scalability and Performance

A stable and scalable application with acceptable performance characteristics and access to the 21 watersheds currently hosted is the immediate priority (by August 31, 2019). Revisions to the configuration of PTMApp – Web to achieve a stable and scalable application with acceptable performance characteristics are currently in progress by the Team. Specifically, MnGEO has separated the SQL database and application onto separate servers, which improved application performance and decreased response time.

The Team has identified additional modifications to PTMApp – Web to ensure scalability (i.e., increase the number of watersheds to the long-term expectations shown in **Table 10**) and improve performance. The primary consideration for the scalability of the application is related to the number of web services; i.e., the more web services the more difficult to scale the application. PTMApp – Web is currently being reconfigured to reduce the number of web services. This will reduce the amount of RAM needed by the application. The amount of hard drive storage needed is not an application scaling factor. The primary consideration for ensuring acceptable performance characteristics includes the number of web services and how information displayed within the various map components is displayed and indexed within the SQL database. The large amount of information displayed on the interactive maps reduces performance because of rendering limitations within the browsers. A revision of PTMApp – Web is underway to resolve this performance issue. Additional improvements are also being considered and include consolidation of tables extracted from Desktop to Web and reduction in two-stage queries which can lengthen the time to render map features.

Implications of Desktop and Web Enhancements

Enhancements to both PTMApp – Desktop and PTMApp – Web (**Tables 4 and 5**) potentially affect scalability, performance, and the need for programming revisions to PTMApp – Web. For example, implementing the NRCS Practice Code BMP Suitability enhancement in PTMApp – Desktop will change the naming convention used to describe BMPs and require the reprogramming of PTMApp – Web for the proper function of the Interactive Map and Action Report tools. Similarly, new business needs may be identified by BWSR Internal Team and/or the External Committee, which requires additional data to be extracted from the file geodatabase created using PTMApp – Desktop and additional web services enabled, increasing the number of ArcSocs and available RAM.

Table 12 identifies the implications of PTMApp – Desktop and PTMApp – Web enhancements which are expected to be completed during the contract period ending June 30, 2020. Desktop enhancements which results in additional data layers are assumed to be made available through PTMApp – Web. **Table 12** shows scalability, performance, and the infrastructure needs to support the application are not expected to be affected by the short-term priority enhancements.

Implications of Technology Trends (Hardware and Software)

Predicting the implications of trends in hardware and software technology on PTMApp – Web is challenging. Changes in technology are rapid and unpredictable beyond a three-year period. However, some trends are likely to continue. Mass storage is inexpensive and will remain so. Larger geodatabase sizes stored on the server are unlikely to substantially inflate cost. Memory is costly. Increasing the number of web services affects both the amount of memory needed and potentially the number of ArcGIS Server licenses. The number of licenses depends upon the amount of RAM and ArcSocs. Typically, one ArcGIS Server license can make available 100-125 ArcSocs. Therefore, no additional service licenses are anticipated and no performance degradation is expected following enhancements.

Table 12. Implications of Prioritize, Target, and Measure Application for Desktop (PTMApp-Desktop) and for Web (PTMApp-Web) enhancements to PTMApp – Web performance, scalability, and application infrastructure. New data created using PTMApp – Desktop assumed to be made available through PTMApp – Web.

Enhancement	Enhancement Type	Impact on Performance	Impact on Scalability	Required Web Re-programming	Change(s) to Amazon Web Server Needs	Change(s) to ArcGIS Web Services	Change(s) to Maintenance Needs
Natural Resource Conservation Service (NRCS) Practice Code BMP Suitability	Desktop	Potential performance decrease due to additional layers	Potential impact due to additional layers	Yes, 6 treatment groups expanded to 18+ BMP types	Increase storage	Yes	Can support both treatment groups and BMP types in the same system
Integrated Agricultural Conservation Planning Framework (ACPF) – PTMApp (IAPA)	Desktop	None, ACPF output products not currently supported on Web	None	None	None	None	None
Updated Base Catalog	Desktop	None, Base catalog data not on Web	None	None	None	None	None
Field-scale Agricultural Management Practices	Desktop	Potential performance decrease due to additional layers	Potential impact due to additional layers	Yes, additional BMP types added	Increase storage	Yes	Only initially

Scalability and Performance Enhancements	Web	Will improve	Will improve	Yes, significant changes	Lessens Needs	Yes, significant changes	Yes
Enhancements to Admin User Interface	Web	None	None	Yes	None	None	Great decrease in maintenance needs through automation of web services extraction and/or removal of administrative access
Improvements to Targeted Conservation Portfolio (i.e., Action Report)	Web	None	None	Yes	None	None	None
Align Interactive Map and Action Report with NRCS Practices	Web	Expected performance decrease	Yes, takes more resources to support additional BMP types	Yes	Yes, additional layers will be added	Yes, additional layers will be added	None
Rasters to Interactive Map	Web	Expected decrease could lead to slow rendering times	Yes, significant impact	Yes	Yes, increased resources necessary	Yes, additional layers will be added	May want to consider re-extracting datasets currently on PTMApp – Web to include rasters
Watershed Implementation Scenario Report (i.e. Scenario Builder)	Web	None (for existing functionality)	Very little (or no) impact	Yes, new programming for additional button	None	None	Very little

Operational Considerations

Creating an executable to automate the process of establishing web services used by PTMApp – Web is highly recommended, especially considering that new feature classes created using desktop will be served by the web. Creating an executable will save time and fiscal resources. This was recommended as an enhancement in **Table 4** and is included with the time budgeted in the ‘Enhancements to Admin User Interface’ in **Table 13**.

Enhancement Priorities and Cost

The vision of PTMApp-Web is to have 80% of LGU business needs addressed through the portal. Priorities in this contract are considered predominantly based on this, along with achieving a robust, stable, and scalable web application. Other considerations include cost and feasibility to complete and support the web application. The *PTMApp – Web User Needs* subsection goes into additional detail considering how priority ranking criteria were defined as listed in **Table 4**.

Short-term (i.e. completed through the contract period ending on June 30, 2020) priorities for PTMApp – Web can be summarized as those which improve:

- Performance of the application for individual users;
- Scalability of the application both currently and in the future; and
- User experience by better meeting expected business needs of individual users.

Specific actions and information products to address these priorities are shown in **Table 13**, along with their estimated cost to complete. The estimated cost only reports the cost to complete coding, testing, and deployment by the contractor (HEI/IWI). Any additional effort by MnGEO to support these enhancements is not included, but likely only includes adding service changes (and associated testing and deployment) implemented by the contractor.

Performance and scalability improvements, proposed as short-term priorities to be completed under the current contract, are also anticipated to be long-term priorities. BWSR and MNIT@BWSR will need to continuously (i.e. at least annually) revisit priorities to ensure data developed by users and hosted on PTMApp - Web remains available (under a functional application) to users when they need to access it. Completion of the 1W1P program and other watershed planning activities are expected to bring the total number of watersheds on PTMApp – Web to 40 within the contract period. Technical resources will need to be available to support these watersheds.

The current contract includes these enhancements along with two others:

- 1) **Report:** Create a series of standard reports that are used by local professionals which display data in tabular, graphical, and geographic formats
- 2) **Table Generator:** Update functionality of the table generator module to increase the generation speed and functionality of reports.

These were identified as enhancements and listed in **Table 4**. ‘Report’ is listed as the Landowner Information Packet in **Table 4**. This enhancement is considered a medium (Priority Rank = 2) priority which should be considered if additional dollars are available in the future. Table Generator is primarily used to query and rank data but has since been made defunct by the development and publishing of the Action Report tool. As this tool no longer has a defined purpose it is recommended to be removed from future PTMApp – Web versions.

Table 13. Summary of current and proposed PTMApp – Web enhancements to be completed during the contract period, ending June 30, 2020. Please see **Table 4** for a full description of each enhancement, its expected functional changes, and reasoning for priority rank.

Enhancement Name	Description	Recommended Priority Rank	Estimated Cost
Scalability and Performance Enhancements	<p>Modify structure of database tables to reduce the number of web services and modify image rendering to improve application response time to achieve a stable and scalable web application.</p> <p>Create and print standard information products. Describe watershed condition, identify resources, complete source assessment, evaluate practice feasibility, estimate individual practice water quality benefits, and target preferred practice locations. Upgrade API from Javascript 3.x to 4.x.</p>	In Progress	\$31,928
Enhancements to Admin User Interface	<p>Program enhancements for ease of administering the web application.</p> <ul style="list-style-type: none"> • Develop automated process for preparing web services • Add Pagination to the data grids (tables) in all the tabs (Current Users, New Account Requests, Watershed Requests, All Users, Comments); • Add a search bar in Current Users and All Users tab; • Track User’s last logged in time; • Notifications to users; • Management of watershed assignment by admin 	In Progress	\$16,104
Improvements to Targeted Conservation Portfolio (i.e. Action Report)	<p>Select a lake, stream or other resource location (identified in PTMApp - Desktop), enter user decision criteria for query-based selection of the “best” structural and management practices. Generate, print, and save a report with a map of selected locations and a table ranking the practices from most to least preferred based on the user decision criteria and the estimated load reduction value, cost, and cost-effectiveness at the selected resource and edge of field.</p> <p>This enhancement will also include recent requests provided by users to improve scaling and BMP display information on Interactive Map and enhance Action Report to improve mapping functionality</p>	1	\$9,380

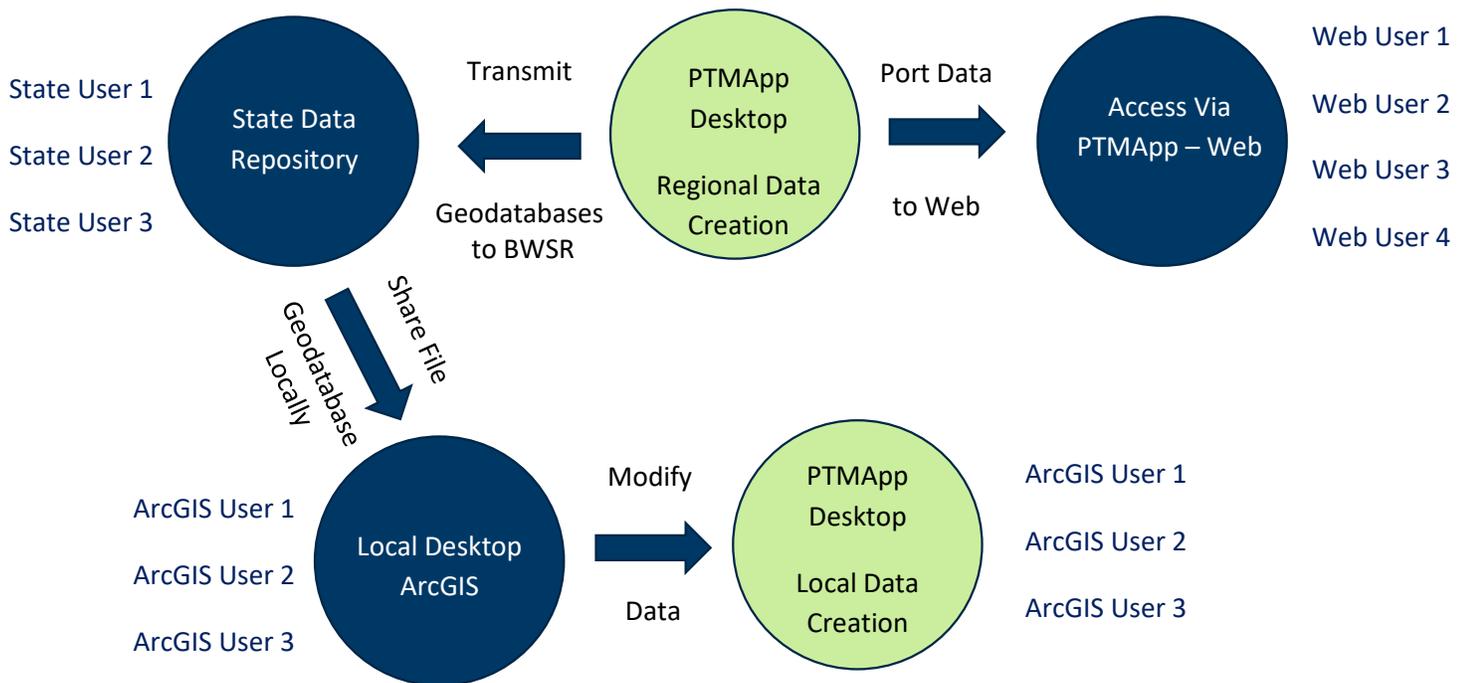
Enhancement Name	Description	Recommended Priority Rank	Estimated Cost
	and print a shapefile of proposed best management practices (BMPs).		
Align Interactive Map and Action Report with Natural Resource Conservation Services (NRCS) Practices	The PTMApp – Desktop enhancement to align PTMApp output with NRCS Practice Code (thereby removing treatment groups) will lead to considerable changes on PTMApp – Web to both the Interactive Map and Action Report. This enhancement will bring functionality added to the Desktop application to the Web environment	1	\$6,164
Rasters to Interactive Map	Provide on the Interactive Map raster information typically used for planning and implementation purposes, including fac_total (as flowlines), SPI (as polylines), and sediment, TP, and TN delivery to the flowline	1	\$8,040
Watershed Implementation Scenario Report (i.e. Scenario Builder)	Build upon the Targeted Conservation Portfolio. Add functionality to interactively (graphically on a map) select (remove) specific treatment group polygon types and locations, save the implementation scenario, and evaluate the water quality outcome at the selected resource or at the field edge. Save and edit the scenario. Print and download a report.	1	\$13,400
Estimated Total Cost for PTMApp – Web Enhancements =			\$85,016

PTMApp - Desktop

Planned Use

The planned use for PTMApp – Desktop, currently and into the future, is serving as the primary application to create the standard information products delivered to PTMApp – Web to achieve the water quality business needs of BWSR and LGUs (see **Figure 8**). The PTMApp standard information products are expected to be created for large areas with PTMApp – Desktop using regional staff resources (with skill level 1 or 2 – see **Figure 2**). Once created, the PTMApp – Desktop file geodatabases should be provided to and retained by BWSR and made available to county, soil and water conservation district, and watershed district staff.

Figure 8. Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) data creation and distribution process.



Satisfying every water quality business need through PTMApp – Web is unrealistic. Therefore, some LGUs may choose to use the data locally within their GIS software to create the standard information products, custom products, or to meet specific local needs. Some local government staff use of PTMApp – Desktop is expected, either because staff are experienced using GIS or because of custom, locally-specific needs. The PTMApp standard information products may also be created or reprocessed at smaller scales (e.g., a lakeshed) from the regional file input geodatabase to serve specific local needs. **Table 14** identifies some of the possible uses of the information contained within the file geodatabases created using PTMApp – Desktop. Use of the file geodatabases locally (by Skill Level 3, with training) is expected to achieve the remaining water quality business need, unfulfilled from the use of PTMApp – Web.

The use of PTMApp – Desktop requires moderate GIS skills, primarily because of the need to develop the required input data. TSA or skilled LGU staff, each receiving targeted PTMApp training, are expected to be the primary PTMApp – Desktop users locally.

The ability to reprocess an existing PTMApp file geodatabase or use the base inputs to create standard information products for a smaller area to satisfy locally specific custom needs depends on the amount of detail used to hydro-condition the DEM. PTMApp standard information products initially created based on H3DEM+ conditioning quality (see **Figure 6**) and inputs with a small raster cell size (e.g., 5 meter x 5 meter) should only require reprocessing if a new resource location(s) (PTMApp priority resource point) or feature(s) like a lake is added. Hydro-enforcement lines created when conditioning the hDEM for a small raster cell size (e.g., 5 meter) must be long enough to allow reprocessing of the hDEM at a larger raster cell size (10 meter) for planning purposes. PTMApp standard information products initially created based on H2DEM or H2DEM+ conditioning quality (see **Figure 6**) will likely require new data creation to meet at least level H3DEM standard if used for addressing implementation business needs at the field-scale. Some considerations for easing this data generation (or re-generation) were considered when developing the list of PTMApp – Desktop enhancements (first 4 enhancements in **Table 5**). For consistency with current expected business need and user skill level, it was anticipated users with advanced skill level in GIS would be creating these products and would therefore not require these enhancements if they received proper training.

Ensuring Functionality for Users

Committing to the required skill level for the use PTMApp – Desktop is essential for ensuring functionality for users. The use of PTMApp – Desktop to create or reprocess an existing file geodatabase to create the standard information products requires Skill Levels 1 and 2. Skill Level 1 means a GIS degree/certificate with considerable professional GIS software experience. Skill Level 2 means at least weekly use of GIS software for at least the last 2 years. No users in Skill Levels 3 or 4 should be creating or reprocessing PTMApp – Desktop data.

Table 14. Possible uses of Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) file geodatabases in geographic information system (GIS) software to achieve remaining water quality business need or as an alternative to Prioritize, Target, and Measure Application for Web (PTMApp – Web).

Product Use	Primary Business Need	Required Staff Skill Levels	Description
Watershed planning	Local and State	Skill Level 1	Regional planning efforts like 1W1P.
Implementation strategies	Local	Skill Level 1 and 2	Data created regionally can be used to rapidly develop implementation strategies and action plans using ArcGIS (or the web) at many spatial scales.
Communication programs	Local	Skill Level 1 and 2	Data within the PTMApp file geodatabases are supplemented with parcel or field ownership data for communications efforts to contact landowners and renters.
Landowner engagement	Local	Skill Level 1 and 2	Data within the PTMApp file geodatabases are used to provide field or parcel specific information related to project implementation.
Policy development	State	Skill Level 1	Fiscal investment needed to achieve state-wide or regional load reduction goals, the practicability of various load reduction goals, identifying “preferred” conservation practice types for implementation, and establishing a cost-effectiveness range (\$ / lb) for conservation practice cost sharing.
Accountability reporting	Local and State	Skill Level 1	Created to evaluate large scale progress toward water quality goals.
Fiscal planning	Local and State	Skill Level 1	Assess magnitude of investment to achieve load reduction goals.

Operational Considerations

Technical

Current Software & Hardware Requirements

Current software requirements for PTMApp – Desktop are listed in the PTMApp – Desktop user manual (**Appendix A; Table A2**). With the recent upgrade in the toolbar to support ESRI ArcMap version 10.6, support for versions 10.3 and 10.4 has been dropped. During the contract period HEI/IWI will be upgrading the toolbar again to support ArcPro, which is ESRI’s newest software package for using GIS products. BWSR is committed to supporting up to three versions of the toolbar, which will include at least one version in ArcMap and ArcPro at least through the contract period and for the foreseeable future.

ESRI also recently announced development of ArcMap 10.7 but has not released what additional functionality will be available; therefore, it is difficult to recommend whether an immediate upgrade to this version is necessary during the contract period. It is likely that ESRI users that wish to postpone upgrading to ArcPro will hold out with whichever latest version of ArcMap is available, which is expected to be ArcMap 10.7. With this in mind, an upgrade to ArcMap 10.7 (and an eventual drop of support for 10.6) is likely at some point.

Necessary hardware requirements for running PTMApp – Desktop vary greatly based on project size and scope. Project size is driven primarily by the project’s geographical area, raster cell size, and number of resource points among other more minor factors. Smaller projects (i.e. small geographical area, coarse raster cell size, and limited number of resource points) require less processing power. Conversely, larger projects with small raster size require significantly more. PTMApp – Desktop is often run in Minnesota for major watersheds as part of large regional planning projects such as 1W1P. Recommendations for data management and hardware for these types of projects were listed in the *PTMApp – Desktop Performance* brief in **Appendix A**. In summary, users are expected to decide what cell size and number of resource points best meets their project needs and objectives. In most cases a 5-10 meter grid cell size is sufficient. Resource points should be limited to those only absolutely needed for planning and implementation. Users should consider using a computer with at least 16 GB of available RAM and a minimum of 1 TB in storage. These recommendations can be relaxed for smaller project areas. For example, a user re-running a minor watershed (e.g. HUC-12) can easily do so on most laptop processors using a 3-meter grid.

Future Changes to Software & Hardware Requirements

The PTMApp – Desktop toolbar was designed to work exclusively with ESRI ArcGIS Desktop. This decision was made as ESRI GIS software packages are used almost exclusively by natural resource practitioners in LGU offices for accessing, displaying, and manipulating GIS data. Other software packages are available for these purposes, most notably open-source software which require no annual licensing costs. Transitioning to other, open-source software packages would have two notable benefits. First, it would provide freedom from the un-anticipated ESRI upgrades and patches which oftentimes require significant PTMApp – Desktop code modifications. Secondly, it would reduce the cost users most pay to access both the ArcGIS Desktop and Spatial Analyst licenses necessary to run PTMApp – Desktop. Despite these potential benefits, a transition is not recommended at this

time for three reasons. As previously noted, ESRI GIS software is used ubiquitously across LGU offices, so most users are already paying for at least an ArcGIS Desktop license to support other business needs of the LGU. Many are also already paying for a Spatial Analyst license. Thus, dropping the requirement for these licenses to use PTMApp – Desktop may result in no cost savings for the user as they would have been paying for those licenses anyway. Secondly, since most LGUs are using ESRI software, there would be additional time on their behalf to learn how to use the open-source GIS software. As increasing user adoption and decreasing difficulty to use the program are a focus of this contract period, adding another layer of complexity should be avoided. Lastly, the cost to redesign the program would be significant and would not justify the benefit to users or to BWSR. A transition should be reconsidered if/when either the benefits become greater or the drawbacks lessen.

As noted in the previous section, hardware requirements vary greatly based on project size, scope, and how the user prepares data. The recommended processes for preparing data, as outlined in the *PTMApp – Desktop Performance* brief in **Appendix A**, are not expected to change in the foreseeable future. As the cost for internal storage and RAM decreases, processing power increases, and performance improvements are incorporated into the toolbar, it is probable hardware requirements will lessen and hardware costs to run PTMApp will become cheaper. This assumes technological and programmatic changes in line with changes seen in the recent past.

Input Data

The input data for PTMApp – Desktop is comprised of two components: i.e., 1) a database called “Base.gdb” which can be downloaded state-wide (<https://ptmapp.bwsr.state.mn.us/User/PTMAppDesktop>) and is comprised of static GIS information, some of which is used in the computational processes within PTMApp – Desktop or used internally to compute additional inputs; and 2) inputs provided by the user based on their needs. The inputs required by PTMApp – Desktop are summarized in **Table 15**.

Table 15. Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) input file requirements.

Input	Description	Source	Update Schedule
Base files (Base.gdb)	Includes many state-wide (MN only) geographic information system (GIS) layers. Some of these require geoprocessing depending upon the hydro-conditioned digital elevation model (hDEM) raster cell size.	Can be downloaded from https://ptmapp.bwsr.state.mn.us/User/PTMAppDesktop	Requires updates at least every two years from data in Minnesota Geospatial Commons
Plan / Watershed Boundary	Several boundary types included in Base.gdb. These include Watershed Boundary Dataset hydrologic unit codes (HUC; 12-digit, 10-digit, and 8-digit) and MN watershed districts. The	User provided or clipped from Watershed Boundary	Requires updates at least every two years from data in Minnesota Geospatial Commons and US Geological Survey (USGS) Watershed Boundary Database

Input	Description	Source	Update Schedule
	user can also create or use boundaries for specific lakes or stream reaches.	Dataset in Base.gdb.	
Priority Resource Locations	Points representing the specific resource locations (i.e., a lake or stream outlet) of interest to the user. A user created file.	User created.	None, provided by user for each project
Digital Elevation Products	Hydro-conditioned products include raw DEM, flow direction raster, and flow accumulation raster. May be created by the user through a hydro-conditioning process or existing federal datasets (i.e., National Elevation Dataset and National Hydrologic Dataset (NHD) Plus). Calculations in PTMApp – Desktop are performed using the cell size of these rasters.	Static or user created.	Automation of the hydro-conditioning steps within PTMApp – Desktop is feasible. User would provide raw DEM and hydro-enforcement lines.
Travel Time Raster	Created by the user using a travel time tool available from the Minnesota Department of Natural Resources (https://gisdata.mn.gov/dataset/dnr-arcgis-toolbox) or other similar software. Uses the digital elevation products as inputs. Travel time rasters needed are upstream, downstream, and cell to cell. Raster must be at same cell size as hydro-conditioned DEM products.	User created.	Automated creation of the travel time rasters within PTMApp – Desktop is feasible. BWSR and Department of Natural Resources considering partnership to jointly support this tool.
Curve Number Raster	File currently available statewide and may be downloaded from the PTMApp website: https://ptmapp.bwsr.state.mn.us/User/PTMAppDesktop . Raster must be at same cell size as hydro-conditioned DEM products.	Static but may require geoprocessing depending upon raster cell size	Requires updates at least every two years from data in Minnesota Geospatial Commons and/or when statewide land cover data is updated.
Soil Survey Geographic (SSURGO) Soils	Crop Productivity Index (CPI), Hydric Soil (HS), Hydrologic Soil Group (HSG), and Depth to Groundwater (DTGW). Rasters must be at same cell size as hydro-conditioned DEM products.	User created.	Vector datasets for the state could be provided and PTMApp – Desktop coded to create SSURGO inputs based on hDEM raster cell size. Additional data would need to be bundled into Base.gdb.

Input	Description	Source	Update Schedule
Revised Universal Soil Loss Equation (RUSLE) Parameters	Erosivity (R), Soil Erodibility Factor (Kw), Cover Management Factor (C), Support Practice Factor (P) user created. Rasters must be at same cell size as hydro-conditioned DEM products.	User created.	Vector datasets for the state could be provided and PTMApp – Desktop coded to create RUSLE inputs based on hDEM raster cell size. Additional data would need to be bundled into Base.gdb.

The need to create these inputs is the primary reason the use of PTMApp – Desktop requires a skilled GIS user.

During the last several years, a majority of the user support requests are related to issues and challenges creating the inputs. The primary reason is the inability to “enforce” the business model and user requirements for PTMApp – Desktop. Assuming the minimum skill level requirements for PTMApp – Desktop are agreed upon, input creation should be addressed through training and workshops.

These inputs can be generated through a variety of processes, either directly using geoprocessing operations in ESRI ArcGIS software or through public and proprietary tools and toolbars. One such example is the Minnesota Department of Natural Resources’ Travel Time Tool, which generates the travel time rasters used by PTMApp to estimate sediment and nutrient runoff. BWSR is exploring a public-private partnership with the Department of Natural Resources and HEI to ensure the tool is supported long-term. Opportunities may exist to support other tools which aid users in creating and formatting input data. BWSR is committed to exploring these opportunities and investing in them where a clear value is available for PTMApp – Desktop users.

Quality of Conditioning

The hydro-conditioned DEM raster cell size dictates the cell size of the remaining input data. Not only must each input use the same cell size, but each input MUST also have the same physical (gridded) structure and projection, or an error will occur when executing PTMApp – Desktop.

The quality of hydro-conditioning also affects how the standard information products can be used (see **Figure 6**). Understanding the relationship between the quality of hydro-conditioning and the use of PTMApp standard information products is a user responsibility and continues to be an important training topic.

Extract for Web

Many standard information products created by PTMApp – Desktop and stored in the Processing.gdb (the file created by PTMApp – Desktop containing the standard information products) are prepared for web use by automatically extracting them into a database. This database is then loaded to the web server and web services enabled to access these data within PTMApp – Web. Of considerable concern is the resource needs to update PTMApp – Web programming and web services should PTMApp – Desktop functionality evolve. The primary means of mitigating this concern is to automate the programming of the information needed by PTMApp – Web. For example, assume the rasters like the soil loss raster are made available on PTMApp – Web, the extract for

web tool within PTMApp – Desktop should be modified to automate the process of not only extracting the data from the Processing.gdb, but also enabling web services.

Scheduled Releases

Similar to PTMApp – Web, scheduled releases are necessary for the PTMApp – Desktop toolbar to inform PTMApp users that functionality will be continuously maintained and technology updated when necessary.

Table 16 outlines a release schedule to address non-critical trouble tickets and to release new functionality and enhancements as outlined in **Table 4**. Critical tickets, meaning any trouble tickets which require an immediate update to the toolbar, will be addressed with immediate releases when the issue has been fixed.

Please note that these scheduled releases include upgrades to both ArcMap v.10.6 and ArcPro. ESRI recently announced development of ArcMap v.10.7 but has not released details of what v.10.7 will include. It's impossible to determine the need of supporting 10.7 without knowing what functionality it includes. Therefore, is was not included in the release content.

Table 16. Scheduled release dates for Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) with expected release content and the versions of Environmental Systems Research Institute (ESRI) software which will be supported.

Date	Release Content	ESRI Supported Versions
Jan. 2019	<ul style="list-style-type: none"> • 10.6 release • Addressed non-critical tickets 	ArcMap: 10.5, 10.6 (new) <i>Note: Dropped 10.3 and 10.4</i>
Apr. 2019	<ul style="list-style-type: none"> • Addressed non-critical tickets 	ArcMap: 10.5, 10.6
Aug. 2019	<ul style="list-style-type: none"> • Integrate ACPF - PTMApp IAPA enhancement • Update Base Catalog enhancement • Addressed non-critical tickets 	ArcMap: 10.5, 10.6
Oct. 2019	<ul style="list-style-type: none"> • Pro release • NRCS Practice Codes from BMP Suitability enhancement • Addressed non-critical tickets 	ArcMap: 10.5, 10.6 ArcPro: 2.X (new)
Jan. 2020	<ul style="list-style-type: none"> • Addressed non-critical tickets 	ArcMap: 10.5, 10.6 ArcPro: 2.X
Apr. 2020	<ul style="list-style-type: none"> • Addressed non-critical tickets 	ArcMap: 10.5, 10.6 ArcPro: 2.X

Procedural

A mechanism needs to be established for the distribution of completed PTMApp databases (see **Figure 8**). The most logical approach is providing these files through the Minnesota Geospatial Commons.

Performance Tuning

PTMApp – Desktop toolbar functionality is continuously reviewed to identify opportunities for performance improvements through tuning. Performance tuning is defined as any improvement to system performance which can increase load and processing speed and reduce bottlenecks. Some of these improvements are technological, such as upgrades to hardware or supporting software which result in decreases in processing times. A recent example of this is shown in **Table 17**. The upgrade of the PTMApp – Desktop toolbar to ESRI ArcMap v.10.6 resulted in the capability of adding parallel processing to certain ESRI hydrology tools which historically resulted in slower runtimes in previous versions of ArcMap. Other improvements may be changes to coding logic which will modify how data is processed. **Table 17** details opportunities for performance tuning which could feasibly be implemented during the contract period. These opportunities were ranked based on considerations for (1) benefit to improving performance, (2) difficulty to implement (i.e. level of effort and, therefore, cost), and (3) expected benefit to one or more supported versions of the toolbar. Two of the performance tuning opportunities are already being pursued as part of upgrades to ArcMap 10.6. These are (1) limited parallel processing for hydrology tools and (2) optimization of table writing. Additional detail is available for understanding these changes in the version release notes provided with the ArcMap 10.6 upgrade.

Even with considering the performance improvements in **Table 17**, the best way to ensure reasonable processing times using the PTMApp – Desktop toolbar is through decisions in how to prepare data which are consistent with the user’s needs and objectives for using PTMApp outputs. The decisions that most likely lead to slow processing times are cells size and number of resource points. Please see the discussion above in the subsection *Current Software & Hardware Requirements* for cell size and resource point decision recommendations. Other project management considerations which can reduce processing times while ensuring users create valuable output products are listed in the *PTMApp – Desktop Performance* brief in **Appendix A**.

Table 17. Opportunities for performance tuning in Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop). Opportunities were ranked considering their benefit to improving performance, difficulty to implement (i.e. level of effort and, therefore, cost), and expected benefit to one or more supported versions of the toolbar.

Opportunity Name	Description	Opportunity Type	Recommended Priority Rank	Anticipated Performance Benefit (High/Medium/Low)	Estimated Cost	Compatible Versions	Additional Comments
Limited Parallel Processing in ArcMap 10.6	Parallel Processing in ArcMap 10.6 for specific GIS operations, including flow accumulation and stream length. These are known bottlenecks in toolbar processing.	Technical	Currently Completing with v.10.6 upgrade	High	\$1,120	ArcMap v.10.6	Capability only available for toolbar v.10.6 and above. In the 10.6 upgrade 7 tools were improved by this method.
Optimize internal table writing	Current toolbar code uses individual operations to populate table fields, including notably the 'Calculate Field' operation. By applying cursors and optimizing the creation/deletion of temp data table generation and population can be greatly improved.	Technical	Currently Completing with v.10.6 upgrade	High	\$4,480	ArcMap v.10.5 and 10.6	This enhancement would be most notable for large datasets with significant temp data generated. In the 10.6 upgrade 19 tools were improved by this method.
Apply parallel processing to the Flow Length hydrology tool	Flow length was the only hydrology tool which did not have a parallel processing option added in 10.6. See if ArcMap 10.7 and/or ArcPro will add Parallel Processing Factor in their future updates for Flow Length. If not, contact ESRI to see if it is in their plans. Otherwise,	Technical	High	High	\$5,600	ArcMap v.10.7 ArcPro	High benefit considering the possible limited effort if implemented by ESRI. The following tools would be improved significantly: Ingest Pre-Processing Data, Travel Time to Catchment Outlet, SDR to Catchment Outlet. Very little time if code provided by ESRI (4 hours) whereas a

Opportunity Name	Description	Opportunity Type	Recommended Priority Rank	Anticipated Performance Benefit (High/Medium/Low)	Estimated Cost	Compatible Versions	Additional Comments
	implement custom parallel processing for this tool.						significant effort it if needs to be manually coded (40 hours). Current estimate assumes the latter.
Increased tabular calculations in Lake Routing and Treatment Trains tools	Change method of calculation in Lake Routing and Treatment Trains tools to apply upstream/downstream calculations in tabular form.	Theory	High	High	\$11,200	All	From a technical perspective there is still limited options to improving performance of these two tools. Some of the other tasks mentioned in this report will provide a small performance improvement. However, a theory adjustment would have the biggest impact. Since these are the slowest performing tools it should be considered.
Tool workflow audit	Review code and identify potential redundancies in workflow. Consider (1) combining applicable tools and/or (2) removal of unused output data products.	Technical/Theory	Medium	Medium	\$11,200	All	Each PTMApp tool performs checks such as validation, schema locks test, checking out extension, etc. Some may have similar redundant temp calculations. Review to see if workflow changes will help performance, maintainability, and simplicity.

Opportunity Name	Description	Opportunity Type	Recommended Priority Rank	Anticipated Performance Benefit (High/Medium/Low)	Estimated Cost	Compatible Versions	Additional Comments
Multithreading processes	Running different functions within a tool at the same time on different threads.	Technical	Medium (experimental)	Low	\$7,000	ArcGIS Pro only (ArcMap maybe)	This is different than multiprocessing. Python 3, which ArcGIS Pro uses, has better logic to implement this. Ingest Pre-processing tool is a good candidate for implementing this as it is currently one of the slower tools. Cost depends greatly on how many tools to implement. Assume we choose those currently with the longest runtimes.
Research using different temp raster formats	Currently, all temp data is saved as rasters in a file GDB. Saving these in a different format could cut down on scratch locking and have some performance benefit.	Technical	Low (Experimental)	Low	\$2,800	All	Some ESRI documentation has recommended putting temp rasters outside of file GDBs. There are several formats to consider. Need to research impact and potential changes to output data accuracy.
Raster calculations as Integer instead of Float	Within tools, convert rasters currently in Float type (i.e. decimal) to Integer type to lower processing times. Convert final rasters back to Float type at tool completion.	Technical	Low		\$11,200	All	Previous tests have shown small improvements with this method. However, potential high risks of getting inaccurate results. Therefore requires extensive testing.

Opportunity Name	Description	Opportunity Type	Recommended Priority Rank	Anticipated Performance Benefit (High/Medium/Low)	Estimated Cost	Compatible Versions	Additional Comments
Full Parallel Processing	Implement parallel processing on all remaining tools (not already completed in the 'Limited Parallel Processing in ArcMap v.10.6' activity)	Technical	Low (experimental)	Low	\$6,160	ArcMap v.10.6 ArcPro	Would be limited to some raster calculations. May not produce much with this method. Would require some experimentation. The hydrology tools provided the biggest dent into optimizing via this method already.
Compacting of geodatabase	Compacting GDB to reduce size. May or may not have any benefit in certain tools.	Technical	Very Low	Low	\$560	All	Very negligible performance benefit.

Enhancement Priorities and Cost

During the contract period ending June 30, 2020, improvements to the toolbar are proposed which will improve performance of existing tools and modules while proving additional functionality to better meet the changing needs of users. **Table 18** summarizes the proposed improvements to toolbar performance. **Table 19** summarizes the proposed enhancements to the toolbar to better meet the business needs of expected users.

Table 18. Proposed Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) performance tuning opportunities.

Opportunity Name	Description	Opportunity Type	Compatible Versions	Estimated Cost
Limited Parallel Processing in ArcMap 10.6	Parallel Processing in ArcMap 10.6 for specific GIS operations, including flow accumulation and stream length. These are known bottlenecks in toolbar processing.	Technical	ArcMap v.10.6	\$1,120
Optimize Internal Table Writing	Current toolbar code uses individual operations to populate tables fields, including notably the 'Calculate Field' operation. By applying cursors and optimizing the creation/deletion of temp data table generation/population can be greatly improved.	Technical	ArcMap v.10.5 and 10.6	\$4,480
Estimated Total Cost for PTMApp – Desktop Performance Tuning Opportunities =				\$5,600

Improvements to BMP Suitability, Benefits Analysis, and the technical memorandums to address streambank erosion and altered hydrology were originally included in the contract and remain proposed to complete as part of this Needs Assessment. The following enhancements were listed in the contract but are not being recommended for completion during the contract period:

- 1) Incorporate Crop Rotation into Sediment Analysis: Develop a crop rotation and residue management approach to adjusting and accounting for RUSLE parameters.
- 2) Modify Sediment Loss Calculations: USDA-NRCS is transitioning to the Water Erosion Prediction Project (WEPP) Model. Develop a strategy and timetable to migrate to utilizing WEPP.
- 3) Improve Nitrogen Routing Routines: Assess and enhance the equations addressing nitrogen for agricultural sub-surface drainage practices.
- 4) Improve TP and TN Load Estimation Methods: Current loads leaving the landscape are based on literate yield coefficients, based on NLCD. This limits the spatial scale of the estimate because of the coarseness of the NLCD layers. Modify the program to use the estimated 2-yr, 24-hr runoff depth and an event mean concentration tied to land use.

Each of these enhancements was considered and prioritized in **Table 5**. Enhancements listed above as 1, 3, and 4 were prioritized lower because they were not considered likely to lead to different conservation decisions (see **Table 5** for explanation). Enhancement 2 was considered a medium priority (Priority Rank = 2) but was not recommended for completion during this contract period as WEPP is not yet consistently used. This should be considered in the future when WEPP use is more common and additional dollars are available.

Table 19. Summary of current and proposed Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) enhancements to be completed during the contract period, ending June 30, 2020. Please see **Table 5** for a full description of each enhancement, its expected functional changes, and any anticipated implications for Prioritize, Target, and Measure Application for Web (PTMApp – Web).

Enhancement Name	Description	Recommended Priority Rank	Estimated Cost
Natural Resource Conservation Services (NRCS) Practice Code BMP Suitability	This enhancement consists applying the treatment group equations to the practice codes and thereby changing the PTMApp language for structural practices to be consistent with the NRCS. PTMApp – Desktop currently uses various criteria to evaluate the technical feasibility of structural conservations practices using “treatment groups.” Practices within a treatment group (e.g., storage) remove sediment and nutrients in a similar manner (by settling). Specific equations are applied to estimate sediment and nutrient removal for each treatment group. PTMApp – Desktop also uses various criteria to evaluate the technical feasibility of structural practices as classified by the Natural Resource Conservation Service (i.e., Practice Codes).	1	\$31,730
Integrated ACPF – PTMApp (IAPA) Maintenance and Updates	PTMApp – Desktop currently has the functionality of being able to “ingest” or “bring – in” conservation practice polygons created using the US Department of Agriculture – Agricultural Research Service (USDA-ARS) ACPF enhance these polygons. The polygons are enhanced using PTMApp data in the background, to assign water quality information to the polygons, including their load reduction value. ACPF was recently upgraded to version 3.0 and testing and likely updates are necessary to ensure compatibility with PTMApp – Desktop.	1	\$9,500
Updated Base Catalog	The base catalog, used for processing in PTMApp – Desktop toolbar modules and for qualitative review of products created in the toolbar, has not been updated since the original development of PTMApp. This enhancement would include a review of current catalog layers, consideration for additional (qualitative) layers, and an update of current layers. Note: As requested by PTMApp External Committee members, Base Catalog layers which are used for processing in PTMApp will be extended to the hydrologic boundary of major watersheds in Minnesota.	1	\$2,680

Enhancement Name	Description	Recommended Priority Rank	Estimated Cost
Technical Memorandum to Determine Feasibility of Estimating Streambank Sediment and Nutrient Sources	This enhancement consists of exploring the technical feasibility of implementing methods to estimate sediment and nutrient annual loads from streambanks and bluffs. Sediment and nutrient sources from surface water runoff are currently estimated by PTMApp – Desktop. Streambanks and bluffs can be an important source of sediment and nutrients. The methods to address sediment and nutrients originating from streambank and bluffs can differ from surface water runoff and thus the feasibility to quantitatively estimate these would have to be determined before considering implementation.	2	\$10,180
Technical Memorandum to Determinate Feasibility of Incorporating Hydrologic Routing and Altered Hydrology	This enhancement consists of exploring the technical feasibility of incorporating hydrology into PTMApp, including the ability to generate hydrographs, route the hydrographs downstream, and estimate the runoff volume and peak reduction associated with the structural and management practices. Peak discharge rates for user specified precipitation depths and runoff volumes is currently implemented within PTMApp – Desktop, but this memorandum would explore the necessary functionality to accomplish hydrologic routing consistent with the methods used within the U.S. Army Corps of Engineer’s HEC-HMS model.	2	\$10,180
Estimated Total Cost for PTMApp – Desktop Enhancements =			\$64,270

Increasing Adoption and Use

Opportunities for Increasing Adoption

During the current contract period (ending June 30, 2020), BWSR has identified increasing user adoption of PTMApp as a focus of program efforts. Registered users for both PTMApp – Desktop and PTMApp – Web have been gradually increasing since its inception, but most registered users are not utilizing either platform regularly despite the fact that both platforms have functionality providing them with the tools and information to meet their long-term and day-to-day business needs. A select number of these users are regular users, but widespread, consistent use across LGU staff in the state is a desired outcome of the program. To increase user adoption, opportunities have been outlined in the following sections based on these three main categories:

- **Communication and Outreach:** How can we better inform LGU staff about PTMApp and what functionality the platform provides to assist in their work?
- **Training:** Once staff are aware of the program, what resources can we provide to ease their use and improve their experience?
- **Input Creation:** Can we develop and format application inputs for them which may shorten the learning curve and allow them to more quickly and easily develop output products?

Communication and Outreach

The original and ongoing vision of PTMApp is to provide local government staff with a tool to assist them with their watershed management planning and conservation implementation work. In this way, PTMApp would be used on a week-to-week and even day-to-day basis for project planning and engagement with landowners. For this vision to be realized, more LGU staff need to be made aware of the application and its capabilities for watershed management and implementation. To date, LGU outreach has consisted of invitations to workshop trainings and annual presentations at BWSR Academy and similar seminars. Communications have generally been organic, coinciding with conversations typically initiated with larger planning efforts managed by state agencies, such as BWSR's 1W1P or MPCA's WRAPS programs. LGU staff not currently involved in those planning programs, and not actively seeking out training opportunities, may not be aware of the application's abilities and how it may be of use to them. A coordinated outreach campaign will be designed to better reach these staff through channels they're currently engaged in. These include:

- 1) E-mail blasts
- 2) Newsletters or other mailers
- 3) Social media releases
- 4) Other communication systems (e.g. farm bureaus or dealers/retailers)

- 5) Handouts at conferences and expos
- 6) Articles and advertisements in newsprint or magazines

As an outreach campaign has not been implemented to date, planning work would be necessary to understand specifically which users to target (**Figure 2**) and what channels would be most suitable to reach and engage them in. This campaign would need to be designed and vetted with approval by BWSR staff, but could utilize existing activities BWSR is already engaged in. For example, BWSR and its partners already reserve booths at conferences, so only the handout would need to be designed and printed. BWSR and its partners also already have numerous social media and email accounts, so just individual posts and email blasts would need to be crafted and vetted.

During the contract period, \$8,619 will be set aside for the development of a campaign and the design of initial materials to engage LGU staff. The preliminary objectives of this campaign will be to:

- 1) Establish the specific PTMApp users (**Figure 2**) which will be the target of the campaign;
- 2) Determine the specific channels and/or activities to engage these users in;
- 3) Determine the materials best suited for these users and/or the activities which are most likely to “catch their eye”;
- 4) Begin designing those materials considered the highest priority by the Team; and
- 5) Where possible and beneficial, improve existing materials to better meet need.

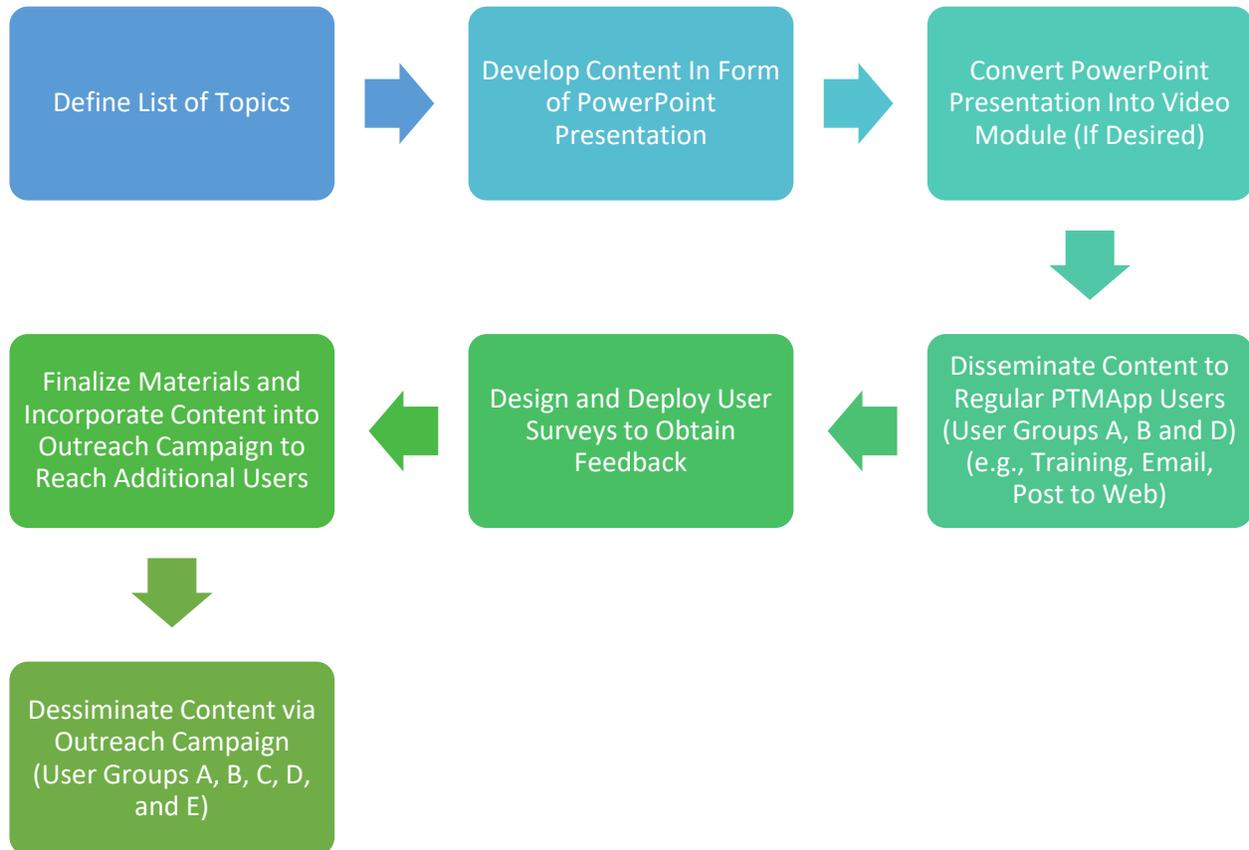
It is also worth noting that additional outreach with state agency staff, especially staff within BWSR, is also necessary to meet the vision of increasing LGU use of PTMApp. State agency staff are often used by LGUs as resources, and state agency staff which are uninformed on PTMApp and its capabilities further increases the likelihood that LGU staff won't seek further information on the application. State agency staff are included in **Figure 2**, but should be considered “special” cases for communication, training, and outreach. Although they may not become users of the program, they must understand what the program does (and does not do) and how it can be utilized by LGU staff to better meet their business needs.

Training

Feedback from previous PTMApp trainings has been consistent. Content must be more user-focused. This feedback is primarily driven by the diverse audience attending training sessions. Audience members can vary from the LGU technicians and specialists expected to create data, run the model, and process results, to administrators who may use PTMApp output products to develop plans or apply for grants, to managers who may never see the output products but still need to understand implications for policymaking. These specific needs led to development and refinement of the PTMApp user groups, as outlined in **Figures 2** and **3**. Therefore, future training topics, materials, and even formatting must be redesigned to meet these individual user group needs. **Figure 9** establishes a process for defining those future topics, developing the training materials, and disseminating those materials to users. The PTMApp website (<https://ptmapp.bwsr.state.mn.us/User/Documentation>) includes a list of materials

already developed for training users. Much of this material can be used or modified to meet the needs of individual user groups (**Figure 2**) and skill levels (**Figure 3**).

Figure 9. Process for developing materials for use in training Prioritize, Target, and Measure Application (PTMApp) users. Training materials will be provided to regular users through established channels (e.g. PTMApp website) but will also be incorporated into the outreach campaign to reach new users.



Training materials will be designed to meet the needs of users in user groups A, B, and D consistent with business needs established in this Needs Assessment. Following the process in **Figure 9**, these will be distributed to regular users through established channels, including links on the PTMApp website, emails to registered users, in-person workshops, and personal communication. Feedback will be obtained by users and materials will be modified to address concerns and comments. Modified material will then be considered for incorporation into the outreach campaign to reach additional users outside those engaged through established channels. For example, a product demonstration of new functionality prepared for current users could be re-purposed (preferably with user testimonials of how the new product addresses their business need) to engage potential new users. These videos could be disseminated to potential new users via BWSR email and social media blasts, leading recipients to links

to these videos on the BWSR website and BWSR YouTube channel. Potential new users would also be provided access to other resources and background information.

The main purpose of these training materials is to provide staff that are already aware of PTMApp with the additional resources they need to better utilize the program. This may be to better train regular users of existing and new functionality, or it may be to provide a new or novice user with the information they need to become a regular user. **Table 20** lays out a potential list of topics for each user group and skill level. The table also details whether training content has already been developed and what level of effort it would take to (1) develop/modify the content in PowerPoint for an in-person workshop, (2) use those materials to create a video training, and (3) incorporate the content into materials for the outreach campaign. Content modification is expected, even for training topics already used in current trainings to ensure training content is consistent with new user groups (**Figure 2**) and skill levels (**Figure 3**). It is not expected that each of these training modules will be completed during the contract period. Considering user need and current available budget its expected module topics 1-8 can be completed this contract period (**Table 20**). Additional presentation and training materials to support in-person training workshops for User Group A users (**Figure 2**) is also proposed (**Table 20**; for modules with a value in 'Estimated Hours During This Contract Period' column).

User Group A is a particular focus as these staff are responsible for developing the PTMApp - Desktop data reviewed and used by other user groups. Based on experience gathered in previous trainings, many training attendees did not have the GIS experience necessary to prepare data for and run the PTMApp-Desktop toolbar. To ensure future workshops focused on User Group A users are successful, the following is proposed:

- 1) Pre-training questionnaire to ensure attendees have the technical capabilities and training and/or experience to develop PTMApp - Desktop outputs; and
- 2) Certification to users once they complete the training.

The pre-training questionnaire is meant to select only those trainees with the skill set that will better assure success for the trainee in using PTMApp. The certification can be utilized by the trainee to demonstrate competence in using the application. BWSR must also commit to only supporting those which have developed that competency by:

- 1) Addressing all questions and/or tickets submitted by certified users, whether the question/ticket currently requires a 'Limited' or 'Detailed' response as outlined in the current Technical Support Policy Guidance (**Appendix A**); and
- 2) Not addressing technical questions and/or tickets submitted by users which have not attained their certification.

When technical questions are asked by uncertified users, they would be directed to the necessary training materials and/or session to receive their certification. Please note this would not prevent BWSR staff from answering general questions from uncertified users, especially those that would limit their interest in exploring opportunities to learn more about the program.

Video training is an emphasis based on feedback from users requesting resources to assist in using PTMApp when they were not able to attend an in-person workshop. For tasks that are completed frequently, such as creating PTMApp inputs or using PTMApp output products to develop plan content, video trainings can be developed which walk users through the process via step-by-step instructions. Many workshop attendees also found they weren't able to recall certain steps months after the training once they were actually able to use the program. Video modules, available and accessible whenever a user may need them, provide users with the information they need the moment they need it. A video outline process has been drafted based on development of an initial proof of concept in 2019 and is outlined below:

Video outline:

- a. Introduction
- b. Establish Need:
 - i. What problem can this video solve?
 - ii. What will you learn watching this video?
 - iii. For PTMApp Standard Products, which portion of the "pin-wheel" does this video address?
- c. Define Problem
 - i. Detail on why a solution is necessary
- d. Outline Process
 - i. Steps to address problem utilizing PTMApp-Web or PTMApp-Desktop products
- e. Re-establish Need and Describe Solution
 - i. What was the problem and how has it been solved in the video?
- f. Closing Thoughts
- g. Where applicable: other uses, additional resources (e.g. videos)

The schedule to complete training topics and the outreach campaign is detailed in **Table 21**. Once priorities outlined in this Needs Assessment are finalized, work can begin immediately to establish training topics and audience for the outreach campaign. Initial development of training materials is expected to last through Summer 2019, with in-person workshop materials developed first followed by video content based on PowerPoints. Feedback will be solicited and materials updated as requested by users, which is expected to continue through the end of the contract period and beyond.

It is worth noting the consistent feedback received from users requesting in-person trainings be more tailored for each region and the unique needs of its regional users. BWSR is committed to providing PTMApp users with the resources they need to effectively use the program to meet their business needs. Regional trainings can adapt module content to better meet their needs. Peer-to-peer training is another focus that will provide additional emphasis on how to best solve local problems (**Table 20**). As the pool of users becomes larger, and the skillsets of those users more extensive, peer-to-peer trainings will become higher priorities. More frequent users can then become critical resources for new and novice users to ask questions and receive feedback from colleagues who have very likely faced similar problems. BWSR is in the process of experimenting with this training format and expects it will become a regular part of future trainings.

Lastly, BWSR and its partners are open to and exploring current and future upgrades to resources for PTMApp users. These include both the training materials previously discussed as well as the digital platforms they are exchanged upon. During the March 2019 External PTMApp Committee meeting specifically, three mediums were discussed in detail including the PTMApp Website, the BWSR YouTube Channel, and a potential PTMApp User Group Forum. BWSR is currently updating its website and staff expect the PTMApp website will also be updated as part of that project. The PTMApp training videos will be made available both on this updated BWSR PTMApp website as well as on the BWSR YouTube channel. BWSR will also explore the creation of a PTMApp User Group Forum during FY2020. Other environmental modeling software, such as ArcSWAT, have forums which receive high traffic and can be supported solely by the users. Its expected that, while PTMApp grows, BWSR staff and their partners will need to remain active in the forum to ensure its success.

Table 20. Content examples for modularized training sessions. The table details whether content already exists and what level of effort is necessary to prepare the content for new modules and for a new medium.

Onsite Training Session Number and Description	Module Topic No.	Module Topic	Topic Training Session Duration (Hours)	Targeted User Groups	Content Already Exists?	Hours Needed to Develop Module Content in Power Point	Hours to Convert to Video Module (Create, Edit, Deploy to Web)	Hours Needed to Develop Written Content for Outreach Campaign (draft & edit)	Training / Communication Purpose	Estimated Hours	Estimated Hours During This Contract Period
1 Introduction to the Prioritize, Target and Measure Application (PTMApp)	1	What is the Prioritize, Target and Measure Application (PTMApp)?	0.5	A, B, C, D, E	Yes	8	30	4	Understand PTMApp	42	42
	2	Understanding PTMApp Standard Information Products– What they Mean and Don't Mean!	0.5	A, B, C, D, E	Yes	8	30	4	Understand PTMApp standard information products (interpretation provided)	42	42
	3	How to Communicate Standard Information Products to the Public	1.0	A, B, C, D, E	Yes	8	30	4	Understand PTMApp standard information products (interpretation provided)	42	42
	4	Introduction to Using PTMApp – Web	0.5	A, B, C, D, E	Yes	6	30	4	Understand PTMApp standard information products (interpretation provided)	40	40
	5	How to Obtain and Access PTMApp Standard Information Products in PTMApp-Web: Source Assessments (Catchment and Watershed Scales)	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	38
	6	How to Obtain and Access PTMApp Standard Information Products in PTMApp-Web: BMP Technical Feasibility and Benefit at the Practice	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	38
	7	How to Obtain and Access PTMApp Standard Information Products in PTMApp-Web: BMP Effectiveness at Catchment (Field) and Watershed Scales	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	38
	8	How to Obtain and Access PTMApp Standard Information Products in PTMApp-Web: Estimating and Understanding BMP Cost-effectiveness at Catchment (Field) and Watershed Scales	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	38
	9	Introduction to PTMApp – Desktop	0.5	A, B, C, D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	

Onsite Training Session Number and Description	Module Topic No.	Module Topic	Topic Training Session Duration (Hours)	Targeted User Groups	Content Already Exists?	Hours Needed to Develop Module Content in Power Point	Hours to Convert to Video Module (Create, Edit, Deploy to Web)	Hours Needed to Develop Written Content for Outreach Campaign (draft & edit)	Training / Communication Purpose	Estimated Hours	Estimated Hours During This Contract Period
	10	How to Obtain and Access PTMApp Standard Information Products in PTMApp-Desktop: Source Assessments (Catchment and Watershed Scales)	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	
	11	How to Obtain and Access PTMApp Standard Information Products in PTMApp- Desktop: BMP Technical Feasibility and Benefit at the Practice	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	
	12	How to Obtain and Access PTMApp Standard Information Products in PTMApp- Desktop: BMP Effectiveness at Catchment (Field) and Watershed Scales	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	
	13	How to Obtain and Access PTMApp Standard Information Products in PTMApp- Desktop: Estimating and Understanding BMP Cost-effectiveness at Catchment (Field) and Watershed Scales	0.5	D, E	Yes	4	30	4	Understand PTMApp standard information products (interpretation provided)	38	
2 Introduction to the Use of PTMApp – Web	14	How to use PTMApp – Web Features	2	B, D	Yes	16	60	4	Interpret, Understand and Use PTMApp standard information products created using PTMApp – Desktop and PTMApp – Web	80	
	15	Using PTMApp Standard Information Products for Developing a Watershed Plan	3	B, D	No	32	90	4	Interpret, Understand and Use PTMApp standard information products created using PTMApp – Desktop and PTMApp – Web	126	
	16	Using the Action Report tool to Find Preferred Practices	1	B, D	No	16	45	4	Interpret, Understand and Use PTMApp standard information products created using PTMApp – Desktop and PTMApp – Web	65	
3 Creating Watershed and Implementation Action Plans Using PTMApp – Web	17	Using PTMApp Standard Information Products for Developing an Action Plan	2	B, D	No	24	60	4	Interpret, Understand and Use PTMApp standard information products created using PTMApp – Desktop and PTMApp – Web	88	
	18	Using PTMApp Standard Information Products to Assess Field Condition	2	B, D	No	24	60	4	Interpret, Understand and Use PTMApp standard information products created	88	

Onsite Training Session Number and Description	Module Topic No.	Module Topic	Topic Training Session Duration (Hours)	Targeted User Groups	Content Already Exists?	Hours Needed to Develop Module Content in Power Point	Hours to Convert to Video Module (Create, Edit, Deploy to Web)	Hours Needed to Develop Written Content for Outreach Campaign (draft & edit)	Training / Communication Purpose	Estimated Hours	Estimated Hours During This Contract Period
									using PTMApp – Desktop and PTMApp – Web		
4 Hydro-Conditioning; Mechanics and PTMApp Considerations	19	Hydro-conditioning Considerations for Using PTMApp – Desktop	2	A	Yes	16	50	4	Create PTMApp data using PTMApp - Desktop	70	4
	20	Mechanics of Hydro-Conditioning	6	A	Yes	24	90	4	Create PTMApp data using PTMApp - Desktop	118	16
5 Creating Inputs and Data to Run PTMApp – Desktop	21	How to create inputs for using PTMApp – Desktop	3	A	Yes	16	60	4	Create PTMApp data using PTMApp - Desktop	80	16
	22	How to modify the Base.gdb for using PTMApp – Desktop	3	A	No	24	60	4	Create PTMApp data using PTMApp - Desktop	88	
6 The Mechanics of Running PTMApp - Desktop	23	How to Install the Toolbar and Prepare for Running PTMApp – Desktop	1	A	Yes	8	45	4	Create PTMApp data using PTMApp - Desktop	57	8
	24	The Mechanics of Running PTMApp – Desktop and Understanding Geodatabase Structure Created	3	A	Yes	16	60	4	Create PTMApp data using PTMApp - Desktop	80	16
7 Reviewing Your PTMApp – Desktop Data and Porting it to PTMApp – Web	25	Uploading PTMApp – Desktop Data to PTMApp – Web	0.5	A	No	8	30	4	Create PTMApp data using PTMApp - Desktop	42	8
	26	How to Complete Quality Assurance Review of Your PTMApp – Desktop Standard Information Products	3	A	No	24	60	4	Create PTMApp data using PTMApp - Desktop	88	16
8 Advanced PTMApp – Desktop; Creating Custom Products	27	Advanced PTMApp – Desktop, Developing Custom Products	6	A, B, D	No	60	100	4	Create PTMApp data using PTMApp – Desktop AND Interpret, Understand and Use PTMApp standard information products created using PTMApp – Desktop and PTMApp – Web	164	

Onsite Training Session Number and Description	Module Topic No.	Module Topic	Topic Training Session Duration (Hours)	Targeted User Groups	Content Already Exists?	Hours Needed to Develop Module Content in Power Point	Hours to Convert to Video Module (Create, Edit, Deploy to Web)	Hours Needed to Develop Written Content for Outreach Campaign (draft & edit)	Training / Communication Purpose	Estimated Hours	Estimated Hours During This Contract Period
9 Peer-to-Peer Training in How to use PTMApp – Desktop Products	28	Peer-to-Peer Training in How to use PTMApp – Desktop Products	3	A, B, D	No	45	60	4	Provide local government staff experience of using and applying PTMApp – Desktop products to solve problems faced in their office by leveraging experience of their peers.	109	
10 Peer-to-Peer Training in How to use PTMApp – Web Products	29	Peer-to-Peer Training in How to use PTMApp – Web Products	3	B, D	No	45	60	4	Provide local government staff experience of using and applying PTMApp – Web products to solve problems faced in their office by leveraging experience of their peers.	109	
Hours to Complete =						464	1,380	116		1,960	402

Table 21. Descriptions and timeline to complete tasks to increase user adoption of the Prioritize, Target, and Measure Application (PTMApp).

Increasing User Adoption Task	Description	Timeline
In-Person Workshops	Discuss and finalize the list of use-focused training module topics, based on user groups (Figures 2 and 3), to complete during contract period.	Summer 2019
	Develop module content.	Summer - Fall 2019
	Conduct Workshops. Presume four in-person workshops through June 2020, workshop materials refined based on feedback following each workshop.	Summer 2019 – Summer 2020
Video Modules	Establish topics for video modules and determine medium for publishing (e.g. YouTube, Board of Water and Soil Resources (BWSR) website, etc.).	Summer 2019
	Develop content (script based on workshop PowerPoint), record, and edit sessions.	Summer - Fall 2019
	Work with BWSR and Minnesota Geospatial Office (MnGEO) to publish, update as necessary based on user feedback.	Summer 2019 – Summer 2020
Outreach Campaign	Establish targeted user groups and determine channels and/or activities to engage users	Summer 2019
	Determine content suitable for inclusion in outreach campaign. Refine materials for use in handouts, email blasts, social media posts, etc. Modify as needed based on feedback.	Summer 2019 – Summer 2020

Input Creation

A majority of time to create PTMApp products is in the creation of the input data to run the application. This effort is typically estimated to consume up to 75% of total project costs and is primarily driven by the level of hydro-conditioning required based on the intended use of the data. For example, if users wish to use PTMApp data to identify field-scale locations of practices with reasonable confidence, H3DEM or H3DEM Plus conditioning is necessary (**Figure 6**). On the other hand, if users simply need an estimate for catchment-scale loading and BMP identification to be used for planning purposes (i.e. how many BMPs would I need to reach my water quality goal(s)), then H2DEM conditioning is sufficient (**Figure 6**). In either case, significant effort is necessary to gather GIS files, hydro-condition, and develop and format the other inputs necessary to run the application (**Table 15**).

There are strategies for the State of Minnesota to decrease this level of effort for PTMApp – Desktop users to create their data. They include:

- Development of inputs which are consistent statewide and do not vary based on hydro-conditioning level, such as the SSURGO and RUSLE inputs. The Curve Number raster has already been created across the state.
- Creation of a tool to streamline the process for generating inputs related to hydro-conditioning, including hydro-modified digital elevation models, flow accumulation rasters, and flow direction rasters, and rasters related to travel time.
- For cases where PTMApp data has been created but a user wishes to run the application for a portion of that watershed (e.g. to get data at a finer grid scale, to run with new PTMApp functionality, or to add additional resource points), creation of a tool which could re-generate inputs for portions of the previously-generated PTMApp data based on a smaller project area provided by the user.

These strategies are outlined in **Table 5** but have not been proposed as enhancements to the PTMApp – Desktop toolbar as the current PTMApp business need holds that input generation should be completed by those in User Group A with a high GIS skill level. BWSR is exploring a partnership with the Minnesota Department of Natural Resources and HEI to support the department’s Travel Time tool. This partnership would ensure long-term support for the tool, which is used to create three different inputs to the application.

Budget dollars have been set aside in the contract for development of a technical memorandum which would establish an action plan and cost estimate for creating PTMApp data inputs statewide. As noted above, using the currently-established business need, this should be completed through trainings. These dollars could be used to begin development of inputs which are typically static from project to project. These include inputs rasters related to SSURGO soils (ssurgo_cpi, ssurgo_dtgw, ssurgo_hs, and ssurgo_hsg) and RUSLE parameters (rusle_c, rusle_kw, rusle_m, rusle_p, and rusle_r). Users would still be responsible for developing inputs related to project management decisions (e.g. project boundary and resource points) and those resulting from a hydro-modified DEM.

Table 22. Summary of current and proposed Prioritize, Target, and Measure Application (PTMApp) tasks to be completed during the contract period, ending June 30, 2020, to increase user adoption and use.

Task Name	Recommended Priority Rank	Description	Level of Effort
Outreach Campaign	1	<p>Development of a campaign and the design of initial materials to engage LGU staff. The preliminary objectives of this campaign will be to:</p> <ol style="list-style-type: none"> 1) Establish the specific PTMApp users (Figure 2) which will be the target of the campaign; 2) Determine the specific channels and/or activities to engage these users in; 3) Determine the materials best suited for these users and/or the activities which are most likely to “catch their eye”; and 4) Begin designing those materials considered the highest priority by the group. 	\$8,619
In-Person Workshops	1	<p>Establishment of new, use-focused training modules based on user groups (Figure 2) and skill levels (Figure 3). A list of training session topics is on Table 20. Level of effort includes time to discuss and finalize topics, develop workshop materials, and conduct workshops.</p>	\$54,002
Video Modules	1	<p>Utilize materials developed from in-person workshops to record video modules to guide users, step-by-step, through common PTMApp workflows. Level of effort includes time to modify training materials for video use, write script, record, edit, and publish to pre-determined mediums (e.g. BWSR Website and/or YouTube channel).</p>	\$32,678
Estimated Total Cost for Increasing User Adoption Tasks =			\$95,299

Action Items and Timeline

Summary of Action Items

The following action items will be completed by the end of the contract period, June 30, 2020.

- PTMApp – Web enhancements as listed in **Table 13**;
- PTMApp – Desktop performance improvements as listed in **Table 18**;
- PTMApp – Desktop enhancements as listed in **Table 19**; and
- Activities to increase user adoption of PTMApp as listed in **Table 22**.

These action items are in addition to maintenance and other, similar management activities for PTMApp – Desktop and PTMApp – Web being executed under Swift contract number 146576. The contract (as currently written with no expected addendums) sets the total cost to complete these tasks at \$498,855. **Table 23** below details the contracted tasks, the estimate cost to complete them as currently listed in the contract, and any proposed changes as part of this document.

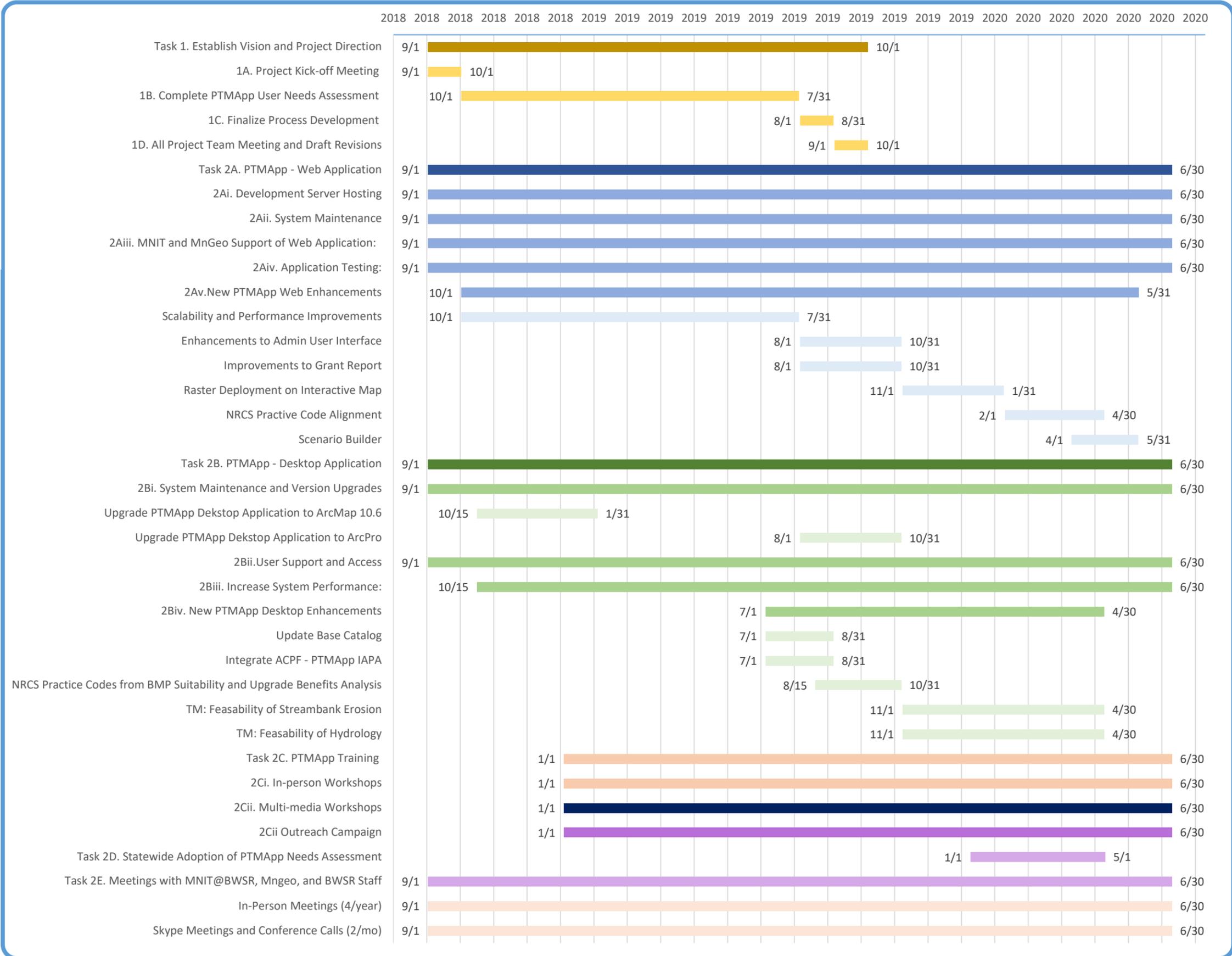
Table 24 also includes an updated project schedule over the contract period (September 1, 2018 to June 30, 2020) which is now consistent with enhancements and other activities as proposed in this PTMApp Needs Assessment.

Table 23. Tasks to be completed by the contractor (Houston Engineering, Inc / International Water Institute) under Swift contract number 146576, along with the estimated cost and any proposed changes to the cost as proposed in this Prioritize, Target, and Measure Application (PTMApp) Needs Assessment.

TASK DESCRIPTION	Estimated Cost in Contract	Proposed Change in Cost (If Any) *	Estimated Cost Following Any Proposed Change
Task 1: Project Kickoff and PTMApp User Needs Assessment	\$33,097	\$0	\$33,097
1A: Project Kickoff Meeting	\$2,111	\$0	\$2,111
1B. Complete PTMApp User Needs Assessment	\$17,059	\$0	\$17,059
1C: Finalize Process Development	\$11,816	\$0	\$11,816
1D: All-Project Team Meeting	\$2,111	\$0	\$2,111
Task 2A: PTMApp-Web Application	\$105,634	\$33,870	\$139,504
2Ai: Development Server Hosting	\$5,560	\$0	\$5,560
2Aii: System Maintenance	\$12,232	\$0	\$12,232
2Aiii: MNIT and MNGEO Support	\$24,464	\$0	\$24,464
2Aiv: Application Testing	\$12,232	\$0	\$12,232
2Av: New PTMApp-Web Enhancements	\$51,146	\$33,870	\$85,016
Task 2B: PTMApp Desktop Application	\$231,667	-\$42,489	\$189,178
2Bi: System Maintenance and Version Upgrades	\$102,298	\$0	\$102,298
2Bii: User Support and Access	\$17,010	\$0	\$17,010
2Biii: Increase System Support and Performance	\$7,980	-\$2,380	\$5,600
2Biv: New PTMApp Desktop Enhancements	\$104,379	-\$40,109	\$64,270
Task 2C: PTMApp Training	\$86,680	\$8,619	\$95,299
2Ci: In-person workshops: PTMApp-Desktop and PTMApp-Web	\$54,002	\$0	\$54,002
2Cii: Interactive and Remote Training Modules	\$32,678	\$0	\$32,678
2Ciii: Outreach Campaign	\$0	\$8,619	\$8,619
Task 2D: Statewide Adoption of PTMApp Needs Assessment	\$6,844	\$0	\$6,844
Task 2E: Meetings and Contract Management	\$31,920	\$0	\$31,920
Totals =	\$495,842	\$0	\$495,842

* A positive number means an increase in estimated cost. A negative number means a decrease in estimated cost.

Table 23. Project schedule outlining tasks to be completed and their estimated timeline for completion during the contract period, September 1, 2018 to June 30, 2020.



Appendix A. Technical Support Processes and Documents

Table A1. Documents developed to guide processes for providing Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) and Prioritize, Target, and Measure Application for Web (PTMApp – Web) technical support. Each of these documents are currently hosted in Assembla.

Document Name	Description	Document Date / Version No.	Relevance (Desktop and/or Web)	Responsibility for Document Maintenance
PTMApp – Web Application Deployment	Step-by-step instructions for deploying compiled PTMApp – Web code onto the IIS server	1-9-2018	Web	Houston Engineering, Inc (HEI) / International Water Institute (IWI)
PTMApp – Web Development Code Setup	Step-by-step instructions to set up and run PTMApp – Web development code	1-9-2018	Web	HEI / IWI
PTMApp – Web Instructions Upgrade	Step-by-step instructions for migrating PTMApp – Web code from ASP.NET 5 Beta 8 to ASP.NET Core 2.1.3	1-9-2018	Web	HEI / IWI
PTMApp – Web Upload Enable Web Services	Step-by-step instructions for enabling web services	10-26-2017	Web	HEI / IWI; may consider removal if process no longer followed by Minnesota Geospatial Office (MnGEO)
PTMApp – Web Users Watershed Assignment	Step-by-step instructions for assigning watersheds to new users upon request	10-26-2017	Web	HEI / IWI; may consider removal if process no longer followed by MnGEO

Document Name	Description	Document Date / Version No.	Relevance (Desktop and/or Web)	Responsibility for Document Maintenance
PTMApp – Web User Account Approval Process	Step-by-step instructions for assigning approving new users accounts	10-26-2017	Web	HEI / IWI; may consider removal if process no longer followed by MnGEO
PTMApp – Desktop PIN Creation and Issuance List	Excel spreadsheet of registered PTMApp – Desktop users with their current contact information	1-10-2019	Desktop	HEI / IWI
PTMApp – Desktop Error Submission Steps	Step-by-step instructions for PTMApp – Desktop users to submit trouble tickets	10-18-2017	Desktop	HEI / IWI
PTMApp – Desktop Assembla Responses	Clearinghouse of example responses for typical PTMApp – Desktop support requests	10-26-2017	Desktop	HEI / IWI
PTMApp Cross Function Support 2	Defines responsible party(ies) and workflow for addressing support tickets	9-7-2018	Desktop & Web	Board of Water and Soil Resources (BWSR) / Minnesota IT Services (MNIT@BWSR)
PTMApp Upgrade Flow Chart	Defines workflow and expectations for addressing program “bugs”, enhancements, and upgrades to PTMApp – Desktop and PTMApp - Web	9-7-2018	Desktop & Web	BWSR / MNIT@BWSR
PTMApp Web Updates	Defines workflow and expectations developing documents and/or code as well as uploading new watersheds to PTMApp - Web	9-7-2018	Web	BWSR / MNIT@BWSR
PTMApp – Web QA Test Cases	Quality assurance testing standards for HEI and MnGEO staff for PTMApp – Web development code	1-22-2019	Web	HEI / IWI

Table A2: Documents developed to provide technical support to Prioritize, Target, and Measure Application for Desktop (PTMApp – Desktop) and Prioritize, Target, and Measure Application for Web (PTMApp – Web) users. Each of these documents are currently hosted on the PTMApp website, along with other documents that describe the theory behind the application, provide products examples, and other tools available to analyze PTMApp data.

Document Name	Description	Document Date / Version No.	Relevance (Desktop and/or Web)	Responsibility for Document Maintenance
PTMApp – Web User Guide	Comprehensive manual for how to set up and run PTMApp - Web	1-9-2018	Web	Houston Engineering, Inc (HEI) / International Water Institute (IWI)
PTMApp – Theory and Development Documentation	Document providing background on the science and theory behind PTMApp – Desktop	3-14-16	Desktop	HEI / IWI
PTMApp – Desktop User Guide	Comprehensive manual for how to set up and run PTMApp - Web	July 2018	Desktop	HEI / IWI
QA / QC Desktop Outputs	User resource for checking the quality of output products created with PTMApp - Desktop based on comparable results from other data created in Minnesota	October 2017	Desktop	HEI / IWI
Data Catalog	Listing of PTMApp – Desktop input and output data names, type (i.e. raster, feature class, or table), and description of the data	10-26-2017	Desktop	HEI / IWI
Attribute Catalog	Attribute names and descriptions for feature classes and tables created by PTMApp - Desktop	10-26-2017	Desktop	HEI / IWI
Error Submission Instructions	Step-by-step instructions for PTMApp – Desktop users to submit trouble tickets	10-18-2017	Desktop	HEI / IWI

Document Name	Description	Document Date / Version No.	Relevance (Desktop and/or Web)	Responsibility for Document Maintenance
Version Release Notes and Known Problems	Summary of modifications to the toolbar following each new version release, along with descriptions of known issues encountered by users and developers	September 2018	Desktop	HEI / IWI
Workshop 1: Develop Inputs	Step-by-step instructions for PTMApp – Desktop users to develop input data	June 2018	Desktop	HEI / IWI
Workshop 2: Run PTMApp - Desktop	Step-by-step instructions for PTMApp – Desktop users to run the application	June 2018	Desktop	HEI / IWI
Workshop 3: Build Products	Step-by-step instructions for PTMApp – Desktop users to create output products for watershed planning and implementation	June 2018	Desktop	HEI / IWI
Technical Support Policy	Policy’s for addressing support requests from users	March 2017	Desktop and Web	HEI / BWSR

Appendix B. Discussion Summary from External PTMApp Committee Meeting March 28, 2019

On March 29, 2019 the PTMApp External Committee held their inaugural meeting and discussed the content proposed in the draft PTMApp User Needs Assessment. Listed below are the discussion topics and, following in Table B1, is the discussion results. Where those results led to changes in User Needs Assessment content is also noted.

Discussion Topic 1A: PTMApp Functionality and Use (30 min.)

Question: What functionality currently in PTMApp is most helpful to you and can it be modified/improved to help you more? What is it missing that would really help you?

Some examples:

- ✓ Watershed characterization
- ✓ Priority concerns analysis
- ✓ Landscape Load and runoff source identification
- ✓ Field-scale Best Management Practice (BMP) and Conservation Practice (CP) feasibility analysis
- ✓ Field-scale BMP and CP location analysis and functional assessment
- ✓ Local and downstream BMP and CP load reduction effectiveness
- ✓ Local and downstream load reduction treatment cost and cost-effectiveness
- ✓ Water quality goal progress evaluation
- ✓ Load reduction strategy feasibility analysis
- ✓ Informing HSPF, SWAT modeling analysis and other studies (e.g. solutions to address altered hydrology)
- ✓ Buffers alternative practices

Do you concur the examples above meet your needs? What information would improve your watershed planning and implementation?

Instructions: Discuss the question and your answer(s) in small groups for 5-10 minutes. Provide small group consensus to the larger group for further discussion.

Discussion Topic 1B: PTMApp Functionality and Use (30 min.)

Question: Are the currently established PTMApp business needs consistent with your organization's (or organizations you directly support) needs? If not, how should they be modified to better meet those needs?

PTMApp Business Needs:

- Provide the information, methods, and tools for local practitioner use.
- Provide a source of information to identify and agree upon the priority resources within the watershed.
- Develop, compare, and contrast the water quality benefit and treatment cost of practical implementation plans.

- Achieve self-reliance for developing targeted implementation plans (i.e. cradle to grave local planning and implementation capability).
- Achieve daily business use goal for PTMApp information products, primarily through using PTMApp-Web.
- Increase user adoption and overall experience by providing functional applications as well as the necessary technical resources to use the applications and their output products.
- Inform state-level activities and strategies such as One Watershed, One Plan and overall watershed-based funding.

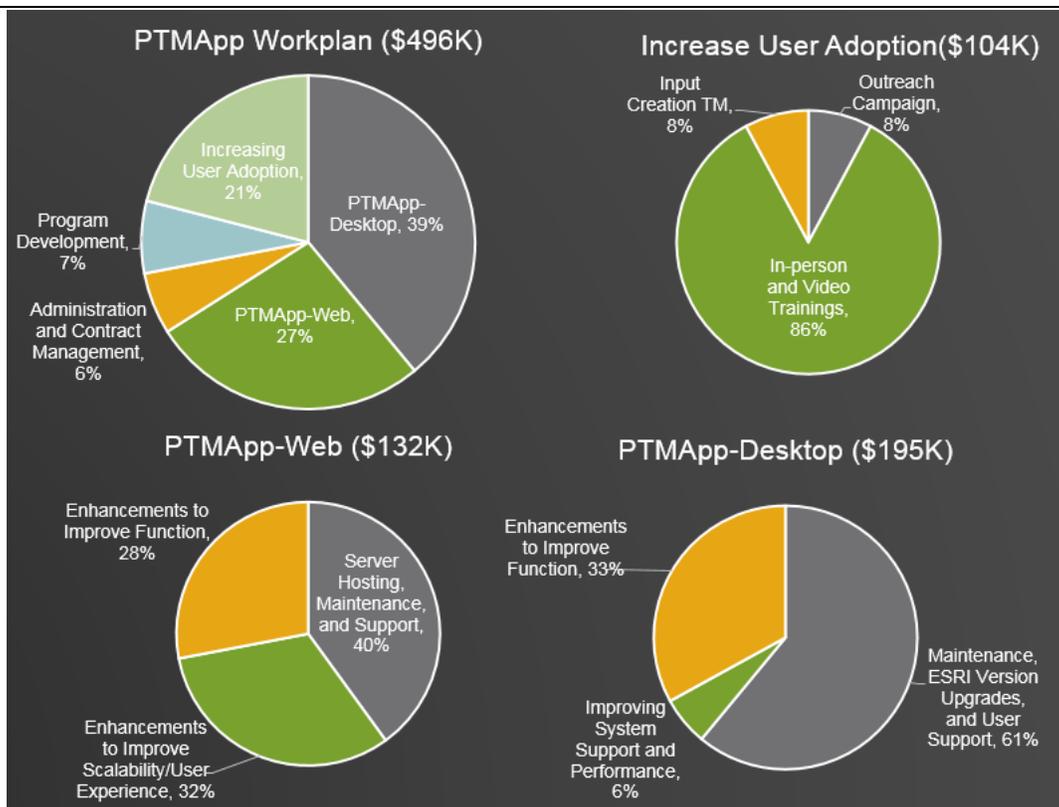
Instructions: Consider the PTMApp business needs shown above and determine whether they are sufficient as stated to meet your organization’s (or organizations you directly support) needs. Discuss this for 5-10 minutes with your group and provide some consensus recommendations to the larger group.

Please keep in mind the list of necessary functions your group developed in the previous discussion. Are these also consistent with the proposed PTMApp business needs?

Discussion Topic 2A: Setting priorities for program investments (30 min.)

Question: Do you agree with how funding was appropriated for the 22-month PTMApp contract period (through June 30, 2020)? Do you believe investments in each category are consistent with where the greatest needs are?

Pie charts created from information on Table 23 of PTMApp Needs Assessment.



Logic behind appropriations:

- 1) Funding for maintenance and user support of PTMApp-Desktop and PTMApp-Web based on expected user and technological needs.
- 2) Additional dollars were invested in expanding the user base, better training current users, and providing current users with additional resources (Increasing User Adoption).
- 3) Priority ranked Desktop and Web enhancements were chosen until remaining funding was exhausted. Priority was given to web enhancements consistent with business needs.

Instructions: Discuss the question and charts in small groups for 5-10 minutes. Provide small group consensus to the larger group for further discussion.

A follow-up question to consider... Would your recommended priorities change beyond 2020? For example, complete an outreach program now, then focus on additional functionality (Web or Desktop) in the future.

Discussion Topic 2B: Individual Desktop and Web Priorities (30 min.)

Question: Do you agree with the individual priorities chosen as enhancements to PTMApp-Desktop and PTMApp-Web? Criteria used to make decisions is shown on pages 23-25 of the PTMApp Needs Assessment. A full list of the priorities follows on pages 26-29 (Table 4) for PTMApp-Web and pages 30-36 (Table 5) for PTMApp-Desktop.

Please see Table 4 and 5 of the Needs Assessment for a full list of enhancements and their description. An abbreviated list is provided on the following page.

Instructions: Discuss the question and your answer(s) in small groups for 5-10 minutes. Provide small group consensus to the larger group for further discussion.

Table B1: Committee members comments received during discussion for the March 28, 2019 External PTMApp Committee meeting.

Discussion Theme	Comment #	Comment	Material	General	Note	Plan Change Made (Yes/No)	Comment Response / Action
Written Comments from Arlyn Gehrke	1	The field scale BMP location analysis has been very helpful when contacting landowners for field walkovers in priority catchment areas			x	No	Comment acknowledged; no action necessary
	2	Feasibility analysis is a local variable with year to year fluctuations based on availability of local contractors			x	No	Comment acknowledged; no action necessary
	3	We are finding some priority areas have existing conservation practices already installed which supports the accuracy of the data but may lead to some over estimation of areas suited for BMP installation and potential load reduction		x		No	Clear need for better tracking of existing BMPs through databases such as eLINK. BWSR recognizes this need and is currently assessing the process to add BMPs to eLINK, as well as the functionality of the eLINK program itself.
	4	Interested to see if anyone has used PTMApp to address alternative practices for the buffer law.		x		No	The MN Soybean Grower's Research and Promotion Council invested in developing a tool which can use PTMApp data to assess alternative practices for a buffer. BWSR provided additional funding for this tool development and is interested in authorizing that tool for assessing alternative benefits to a buffer and is in the process of reviewing the tool for approval. Also, BWSR is interested in utilizing this tool for assessing practice feasibility at the field or parcel scale.
Discussion 1A	5	Tech support necessary for both traditional ("creators" and typical regular "users") as well as non-traditional users.	x			No	The User Needs Assessment identifies both of these as key user groups: "Creators" as User Group A and "users" as User Groups B and D for Desktop and Web, respectively. Training modules were defined to meet the needs of each of these groups.
	6	We especially need more training for hydro-conditioning.	x			No	There are multiple hydro-conditioning modules outlined in the Needs Assessment (Table 20) which can be developed for either or both in-person trainings and videos.

Discussion Theme	Comment #	Comment	Material	General	Note	Plan Change Made (Yes/No)	Comment Response / Action
	7	Tool availability is a concern, especially the DNR Travel Time tool	x			Yes	BWSR is exploring a partnership with DNR to modernize and support the DNR Travel Time Tool. This was added to report text on pages 60 and 81.
	8	More clarity on user experience requirements... requires more than just armchair GIS experience to develop inputs and run the tool. Need to be able to review and understand outputs... i.e. need resources and/or someone to QC.	x			Yes	As part of Increasing User Adoption section, added subsection outlining certification process for new users who seek to create PTMApp data. Prerequisites showing training, aptitude, and need for training will be required. These users will also be provided more resources, including access to have all questions answered when running the toolbar as well as resources to provide their own QA/QC review.
	9	Need to have more resources (time and \$) for LGUs to have capacity to run/use PTMApp.	x			No	To better use limited resources for the program, BWSR is developing a more use-focused training to better identify the specific needs of each user group and provide them additional resources (specifically training opportunities and technical support).
	10	Less reliance on consultants to do the work		x		No	See response to Comment #9.
	11	Support for input incorporation into toolbar and/or for the creation of statewide inputs	x			No	Consistent without currently established business needs, input generation will be a focus of new training modules. In addition, a technical memo will be drafted to examine the feasibility of generating statewide inputs.
	12	Also support for streambank erosion capability in toolbar	x			No	A technical memorandum is already proposed for this contract period to explore the technical feasibility of estimating streambank erosion and assessing restoration opportunities.
	13	Better tool error notation: meaning input/error checks that guide user as to how they can address error.	x			No	This has been an ongoing mission of addressing user support tickets. Where possible, error and "dummy" checks have been incorporated into the tool to identify inaccurate or misleading data and to better clarify for users the reason an error is generated.
	14	Crowdsourcing PTMApp error issues: Consider developing a forum (similar to ESRI ArcMap and ArcSWAT Google forums) which allows users to log questions which	x			Yes	A paragraph was added to the Increasing User Adoption section on page 75 to outline steps to develop such a forum in FY 2020. User forums are typically developed and managed by user groups (or a 3rd party, such as Google). Its expected

Discussion Theme	Comment #	Comment	Material	General	Note	Plan Change Made (Yes/No)	Comment Response / Action
		could potentially be answered by other users.					that as the user community grows forums such as this will develop.
	15	standard data products to extend to major HUC: Recommendation from Mark that base catalog inputs and any other inputs developed statewide extend to major watershed boundaries outside the state. This has been an issue for development of PTMApp products for projects along the state border.	x			Yes	The enhancement to update the base catalog inputs will now include the extension of base inputs used in PTMApp processing to include each of the state's HUC-8 watershed boundaries. Base catalog inputs which are simply qualitative (i.e. not used for processing purposes by the PTMApp toolbar), will be re-generated just within Minnesota's state boundary. This was memorialized in Tables 4 and 19 of the Needs Assessment.
	16	Political boundary issues: Similar to note above. Water doesn't follow political boundary.			x	No	See response to Comment #15.
	17	Technology capacity. Does an entity have the bandwidth to operate?			x	No	See response to Comment #9.
	18	two distinct groups: Creator vs User			x	No	See response to Comment #5.
	19	Data accuracy – stress importance of QAQC, especially if we're emphasizing GIS staff create products they need either (1) someone who understands what output data should look like to review or (2) have resources to review themselves.	x			No	Training modules (Table 20) reflect this need for better training to both (1) create products and (2) critically review them for accuracy.
	20	existing practices: We should work towards better including benefits of existing practices.	x			No	See response to Comment #3. In addition, a future module could be developed when existing BMP databases are comprehensive enough to provide a representative sample of existing practices. In the meantime, there are ways to estimate the benefit of existing practices in the toolbar should users have this need.
Discussion 1B	21	Focus should be on training and getting users the resources they need to create data and address errors (when necessary). For folks developing the data and running the toolbar, they should not need	x			No	See response to Comment #7. Public tools and data are available to make each input required to run the PTMApp toolbar. Updating the DNR Travel Time Toolbar to work in ArcGIS versions 10.5.1 and 10.6 is a goal for BWSR and DNR

Discussion Theme	Comment #	Comment	Material	General	Note	Plan Change Made (Yes/No)	Comment Response / Action
		proprietary tools to develop inputs accurately.					and they working on a partnership to update the tool for those versions.
	22	PTMApp-Web is mission critical as this is the avenue committee sees most people interacting with PTMApp data. Functional improvements to web should be high priorities.	x			No	The User Needs Assessment reestablishes the original vision of PTMApp: to have PTMApp-Web meet 80% of user's water quality business needs. This is reflected in the priorities in the Assessment as well as the budget for enhancements.
	23	Discussion in uncertainty and limitations in model output (hydro-conditioning especially) is warranted to better understand capabilities. (comment from Bruce... not clear what the best medium to have this discussion is. Maybe both user guide and training session on background?)	x			No	An explanation of uncertainty and limitations in the program is provided in Theory and Development Documentation (Section 2.1; https://ptmapp.bwsr.state.mn.us/files/04052016_PTMA_Theory_Report.pdf). This is also covered in training materials but can be a greater emphasis moving forward to allay confusion of PTMApp capabilities.
	24	Consider adding a disclaimer on PTMApp-Web that would alert users as to the level of hydro-conditioning used to create products... and subsequently the accuracy of output products. Joel also brought up potentially "blurring" products on the screen but that may not be technically feasible on web.	x			No	Blurring products is infeasible. A disclaimer (or something similar) could be added as text to the Interactive Map and Grant Report pages. The disclaimer would identify the hydro-conditioning level and a link to a description of what that level means
	25	Concern was given for LGU staff that aren't well educated in PTMApp capabilities. Joel Nelson gave an example of staff turning down his terrain analysis training as it "wasn't PTMApp" and they see PTMApp as "end all be all" for models/tools.	x			No	Training both technical and non-technical staff about what PTMApp does (and doesn't do) will be a focus and immediate priority for training materials.

Discussion Theme	Comment #	Comment	Material	General	Note	Plan Change Made (Yes/No)	Comment Response / Action
	26	BWSR needs to provide LGU staff more background and introductory info trainings. For example, a training each to: 1) Decide what model/tool would be best for solving certain problems (i.e. if my goals/objectives were X Model A would be best but if my goals/objectives were Y Model B would be best. 2) How do I set goals/objectives for completing water quality studies. A precursor training to #1.	x			Yes	BWSR will work with various stakeholders to determine next steps and providing guidance. This topic transcends PTMApp and is applicable to how multiple models can be used in watershed planning to help with decision support. BWSR will add this to information covered in first 3 training modules on Table 20.
	27	Video-based trainings should ALWAYS be supplemental to in-person trainings.	x			No	There was consensus among PTMApp External Committee members that in-person training should be the priority. BWSR agrees and intends to maintain that focus. All presentations will be drafted first for in-person workshops.
	28	PTMApp website needs to be updated (mostly talking about content that's getting to be a few years old) but also layout should be improved.	x			Yes	BWSR will be reviewing this web site in FY2020 and determining an approach to updating the info, ensuring that accessibility requirements are met for PDF documents, and determining what data should be on the new BWSR website itself. Added detail specific to this on page 75 of Needs Assessment
	29	Group overall OK with business needs as writing with emphasis on more education and training.	x			No	Training and education are a focus of the Needs Assessment.
Discussion 2A	30	Group agreed with logic used for setting contract priorities (i.e top priority is making sure applications work, followed by education/training, followed by additional enhancements with emphasis on web).	x			No	Comment acknowledged; no action necessary
Discussion 2B	31	Including a groundwater estimation in PTMApp-Desktop should be considered a higher priority. MDA is considering that a priority with work their doing. (Matt noted it would likely be part of a TM first to	x			No	A technical memorandum is already proposed for this contract period to explore the technical feasibility of incorporating hydrology, which will have a groundwater component. This memo will also explore whether its feasible to consider simply a catchment-level groundwater

Discussion Theme	Comment #	Comment	Material	General	Note	Plan Change Made (Yes/No)	Comment Response / Action
		ensure its feasible and worth BWSR investment).					component to better understand delivery to subsurface BMPs (e.g. bioreactors and saturated buffers) versus groundwater contributions at a resource scale.
	32	Group viewed 'Formatted MXD with Standard PTMApp Output Products' (Desktop enhancement currently not funded during contract period) as a great opportunity to increase user adoption and recommended it be prioritized very high and funded for that purpose. Also thought Landowner Information Packet could provide additional value.	x			Yes	This was moved up a higher priority in Table 4. Although not funded in this contract period it is very likely to be funded in the next. Similar for Landowner Information Packet.
	33	Stream Power Index (SPI) value is NOT universal across watersheds in MN. For example, SPI value of 5 in the RR Valley is a very big deal, but not a big deal in SE MN. Would recommend either not posting them or posting them with some disclaimer and/or metadata describing how it was calculated and what its implications are. Could display statistical range (i.e. use spi_ranks) and note what those values mean somewhere else.	x			No	PTMApp-Desktop creates rasters with both the SPI magnitude ('spi' raster) and statistical range ('spi_ranks' raster) within the watershed. Based on group consensus it was decided displaying the statistical range raster, 'spi_ranks', would be most appropriate and that the supporting data would provide the magnitude for those respective values.
	34	No other comments on web priorities.	x			No	Comment acknowledged; no action necessary