

Appendix G: Water – Increased Knowledge

As a result of the Issue Identification Panels, there were **four goals** that emerged in the area of water that had to do with increasing knowledge, in order to achieve better outcomes.

These four goals were voted on by respondents who participated in the subject matter expert survey.

Table 1. Percent of subject matter experts who prioritized each goal in the area of Water – Increased Knowledge

		Count	Percent selected
Goal 1.	Minnesota water resources are better managed for both water quantity and quality, as a result of better understanding of the connections between surface water and groundwater.	103	66%
Goal 2.	Priority ground water issues for Minnesota have been identified and Best Management Practice (BMP) options to address them have been developed, evaluated, and promoted.	25	16%
Goal 3.	The limits of Minnesota’s water supply are defined and known by local units of government, tribal nations, industry, and other decision makers.	13	8%
Goal 4.	Agencies, permittees, and public policy in Minnesota are all better informed with improved state-specific storm water data and Best Management Practice (BMP) maintenance research.	11	7%
	Other	3	2%
	Grand Total	155	100%

Subject matter experts who participated in the Prioritization Panel were asked to review strategies recommended by survey respondents relating to Goal 1. All of the strategies submitted by survey respondents are included in the next section below. Panel participants were invited to revise strategy ideas or come up with their own, and as a group they prioritized five strategies that would be necessary to achieve the goal. Those five strategies, in no particular order, are:

- Research and demonstrate innovative, market-based policies and partnerships that solve local water issues in both forest-based regions and agriculture-based regions.
- Educate local officials on how to improve and protect water resources, including model projects and policies that can be emulated at all scales.
- Research, demonstrations, incentives, and policies to hold back water and increase evapotranspiration opportunities to prevent water pollution.
- Increase understanding of weather and future weather/climate patterns, and how these align with anticipated water needs across Minnesota.
- Research on the impacts of nitrogen and effective agriculture and urban practices to improve surface and groundwater quality, as well as manage water quantity and mitigate the impacts of agriculture drainage and urban stormwater runoff.

The following provides the full list of strategies for the area of **Water – Increased Knowledge** that were recommended by subject matter experts who responded to the survey. They are organized by goal.

Please Note: These strategy recommendations are provided verbatim, as they were submitted through the survey. Therefore, they may contain errors or typos. They have also **not** been vetted for alignment with the ENRTF mission or charge, and may therefore not be allowable strategies for the ENRTF to pursue or include in its strategic plan.

Goal 1 – 66% of survey respondents prioritized: Minnesota water resources are better managed for both water quantity and quality, as a result of better understanding of the connections between surface water and groundwater.

- Additional research on the connections between ground and surface water. Support of UM Forever Green Initiative
- Further research into water quality aspects: increased micro plastics, increased toxic algal blooms. What causes these, what are their sources, and how can we adapt?
- Identifying incentives for private land owners to hold back water to slow the drainage from ag lands and other intensive-use lands, to prevent sediment and nutrient eutrophication. It would also lead to stream bank stabilization, and recharge of aquifers.
- Research in this area has fallen from the Federal level to the State of Minnesota. So, it is an important area for the State to undertake.
- We need to develop a strategy that balances the needs and uses of water resources, with the impact on everyone. For example, restricting agricultural uses - some peoples livelihood, but ensuring adequate quantity and recharge for all people's use is a hard balance to maintain. Realistic and compromising strategies will be needed. Education, provided by a trusted source, may be the best place to start.
- All of these statements are good so I picked the one that I know the most about. A large amount of expertise, money and time needs to go into this strategy to make it work. But I believe it can pay off if the political will is there.
- Education and supportive applied research on climate change limits/ temporary excesses on surface water. Key contributors and what it will take to reduce their role in surface water contamination.
- Research and management. Added to the connection between surface and ground water, MN should take steps to understand and make decision around other factors in the cycle (pollution, climate change, etc..)
- Prioritizing issues likely to impact human and ecological health, which will require a combination of funding research to understand these issues and funding potential practical, sustainable solutions.
- Increased funding for continuous monitoring
- additional measurement and monitoring of the impact of surface waters on groundwater
- developing some innovative implementation strategies
- measurement
- Investing in research
- Better understanding of small molecule pollutants in waterways and strategies to remediate these
- Funding of projects like wetland restorations that can address both water quantity and quality.
- Water Re-use
- Increase funding support for counties to implement the Wetland Conservation Act.
- We have impaired surface waters, can we fix that in connection with groundwater/surface water connection as well?

- Willingness to spend the money necessary to take drastic large-scale actions/acquisitions to improve water quality and restore natural flow regimes.
- Support geologic mapping and groundwater research that aims to characterize the groundwater system.
- mapping and research into aquifers and surface waters.
- Clearly defined water quality and quantity goals and thresholds are established and enforced by state agencies.
- The role of public and private forests in long-term water quality and quantity are appreciated and supported.
- less regulation and more education
- geologic mapping, hydrologic characterization, and ground water modeling
- Research
- Minnesota needs new innovative, market-based policies to address farming economics in order to make substantive conservation efforts financially feasible (research and demonstrations needed)
- Focus efforts to engage more community members and diverse partnerships to help solve local water issues such as in high nitrate DWMSAs, areas of ground-surface water conflicts (DNR interference areas). These can serve as models for communities to learn from.
- More research is needed to develop an integrated approach that takes into consideration land-use needs and water management. Research on cleaning water is also needed.
- Research on groundwater-surface water connections
- Not sure on this one, could be additional research on groundwater flow but I don't know how much is known.
- More information provided to communities and citizens directly impacted by poor water quality and/or flooding due to drainage of water resources.
- Local elected officials become more knowledgeable leaders on water related subjects and as a result make zoning and land use decisions that protect our water resources.
- Continued investment in basic science of understanding water/groundwater resources - including groundwater observation well network, stream and lake monitoring networks, and county geologic/groundwater atlas program.
- We have to identify the sources of water and ultimately the wastewater and stormwater that is the result from use. Funding is needed to find answers and to implement solutions. This may include infrastructure assistance like water and wastewater plant. I think we know a lot already, but have not acted as quickly on the solutions
- Education and outreach
- More research is needed including rural area
- Research related to Minnesota's public and private drainage systems (drainage impacts on aquifer recharge, capacity of current system to properly handle larger, more frequent rain events, etc.)
- research and application of research results
- Need to continue research on the impacts of Nitrogen and what are effective agricultural and urban practices to improve surface and ground water quality, as well as manage the quantity of water and mitigate the impacts of ag drainage and urban stormwater runoff.
- Determine direction and quantity of water movement within ground watersheds statewide
- Additional groundwater and surface water future conditions modeling at a water level.
- Demonstrate the it can be done by targeting a watershed at an appropriate level and implementing all of the best strategies
- Demonstration/education of impacts and implementation/education on BMPs. Targeting areas: agricultural land, municipalities, etc.
- Additional research on water quality--emerging issues like microplastics and changing temperatures as well as longer term problems like phosphate and mercury.

- Increase research in defining the connections between ground and surface water. Focus on the heterogeneities that focus water movement.
- More coordination or consolidation of state water agencies, somehow get more control over Ag management practices.
- Education in the biotic dimensions of water quality and the benefits to overall environmental health, rather than water clarity, safety for swimming
- research and measurements collected across space and time; surface and groundwater quantity and quality monitored across small-to-large systems across time in such a way that concentrations and fluxes can be computed. This requires contemporaneous quantity AND quality measurements across different spatial scales.
- fund research in remediation of contaminants
- Research and education are both needed to achieve this goal.
- Start with Data: Assess chemicals sold/purchased/used in MN and the amounts and set clear reduction targets. Research is showing U.S. women of childbearing years have high numbers of different types of chemicals in their bodies and breastmilk.
- More research and measurement of ground water - surface water connection
- More extensive monitoring of non-point source pollution of surface water and then taking active steps to make corrective measures (EX producers farming the ditches/right-of ways and hills leading to continuous run-off etc). A survey of out of date septic systems (regardless of grandfathering) and cost share to correct them if you qualify based on income bracket. All septic systems should be in compliance. Failing septic systems lead to eutrophication of lakes and rivers and depleted dissolved oxygen.
- Smart salt workshops statewide
- Research on the relative influence of groundwater to surface water quality and quantity is needed because it differs greatly across the state.
- Research initiative that includes the role of land use and changing climate
- education and implementation of buffer strips, natural plant communities, etc.
- Communications are key, as Minnesotan's, and all upper Midwesterners, have a hard time grasping water quantity challenges and limits. We don't have the everyday visuals that western states do for understanding water quantity
- Research
- This is a local, regional, and global issue. Fund educational programs and model projects that can be emulated at all scales.
- Support research that evaluates and informs on contaminants (legacy and emerging) in drinking water.
- Technical assistance and support for improved agricultural practices
- I chose the most inclusive goal as I think meeting this goal will encompass several of the other goals. Surface and groundwater connections vary widely across our large, geologically-complex state. Meeting this goal will require important hydrologic research in locations where such research is quite difficult and, thus, has been rather ignored.
- research: locations and sectors that are majority nonpoint sources and incentive and BMP approaches that are most effective at reducing nonpoint source pollution
- Support research such as the spring study in SE MN
- Explain case studies ie White Bear Lake that show examples of too much permitting reduces volume of water
- Understanding how different factors influence water
- Research on regional water balance, including future risk to surface water features like wetlands and lakes from combined impacts of climate change and groundwater development.

- Research to better understand groundwater and surface water connections. Research and education on BMPs to minimize groundwater pollution.
- Funding research that affects water quality as it relates to agriculture practices - develop BMP's that are more site specific.
- Understanding the role that drain tiles have in our surface-to-ground water hydrology, exploring alternatives to existing drain tile installation practices. to both meet the needs of the agricultural sector and the environment.
- Demonstration - people need to see impacts to believe them, sometimes - and then some still may not believe demonstrated connections.
- This is just a note: knowledge and understanding are two different things and should be well defined when developing this plan.
- fund monitoring for agencies that are not responsible for regulation and enforcement
- managing the quality and quantity of water impacting our lakes and rivers
- modeling
- education
- Allowing for projects that may not achieve full accomplishment of habitat goals when water quantity is a major concern for sites downstream. For example, allowing for an impoundment in special circumstances in the red river valley if it has significant impacts on the immediate downstream area for fish & wildlife, including less in-channel erosion.
- Permit flexibility regarding Wastewater re-use opportunities
- Support initiatives which work to document drainage ways, tile and wetland areas.
- Seal those abandoned wells!
- Waters, surface and ground are prioritized by the multiple benefits they provide and decisions and resources are allocated accordingly.
- Meaningful and simple model to analyze your specific land owned/operated for both rural and urban landowners/users. Increase awareness and then offer opportunities for assistance.
- include local water systems (municipal) in water planning
- Make sure information is provided to all who have a roll.
- Many solutions for substantive water quality and quantity improvements are the same solutions needed for habitat restoration for grassland species, monarchs and pollinators. Integrating water and habitat strategies from a funding and political perspective will help both ends be achieved, and in the most cost-effective manner.
- Provide targeted research and outreach around water quantity issues making the case for multiple benefits of water storage, particularly in the high loading Minnesota River Basin.
- A demonstration site that shows differences in water quality in ag lands with buffer strips vs. none would be a valuable educational tool.
- Develop funding mechanism specifically for longer term programs needed to build out our water resource monitoring network, so programs are less susceptible to changing priorities at the capital.
- Education to change the culture to understand how we use water and get rid of our wastewater and stormwater. Salt, organic material like grass and leaves, chemicals whether commercial, farming or household and being wasteful.
- Need to develop more long term data layers derived from LiDAR to provide baseline maps/data to be the foundation of future research and practice implementation to meet water quantity and quality goals.
- Identify locations and strategies that have lowest cost and biggest reward to target with funding and implementation of protection and prevention and clean up
- Additional understanding of weather and future weather and climate patterns and how these align with anticipated human demands for water across MN.

- Charge way more for water use, especially highest users.
- Monitoring and a higher bar/more oversight (at the county or state level) for approval of tile permits for ag tiling. Little if any, monitoring of where the tile is going in or what will change with the granting of tile permits from Watershed Districts. The amount of tiling that is going in will have compounding negative effects on water quality, increased water volume (damage to ditches and water control structures), wells running dry, flooding of neighboring land, depletion of groundwater etc.
- Large public exhibits, incorporating both science and arts, to show the flow of water (above and below ground) and inputs (natural and anthropogenic) into those systems
- Education
- Support efforts to communicate on the effects of contamination of surface and groundwater.
- Support for maintaining and expanding forest-based economic opportunities that help continue forested watershed benefits
- Climate change scenarios must be used to meet this goal (after we understand the hydrology of various geologies around the state). More water is running off now due to increased intense rainfalls; this will leave many areas even more vulnerable to groundwater overuse. We must understand this and then research ways to live with it and/or combat it.
- Show research in plain language not technical terms--like a graph of land adjacent to farming rates and TMDLs
- Development of draft administrative rules to implement protection for lake and wetland water levels during groundwater development (i.e., pumping by new Ag production wells)

Goal 2 – which 16% of survey respondents prioritized: Priority ground water issues for Minnesota have been identified and Best Management Practice (BMP) options to address them have been developed, evaluated, and promoted.

- ongoing active management of shallow lakes and wetlands is imperative to maintaining healthy watersheds and groundwater
- There are many agencies out there monitoring and studying our water resources in Minnesota. They need to work together to establish best practices based on science and make sure everyone, whether they be an individual homeowner or a business owner or a city leader, need to be aware of the Best Practices and have access to the mechanism that allow them to implement those BMPs. Informed citizens will demand responsible use of our water resources from within the community.
- Share research with decision-makers at all levels--government, tribal government, municipality, non-profit, community org, schools, family.
- Since much of Minnesota's drinking water comes from groundwater, more emphasis should be placed on groundwater systems. Accomplished through the means of education and demonstration, showing cause-effect scenarios, for example.
- Research
- Increased research and outreach about sensitive groundwater areas and how local partners and landowners can collaborate to protect the resource
- Demonstrate improved water quality in a popular river or lake. Showcase the before and after along with the collaboration to achieve this improvement.
- Research, demonstrations and education are all important. All of the goals in this area are very important, but this seemed the most comprehensive.
- Demonstration projects and assistance with implementing best practices

- BMPs for most forms of surface water
- A full (as full as can be) atlas of ground water resources, and the connections they share with surface water.
- improve soil conservation and control agricultural runoff. examples include reduced tillage and chemical applications, cover crops and encouraging further development of perennial crops promoted by Dr. Wyse at the University of Minnesota, St. Paul.
- Education is always key. Case studies that can be shared to show real communities and businesses and neighborhoods and how they adopted best practices and were able to conserve water and reduce water pollution would be powerful.
- Assign more emphasis on monitoring and measuring outcomes and results.
- Demonstrate improved drinking water quality for a community.
- In addition to addressing ground water issues and BMP, it is important that all stakeholders are educated on the limits of Minnesota's water supply. I believe the prevailing attitude is that water is an unlimited resource in Minnesota.

Goal 3 – which 8% of survey respondents prioritized: The limits of Minnesota's water supply are defined and known by local units of government, tribal nations, industry, and other decision makers.

- Research to further define sustainability within the term "limits" - sustainability includes both quality and quantity.
- I include the general public as "decision makers": use an educational campaign to educate MN governments, tribes, industry and the public ("decision makers") in the fact that clean water resources are limited in MN. The myth of a limitless clean water supply has been persisting for too long in MN.
- There are many conferences and events that this information can be shared at.
- reduce ag irrigation use for surplus commodity crops
- Foster projects that focus on understanding our water budgets on a stateside basis
- Education
- Local governments do not have enough information on water supply. They are asked to provide data to the state but data is not provided to local Councils and decision makers.
- education of the complex interaction of the hydrologic system components
- We need to complete the installation of an adequate monitoring network, so we can know the limits of geographically specific water supplies. Knowing those limits will drive investment and innovation into alternative sources and efficiency efforts that are otherwise ignored until a crisis develops. Minnesota has a lot of water that can be used for economic activity, it's just not distributed equally and the quality is variable depending on geography.
- Broader scale outreach with accessible but accurate information on the state of the State's water supply so all Minnesotans have functional knowledge on the value and limits of this critical resource and use it for personal decision making.
- Highlight real examples from around MN where clean water has become a limiting resource for development, recreation or ecology.
- develop educational materials that simply and clearly lay out the basics of groundwater hydrology and the status of the groundwater resources we are working with
- Demonstration
- use of interactive simulations to help explain and educate the public on the complex interactions of resource management

Goal 4 – which 7% of survey respondents prioritized: Agencies, permittees, and public policy in Minnesota are all better informed with improved state-specific storm water data and Best Management Practice (BMP) maintenance research.

- All agencies across the state are involved and share data with each other that gather information. In consultation with all agencies we can develop an improved best practice management measures that reflect everyone's needs. When information and data is shared we can all make use of the information available to make guided decisions.
- Developing farmer friendly ways to retain more storm water on the land rather than "getting rid" of it as quickly as possible. The benefits of early workable cropland needs to be balanced with stream friendly discharge of the water being exported from the fields.
- available data and BMP on websites with public meetings and disclosure
- fund data synthesis to use information we have and identify knowledge gaps;
- fix the flawed political and idiosyncratic proposal selection process

Other goal ideas offered by subject matter expert survey respondents for the area Water – Increased Knowledge:

- Better connecting land use practices (fall tillage, inappropriate N application, wetland drainage) in the watershed to water quality/quantity.
- Minnesota water resources are better managed for quantity, quality, biological integrity, and watershed health as a result of better understanding of the connections between surface water, groundwater, biodiversity, and watersheds..
- Educate citizens about the connections between land and water by helping them understand that healthy watersheds with intact and diverse plant communities are essential to clean water.

Other strategy ideas offered by subject matter expert survey respondents for the area Water – Increased Knowledge:

- Demonstrating how what one person does on their land affects their neighbors downstream.
- Develop and enhance integrated water and biological data collection, data management, data analysis and delivery of information.
- Education, assistance to landowners and others in creating/maintaining diverse native plant communities and understanding that they are essential to clean water and healthy habitats.
- Expand, enhance, and accelerate statewide baseline biological surveys in all of Minnesota's lakes and rivers.