

Summary of Document Scan

Draft 7/11/2019

Overview

This document summarizes findings from a review of plans and reports as required in Minnesota Statutes 116P.08 Subdivision 3b:

The commission shall consider the long-term strategic plans of agencies with environmental and natural resource programs and responsibilities and plans of conservation and environmental organizations during the development and review of the strategic plan.

Management Analysis and Development (MAD) reviewed 58 documents and selected relevant issues and problem statements, goals, and strategies and organized them by environmental topic (air, water, land, fish, wildlife, other natural resources, administrative, and miscellaneous). Some environmental topics were split into subtopics. To remain inclusive of elements from all plans, MAD adopted broad definitions of goals and strategies. Goals, for the purposes of this summary, are generally longer term and focus on an ultimate outcome. Strategies are the means of accomplishing goals. Where there are numerous strategies, they are organized by types of investment.

Items in **green** were mentioned by three or more groups, agencies, or organizations. Because this is a conglomeration of multiple plans that are often interrelated across topics, there may not be explicit ties between issues, goals, and strategies.

Water

Water consumption

Sources: BWSR, DNR, EQB, Freshwater Society, Friends of the Mississippi River, MDH, Met Council, MPCA, National Park Service, Thrive MSP, Water Resources Center

Issues

- Minnesotans care deeply about the quality and availability of their water.
- The sheer volume of water resources means Minnesota has more to take care of compared to states in other parts of the country.
- **Public water supply is the largest consumptive use of water in the region, and it is the fastest growing.**
- **The cumulative effects of land use change, invasive species spread, pollution and a changing climate are combining in new ways to threaten the health of Minnesota's natural lands and waters.**
 - Nitrate concentrations have increased substantially.

- Invasive Asian carp continue to move upstream, and other aquatic invasive species continue to spread in lakes and wetlands, with potentially devastating consequences to aquatic life and recreation.
- In Minnesota, power plants are the largest user of water, though this is mostly surface water that is returned after use. This use can put stress on aquatic ecosystems during dry periods of the year. Low stream flows combined with high water temperatures can limit the generation capacity of power plants.
- **Changing demographics puts pressure on water resources through increased demands and land use changes.**
 - Minnesota’s population has grown steadily since 1950. In addition to overall population growth, the percentage of people living in urban and suburban communities has increased.
 - Water demand has increased with population growth and rises in per capita water use.
- Health issues related to water affect Minnesotans unequally.
 - Rural communities have fewer people to share the cost of drinking water services and face unique issues such as pollution from agriculture and inadequate sewage infrastructure.
 - Private well owners facing financial, language or educational barriers may be less likely than others to test or treat their well for contaminants.
 - The elderly and children are at highest risk for illness from contaminated drinking water.
 - Some American Indian, poor and minority groups consume high rates of fish and types of fish that increase the risk from contaminants.
 - Young children, developing fetuses and breast-fed babies are at most risk from mercury in fish because small amounts can damage a brain that is just starting to form or grow.
 - Urban poor have limited access to water recreation due to poverty, safety and walkability of neighborhoods, distance from parks and lakes, and transportation limitations.

Goals

- Minnesota water resources will be managed and used sustainably and the water quality will be improved and protected.
 - Place a priority on protecting important water resources including lakes, rivers, wetlands, shorelands, and critical watersheds.
 - Preserve existing high-quality natural areas and water resources. It is far more cost-effective to preserve existing natural communities than it is to restore or reconstruct them.
- Maintain and enhance the resilience of the habitats upon which aquatic Species in Greatest Conservation Need (SGCN) depend.
- Protect, conserve and utilize the state’s groundwater and surface water in ways that protect [public health, support economic growth and development,] habitat and ecosystem health, and provide for recreational opportunities, all of which are essential to our region’s quality of life.
- Quantify the true cost of water, and how to pay for it.
- **Promote sustainable water use.**

Strategies

Education, awareness, and understanding

- Inventory existing water quality-based educational curriculum to determine which currently incorporate nutrient-related information.
- Convey results of water-related research in Minnesota (and beyond).
- Promote and support water conservation measures, including education, outreach and tool development.

- Support community efforts to improve water supply resiliency by cooperatively identifying economically and technically feasible water supply alternatives.
- Support educational efforts through partnership opportunities with agricultural communities
- Facilitate discussions on water supply issues that transcend community boundaries, through subregional work groups and on an ad hoc basis as needed.
- Facilitate discussions on regional water issues that transcend community or watershed organization boundaries.

Foundational data collection and analysis

- Collect, analyze and share data on the status and trends of Minnesota’s waters and their use to support decision-making, permitting and awareness.
- Support community efforts to identify and evaluate the economic and technical feasibility of water supply approaches and best practices that increase water conservation, enhance groundwater recharge, and make the best use of groundwater, surface water, reclaimed wastewater, and stormwater.
- Collect data on adoption of practices that protect water quality so we can track trends, prioritize government support, and measure progress toward goals and requirements.

Implementation of programs and activities

- **Manage water using One Watershed One Plan.**
- Increase and maintain living cover across watersheds.
- Implement Best Management Practices at public water accesses for reducing spread of AIS.
- Motivate consumers to conserve water.

Research

- Amplify water-related research, outcomes, and activities at State Universities and Colleges.
- Develop and deploy research-enabling capabilities, such as project and data management.
- Connect researchers with complementary expertise to pursue compelling opportunities.
- Lead and enable innovative problem-driven research, building a trusted knowledge base to inform water resources management in Minnesota and beyond.
- Research and promote low-impact development, land use practices, agricultural best practices, and cooperative water use practices that minimize impacts on aquifers and maximize groundwater recharge, where practical.
- Complete technical studies to understand regional and subregional long-term water supply availability and demand.
- Identify lands and waters at greatest risk from pressures such as land use change, pollution, climate change and invasive species. Set priorities for protecting and managing resources under greatest threat.

Other

- Ensure local, regional and state agencies have the knowledge and tools available to make water resources management a critical part of land use decisions, planning protocols and procedures to ensure these plans are making progress toward achieving state and regional goals for protection and restoration of water resources.
- Watershed restoration and protection strategies and accompanying comprehensive watershed management plans (e.g., One Watershed One Plan) should be developed to not only have the goal of protecting and restoring water resources within the watershed, but to also contribute to nutrient reductions needed for downstream waters both within Minnesota and those downstream of the state border.

- Work with the watershed management structure in the metro area on issues that transcend watershed organization boundaries in order to prepare water management plans that promote the protection and restoration of local and regional water resources (lakes, rivers, streams, wetlands and groundwater).
- Use a systems-based approach for water management and conservation.

Groundwater

Sources: DNR, EQB, Freshwater Society, MDA, MDH, Met Council, MPCA, Thrive MSP

Issues

- **Groundwater use is unsustainable and depletes one of Minnesota’s natural and economic resources.**
 - We have long assumed that our region has plenty of water, but we now recognize that our reliance on groundwater is unsustainable. Increased pumping of groundwater to support development is depleting aquifers, affecting lakes, streams, and wetlands. In some areas, groundwater levels have been dropping a foot per year since the 1970s.
- **Approximately three out of four Minnesotans rely on groundwater for their drinking water supply.**
 - Public water supply is the largest consumptive use of water in the region, and it is the fastest growing. About 30% of public water supply demand is met by surface water; 70% by groundwater.
 - Pumping by city water systems averaged 123 billion gallons per year, and averaged 53 percent of total reported groundwater pumping
- Measured by reported pumping and the permits sought by well owners and issued by the DNR in recent years, agricultural irrigation is Minnesota’s second-largest use of groundwater. And it is, by far, the fastest-growing segment of groundwater use.
 - The statistical analysis estimated that permitted and reported groundwater use grew 31 percent over that period – an annual increase of about 2.8 billion gallons year after year – while Minnesota’s population grew by 24 percent.
- Animal manure contains significant quantities of nutrients which, if improperly managed, can lead to contamination of surface and groundwater.
- **Nitrate in groundwater is a public health concern especially for pregnant women and infants under six months of age.**
 - **While some nitrate occurs naturally, higher-than-normal concentrations come from activities on or near the surface, such as use of fertilizers containing nitrogen and failing septic systems.**
 - **Current agricultural crop production systems require the input of nitrogen fertilizer to increase food, fiber, feed and fuel production for consumption by humans and livestock. However, nitrate that is not utilized by the crop may leach into the groundwater.**
 - **The drinking water standard is 10 milligrams per liter (mg/L) nitrate-nitrogen (nitrate), referred to as the Health Risk Limit (HRL).**
- **Many of Minnesota’s groundwater aquifers are susceptible to contamination due to diverse geology and soils, climate and land use.**
- There are some very limited areas where arsenic contamination in groundwater has resulted from human activities. The location of wells that exceed the drinking water standard for arsenic are closely related to the distribution of a set of glacial deposits known as the Des Moines lobe glacial till. Long-term exposure to arsenic can cause a number of harmful human health effects including several types of cancer, diabetes, as well as skin, circulatory, and nervous system problems.

- Because arsenic is naturally occurring, it is not a contaminant that can be removed or prevented from entering groundwater. To date, it has been very difficult to predict when a well will have elevated arsenic levels
- Once groundwater is contaminated, the remediation process can be extremely slow, difficult, and expensive.

Goals

- **Groundwater be maintained in its natural condition, free from any degradation caused by human activities.**
 - Heighten the priority given to groundwater management.
 - Ensure the use of groundwater is sustainable and does not harm ecosystems, water quality, or the ability of future generations to meet their needs.
- Improve groundwater and surface water systems.
- All aquifers are without water use conflicts and well interferences.
- Improve groundwater management.
 - Promote the wise use of groundwater and the implementation of water conservation practices.
 - Improve ground water management within regional, basin, watershed, and local water management efforts.
- Minimize the source of pollution to the greatest extent practicable and, at a minimum, reduce nitrate contamination to below the HRL so that groundwater is safe for human consumption.
 - Reduce nitrate levels in groundwater by 20%, which will result in reducing the percentage of wells exceeding the drinking water standard by 50% (in two private well networks located in vulnerable areas of the state).
- Develop a comprehensive understanding of the severity and magnitude of nitrate in groundwater drinking water wells (public and private).
- All aquifers are within sustainability thresholds for water levels., assuming cumulative effects and increasing demands.

Strategies

Education, awareness, and understanding

- Expand and support education of all community sectors in order to raise baseline understanding of
 - 1) hydrogeology;
 - 2) importance of drinking water protection;
 - 3) interconnectedness of surface and groundwater;
 - 4) financial cost of impaired waters/economic value of clean groundwater; and
 - 5) the long-term nature of groundwater protection.
- Prioritize needed education and training for SWCD and other local water management professionals specifically on relevant content in
 - 1) hydrogeology
 - 2) agronomy
 - 3) state and local water management jurisdictions.
- Educate absentee landowners to promote understanding that the health of their land and local natural resources is part of their long-term investment.
- Communicate the importance and practical benefits of water conservation through public awareness campaigns, workshops, media strategies, websites, and social media.

- Support dynamic outreach/public relations campaign(s) to deliver clear and consistent messaging about groundwater value to all community sectors; strategically utilize media outlets.
- More actively engage users, stakeholders, partners, and the general public in discussions about Minnesota groundwater resources.
- **Improve quality and quantity of information on water use by permitted groundwater users.**
 - Improve communication and education for users, stakeholders, partners, and the general public about the importance of groundwater resources and the challenges facing groundwater management.
 - Promote BMPs and provide education about how their use will prevent, minimize, reduce, and eliminate the source of groundwater degradation in order to assist farmers in the adoption of nitrogen fertilizer BMPs to the fullest extent possible for their given operation.
 - Ensure information on state-of-the-art water conservation practices is accessible to permitted groundwater users.

Foundational data collection and analysis

- **Increase groundwater monitoring, education and compliance.**
- Improve and/or expand monitoring and data in order **to** better understand local groundwater status, high pollution sensitivity areas, and specific BMP impacts, to more effectively implement protection.
 - Identify and select wells to be sampled for nitrate from a designated area; collect and test the water samples; obtain and summarize the results; and conduct follow up site visits, if necessary, to confirm the results.
 - Install an additional 6,280 monitoring wells so the DNR can track aquifer health and ground water–surface water interactions.
- Consider the cost versus benefit and technical feasibility of mitigation measures.
- Better information on aquifer water level trends is essential for making the best possible decisions about how to use and manage water wisely. The key is to know where groundwater is being used faster than it can be replenished.
 - To ensure sustainable use of Minnesota’s water, we need to understand how much water we have and how much we are using.
- **Improve quality and quantity of information on water use by permitted groundwater users.**
 - Develop better information on Minnesota’s groundwater resources including identifying sustainability thresholds for aquifers, developing guidelines for adverse impacts on surface water features and improving the statewide monitoring network.

Implementation of programs and activities

- Establish at least three pilot Groundwater Management Areas (as authorized in MN Statutes, section 103G.287, subd. 4).
- Protect the area around public and private wells (the wellhead) from land use and runoff that pollute drinking water.
- Implement groundwater management area plans to help guide water appropriations and water quality improvements within designated areas.

Research

- Develop and implement Alternative Management Tools (AMTs).
- Research and promote low-impact development, land use practices, agricultural best practices, and cooperative water use practices that minimize impacts on aquifers and maximize groundwater recharge, where practical.

- Support efforts to identify groundwater resources that may be susceptible to nitrate, phosphorous, and sediment contamination by mapping geology and aquifers throughout the state.

Other

- Enhance the tools and technical support available to SWCDs in order to improve, target and support resource protection efforts.
- Improve technical guidelines on groundwater use and water conservation practices.

Surface water

Sources: DNR, EQB, MDA, Met Council, MPCA, Thrive MSP, Upper Mississippi River and Great Lakes Region Joint Venture)

Issues

- Minnesota is home to the headwaters for three of the largest drainage basins in North America. This means that the way we manage our water affects many others downstream.
- **The best long-term data about Minnesota streams, on average, show significant reductions in ammonia, biochemical oxygen demand, phosphorus, total suspended solids and fecal coliform bacteria. However, nitrogen has increased over the same period.**
 - Some streams that show overall improvement still do not meet standards designed to protect human health, aquatic life and wildlife.
 - It is not currently possible to measure conditions of all 92,000 miles of streams.
 - Although concentrations of total suspended solids, total phosphorous, and Fecal Coliform have significantly decreased in metro area rivers during the last four decades, water quality impairments currently exist in portions of the rivers, due to excess levels of these parameters.
- Shoreland and watershed development, expanding uses and users, the spread of exotic species and water pollution all threaten lakes.
- Once a lake declines, recovery is costly and can take many years. Full recovery may not be possible. Prevention is the key.
- Water quality in the metro area Mississippi, Minnesota, and St. Croix rivers has changed dramatically during the last four decades. Decreasing trends in the flow-adjusted concentrations of BOD5, TSS, TP, NH3, FC indicate an improvement in water quality.
- **In the 2014 Impaired Waters list, there are over 630 water impairments in lakes, rivers and stream reaches in the metro area.**
 - The metro area impaired lakes, rivers and streams contribute to impairments outside the region.
 - Despite decades of progress in cleaning up water pollution, hundreds of Minnesota’s lakes, rivers and streams are still not healthy enough for people to use safely and enjoy.
 - These “impaired” waters do not meet water-quality standards and pose risks to people, aquatic life, and recreation. They can contain too much sediment, bacteria, mercury, phosphorus, and other contaminants.
 - In southwestern Minnesota none of the lakes in the Missouri River Basin met the aquatic recreation standards in 2014.
- **Increasing temperatures and changes in rainfall lead to the warming and nutrient loading of surface waters and more variation in water levels.**

- Warming surface water leads to die-offs of ciscoes (also known as tulibeets, or lake herring in Lake Superior), which provide a high-energy food for walleye, northern pike, muskellunge, and lake trout.
- Increased summer water temperatures can exacerbate internal phosphorus loading in lakes.
- Animal manure contains significant quantities of nutrients which, if improperly managed, can lead to contamination of surface and groundwater.
- Row crop production leaves soils bare from fall until spring, making it easy for rain and snowmelt to wash soil and nutrients into nearby waters. Cover crops can reduce both erosion and nutrient loss.
- A recent study by the MPCA found high and very high nitrate levels in surface waters, especially in the south-central part of the state. A large percentage of these nitrates were concluded to originate from agricultural sources.
- MPCA wetland surveys found that plant communities in 60% of Minnesota prairie pothole region wetlands are in poor condition and macroinvertebrate communities were listed as poor in 32% of the wetlands.
- Public water supply is the largest consumptive use of water in the region, and it is the fastest growing. About 30% of public water supply demand is met by surface water; 70% by groundwater.
- **Extreme rainfall has increased during the past century in Minnesota. This trend is expected to continue, increasing flooding and erosion, reducing water quality, and affecting transportation, agriculture, human health and infrastructure.**

Goals

- **Conserve remaining natural areas and working lands containing important habitats — especially habitats in jeopardy, such as native prairies, wetlands, shallow lakes and shorelines.**
- **Restore the health of degraded lakes, wetlands, rivers, grasslands and forests.**
 - Increase the percentage of Minnesota’s rivers and streams with healthy fish communities, as measured by the Index of Biotic Integrity,
 - Increase the percentage of Minnesota lakes with good water quality, as measured by acceptable Trophic State Index
 - Reduce the amount of nitrogen in rivers.
 - The Nutrient Reduction Strategy sets Phase I nitrogen targets of a 35% reduction in the Mississippi River basin and a 10% reduction in the Red River Basin by 2025.
 - Reduce nitrogen from cropland sources, point sources, and other nonpoint sources, which contribute 78%, 9%, and 13%, respectively, of the nitrogen load to the Mississippi River in Minnesota during an average precipitation year.
- Enroll marginal cropland in long-term habitat conservation programs.
- Reduce invasive species.
 - Prevent the introduction of zebra mussels and other AIS to lakes and rivers in Minnesota.
- Fully assess habitat of Minnesota’s shallow lakes and document resource condition, determine management potential, and evaluate results of management activities on the subset of shallow lakes that are actively managed.
- Prioritize implementation actions.

Strategies

Education, awareness, and understanding

- Increase awareness and protection of lakes containing measurable stands of wild rice.

Foundational data collection and analysis

- **Continued monitoring will be key to determining whether management actions effectively address these current water quality impairments.**
 - Monitor the quality of regional lakes and rivers and quality and flow of regional streams.
 - Continue long-term monitoring of metro area streams, to determine the impacts they are having on regional river water quality, as well as to assess if tributary watershed improvements are improving the quality of downstream resources.
 - Install an additional 6,280 monitoring wells so the DNR can track aquifer health and ground water–surface water interactions.
 - Improve data management to provide better access to, and analysis of, groundwater and surface water sustainability data.
- **Explore where the installation and use of continuous monitoring equipment at regional river monitoring sites could be expanded to better understand patterns and trends for parameters.**
- **Assess the continuous monitoring information collected at several regional river monitoring sites, to better understand patterns and trends for parameters such as DO, temperature, pH, conductivity, and NO3.**

Implementation of programs and activities

- Manage shallow lakes with public access to enhance migration habitat and hunting opportunities.
- Maximize management of shallow lakes for waterfowl and wildlife habitat that are Designated Wildlife Lakes or are located completely within public lands.
- Provide cost sharing for practices that promote living cover.

Research

- Provide research and guidance on best management practices for effective surface water management.
- **Assess and evaluate long-term water quality trends for the region's lakes, streams, and rivers and identify key issues to be addressed.**
 - Assess the pollutant load dataset (1976-present) for regional rivers, to evaluate comparative load contributions and long-term trends. Information on pollutant loads will complement the results presented here on recent and long-term concentrations of water quality parameters, providing a more complete picture of regional river conditions.
 - Assess the biological monitoring data (macroinvertebrates, zooplankton, periphyton, and phytoplankton) for regional rivers, using available indices and indicators to incorporate the broader concept of water resource integrity. Collection of biological information is necessary to supplement chemical information collected, thereby providing a better understanding of the health of aquatic life.
- **Examine long-term changes in river flows and their associated impacts on water quality.**
 - Conduct mechanistic studies and/or modeling, so that the interrelationships between flow, temperature, nutrients, total suspended solids, light, and chlorophyll-A in regional rivers can be better understood. This is crucial in understanding which factor(s) is contributing most to eutrophication issues and which should be targeted to manage the existing nutrient impairments along all three rivers.

Water Reuse

Sources: EQB, Freshwater Society, MDH

Issues

- Current water costs are low and do not incentivize water reuse.
- Little is known about the possible risks of water reuse (particularly nonpotable water) to human health.

Strategies

- Identify training opportunities for source water and reuse application. Review existing materials and develop materials where necessary.
- Develop water quality criteria for a variety of reuse systems based on the log reduction target approach for pathogens.
- Establish a standard system for indoor graywater reuse that considers potential risks.
- Identify shared authorities regarding graywater reuse and indoor plumbing fixtures, water quality considerations, public health risks, etc.
- Research the costs and benefits of reuse including the impacts of reuse on other water bodies.
- Planners and policymakers need to consider policies and incentives that encourage developers to more intentionally incorporate water reuse into their projects.
- Explore reuse from an integrated or “one water” perspective.
- Update plumbing codes and treatment standards to allow for safe and practical water reuse.

Hydrology

Issues

- River flows have multiplied to worrisome levels, destabilizing the river system and delivering large amounts of pollution.
- Extreme rainfall has increased during the past century in Minnesota. This trend is expected to continue, increasing flooding and erosion, reducing water quality, and affecting transportation, agriculture, human health and infrastructure.
- The addition of roads and pavement changes water quality and the amount of water that reaches and replenishes groundwater aquifers.
- Federal disaster funds don't incentivize rebuilding in a more resilient way.

Goals

- Continue comprehensive watershed management that increases watershed resiliency to wet periods, while reducing downstream effects.
- Protect the natural functions of floodplains.
- Improve watershed resilience through watershed management, including agricultural drainage systems.
- Increase private investment in best management practices for storing water on the landscape.

Strategies

Implementation of programs and activities

- Protect the areas in which streams naturally meander.
- Manage agricultural drainage systems as a holistic water system.

- Establish river flow criteria that will lead to less erosion and transport of sediment near rivers.
- Limit impervious cover on the floodplain.
- Prohibit or limit fill or require equivalent area set aside to store floodwater.
- Reduce risks by removing homes and businesses from floodplains.
- Identify current and potential tiled lands and promote mitigation in these areas.
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Research

- Understand how vulnerable Minnesota is to extreme rain.
- Research and develop drought-tolerant hybrids and investigate how the amount and intensity of precipitation affects nutrient uptake and mobility.

Water Pollution

Sources: Clean Water Legacy, EQB, Friends of the Mississippi River, MDA, MDH, MPCA, National Park Service

Note: The topic of water pollution overlapped significantly with other water topics. Therefore, the information presented in this section represents only that not characterized elsewhere.

Issues

- **The most significant causes of pollution are: Agriculture. Hydro modification. Urban Runoff/Storm Sewers. Municipal Point Sources. Resource Extraction. Forestry. Waste/Land Disposal (landfills, dumps, impoundments). Habitat Modification.**
- If the current trends continue, nearly 8 million tons of additional waste will be sent to landfills over the 20-year period of this Plan.
- Twin Cities Metropolitan Area Metropolitan Solid Waste generation continues to grow, and the region's solid waste diversion efforts currently in place will need to be more robust to meet the goals set out in state law.
- Traditional recycling has decreased slightly since 2008.
- Most contaminants of emerging concern do not enter our environment through purposeful or negligent pollution — they enter our environment when we use products that contain these chemicals.
- **Numerous toxic pollutants affect Minnesota's waters, aquatic life, and lead to adverse health impacts in Minnesota and beyond**
 - Consumption advisories for some game fish remain in effect due to mercury in numerous Minnesota lakes. Health officials issue the advisories to inform anglers how much fish of certain types and sizes can be safely eaten. Minnesota continues to monitor fish contamination trends while working hard to reduce atmospheric deposition of mercury (i.e. pollution of water caused by air pollution), the main avenue of contamination
 - Despite significant progress in reducing exposures over the past 20 years, lead remains a potent neurotoxin that is still widely distributed in the environment. While lead in water is increasing in relative importance, dust from leaded paint in homes built before 1978 remains the primary source for elevated blood lead cases in children between 9 and 72 months old.
 - Surface water N concentrations and loads are high throughout much of southern Minnesota, contributing to the N enriched hypoxic zone in the Gulf of Mexico, nitrate in excess of drinking water standards in certain cold water streams, and a potential to adversely affect aquatic life in a large number of Minnesota rivers and streams. Northern Minnesota has relatively low river N

levels, and pollution prevention measures should be adopted in this area as landscapes and land management change.

- A recent study by the MPCA found high and very high nitrate levels in surface waters, especially in the south-central part of the state. A large percentage of these nitrates were concluded to originate from agricultural sources.
- A growing body of literature suggests associations between nitrate exposure and health effects such as increased heart rate, nausea, headaches, and abdominal cramps. Some studies suggest an increased risk of cancer, especially gastric cancer, from consuming nitrate/nitrite in drinking water, but there's not scientific consensus. High levels of nitrate can also cause fatal condition called methemoglobinemia (blue baby syndrome) in infants.
- Chloride from winter deicing chemicals in urban runoff is an increasing concern for water quality, particularly because removal from water systems is prohibitively expensive.
 - At high concentrations, chloride can harm fish and plant life.
 - Water softener brine discharges to municipal wastewater treatment plants also contribute chloride to water across the state.
 - Chloride concentrations have increased in about one-third of the wells sampled in the Twin Cities metropolitan area.
- Microplastic fibers, pharmaceuticals and triclosan-derived dioxins in the metro river pose uncertain risks to aquatic life and health. Additional research and collective action are required to mitigate their potential long-term impacts.
- Other Contaminants of Emerging Concern (CECs)
- In a statewide survey, 75 percent of professionals and policy administrators statewide rated wider use of pollution prevention/source reduction as a moderate or major priority.
- A statewide survey of professionals and policy administrators rated all of the following topics important or very important as important research topics:
 - Trends in soluble pollutants in groundwater
 - Trends in conventional pollutants in surface waters
 - Trends in biological indicators
 - Development of new metrics

Goals

- Protect and conserve water
- Manage materials in a manner that will protect the environment and public health, reduce greenhouse gas emissions, conserve energy and natural resources, and reduce toxicity and exposure to toxics.
- Reduce nitrogen losses from cropland.
- Reduce the amount of nitrogen in rivers.
 - The Nutrient Reduction Strategy sets Phase I nitrogen targets of a 35% reduction in the Mississippi River basin and a 10% reduction in the Red River Basin by 2025.
 - Reduce nitrogen from cropland sources, point sources, and other nonpoint sources, which contribute 78%, 9%, and 13%, respectively, of the nitrogen load to the Mississippi River in Minnesota during an average precipitation year.

Strategies

Education, awareness, and understanding

- Better information is needed about chemicals in products, buy safer products, and proper use and disposal of products containing Contaminants of Emerging Concern.
- Help consumers make informed choices about products by disclosing potentially harmful chemicals, particularly for personal care and children's products.
- Inform effective pollution reduction at the source. Source reduction, also called pollution prevention, means reducing the production of pollutants from the watershed before they become part of the stormwater runoff stream.
- More education and outreach are needed, as citizens and municipalities can take actionable steps to reduce chloride use

Foundational data collection and analysis

- Assess the performance of green infrastructure to determine where it is having the biggest impact.
- Trends in soluble pollutants in groundwater
- Trends in conventional pollutants in surface waters
- Trends in biological indicators
- Development of new metrics

Implementation of programs and activities

- Manage waste properly
- Support the strong existing system for proper management of hazardous waste and household hazardous waste.
- Voluntary or incentive-based changes in industrial and retail practices.
- Modify manufacturing processes and products to use less harmful chemicals, create less waste and manage environmental releases.
- More reuse and waste and toxicity prevention programs.
- Encourage manufacturers to design for repair, reuse, and recyclability.
- Implement practices to preserve and improve soil health:
 - Keep the soil covered as much as possible;
 - Disturb the soil as little as possible;
 - Keep plants growing throughout the year to feed the soil;
 - Diversify as much as possible using crop rotation and cover crops.
- Provide stable funding for smart salting training programs for highway maintenance.
- Provide funding to deploy smart technology. Historically, deicing chemical applicators decided how much chemical to apply based on experience and route details. Today, technologies are available that reduce the volume of chemicals needed.
- Use the purchasing power of governments and other large organizations to stimulate market demand for products and services that rely on fewer harmful chemicals and create less waste.
- Support updated regulations to ensure the safety of a chemical before it is used in consumer products.
- Encourage addition of substantial acreages of perennials and other living cover, public and private partnerships could create new or enhance existing markets for these products by differentiating them as environmentally responsible
- Promote sustainable and resilient infrastructure. Promote use of energy-efficient, easy-to-maintain and recycled/recyclable materials. Promote conservation of water at facilities and design of facilities to contain water on-site.

- Strengthen recycling markets to increase demand for recyclables and therefore allow for increased recycling and conservation of energy.

Research

- Additional research and collective action Microplastic fibers, pharmaceuticals and triclosan-derived dioxins to mitigate their potential long-term impacts.
- Design products and processes that minimize the use of hazardous chemicals and reduce the negative impact of chemistry on the environment.
- Conduct research to enable higher levels of nutrient reductions from current and speculative BMPs and management approaches.
- Improved understanding of how we make the decisions that we make in natural resource management is needed to ensure that we are making the most informed decisions for the future.

Stormwater

Sources: Minnesota's Clean Water Roadmap (interagency), DNR, EQB, MnDOT, MPCA

Issues

- **Surface runoff from the built environment can contain sediment, oil, fertilizer, pesticides, grass clippings, leaves, litter, pet waste, organic compounds, heavy metals and chlorides.**
- **Suspended sediments, algae, bacteria and other pollutants can make lakes and rivers dangerous and unappealing for swimming and boating.**
- **Aquatic life in streams and lakes can be affected by small increases in pollutants such as metals or chloride, temperature, or altered hydrology.**
- **Source reduction has been successful for reducing inputs to stormwater.**
- Current Best Management Practices (BMPs) for stormwater management are costly.

Goals

- Ensure we are resilient to extreme rainfall.
- Manage runoff in the built environment.
- Achieve clean water, with greater cost efficiency by focusing on improving the effectiveness of stormwater management.

Strategies

Foundational data collection and analysis

- Create a comprehensive storm sewer database to identify areas of concern that need attention during extreme events.

Implementation of programs and activities

- Require stormwater capture at construction sites.
- **Control and filter runoff with green infrastructure.**
 - **Use perennial plants or buffers along rivers and streams.**
- **Design the built environment to mimic natural hydrology.**

- Institute Minimal Impact Design Standards, voluntary standards for managing runoff and stormwater above and beyond permit requirements.
- Increase private investment in best management practices for storing water on the landscape.

Research

- Research education to improve public perception of stormwater management and to improve effectiveness of citizens' actions to improve water quality.
- Research and develop new and innovative stormwater management practices.
- Determine the cost efficiency of stormwater practices.
- Improve performance and reduce maintenance on structural BMPs (stormwater ponds, dry detention basins, infiltration basins, wetlands, rain gardens, etc.).
- Inform effective pollution reduction at the source
- Evaluate the efficacy of stormwater management practices at the watershed scale.
- Improve characterization of urban stormwater and watersheds.

Wastewater and treatment

Sources: EQB, Met Council, MPCA

Issues

- Wastewater treatment is costly.
- Current water pricing may not cover the current and future cost of infrastructure for drinking water and wastewater treatment.
- Wastewater pumped to surface water (rivers and streams) ultimately flows elsewhere and does not replenish aquifers.

Goal

- Achieve wastewater pollutant reduction
- Maximize cost-effectiveness of public infrastructure investment.

Strategies

- Nitrogen can be removed biologically or through enhanced nutrient removal.
- **Investigate the reuse of treated wastewater as a source of nonpotable water.**
- Wastewater treatment requires energy. Upgraded water systems can reduce energy use.
- Create fertilizer surcharge to pay for drinking water treatment.

Other natural resources/ Outdoor recreation

Sources: DNR, MnDOT, North American Waterfowl Management Plan, Upper Mississippi River and Great Lakes Region Joint Venture

Issues

- Outdoor recreation is critical to natural resource conservation but participation is declining.
- Changing demographics, increasing urbanization and competing priorities around leisure time means that less young families, young people, and communities representing diverse cultures, use Minnesota's natural resources.
- Outdoor recreation infrastructure is outdated, deteriorating, and does not meet modern standards for facilities and trails, including American's with Disabilities Act (ADA) requirements.
- Fishing and wildlife recreational spending contributes to Minnesota's economy with sales and jobs in fishing and hunting bringing millions in revenue.

Goals

- Ensure that Minnesota's outdoor recreation opportunities meet the needs of new and existing participants so that all share benefits of Minnesota's natural resources.
- Create welcoming, safe, and comfortable outdoor recreational lands and facilities for all.
- Develop future stewards of Minnesota's natural resources through efforts to increase lifelong participation in parks and trails.
- Invest in innovative facilities design, technologies and improvements to existing buildings and trails for high quality visitor experiences.
- Preserve existing high-quality natural areas and water resources, and create new and expanded park and trail opportunities.
- Improve opportunities for recreational use of lakes, streams, and rivers without having to own land.
- Prevent the introduction, spread and impact of invasive species within Minnesota. Increase hunter access and retention.
- Build capacity to connect people with waterfowl habitat.

Strategies

- **Create new and expanded park and trail opportunities to satisfy current customers as well as to reach out to new ones.**
 - Acquire permanent trail easements within critical grant-in-aid trail corridors so they are not lost to development or other land use changes.
 - **Place a priority on new trail opportunities that are closer to the concentration of users—** including snowmobilers, off-highway vehicles, riders, horseback riders, and canoers/kayakers. The highest concentration of which is in and around the Twin Cities metropolitan area.
 - Establish sustainable trail systems to provide high-quality opportunities for specialized trail interests.
 - Acquire the land needed for support facilities for trail systems (e.g., accesses, portages, rest areas, trail heads). Facilities that serve multiple interests are priorities.
 - Priority for acquisition should be in parts of the state that have the fewest opportunities per person now and projected into the future, particularly densely settled and growing areas; regional centers; private in-holdings in existing parks; trail connections; and lands and facilities that serve tourists and local residents.

- Develop and promote outdoor recreational opportunities for women, families with children, racially and ethnically diverse cultures, urban dwellers, and young people. Build relationships with organizations associated with underrepresented groups to build awareness of outdoor recreation and conservation education opportunities. Develop publications, signs, and other materials in multiple languages.
- Maintain participation of those who are currently active in outdoor recreation, and create retention and marketing approaches to reduce loss of current participation levels.
- Improve understanding of what is preventing people from participating in outdoor recreational activities to better understand specific groups who are not participating and use evidence to inform and improve outdoor recreation programs.
- Design, develop, and upgrade facilities to meet the differing outdoor recreation needs of people of all abilities. Develop infrastructure and amenities that meet the lifestyles of the target communities.
- Manage shallow lakes with public access to enhance migration habitat and hunting opportunities.
- Create an environment that is open and flexible to accommodate new and emerging nature-based recreation uses.
- Provide safe, high-quality park and trail experiences by regular re-investment in park and trail infrastructure, and natural resource management.
- Provide and improve access to public and private lands and waters for compatible recreation.
- Ensure that the public land and water base is easily available and accessible to citizens.

Air

Sources: DNR, EQB, Freshwater Society, MDH, Met Council, Minnesota Prairie Plan Working Group, MPCA, Partners in Flight, The Nature Conservancy

Issues

- **Climate changes in the next 50-100 years will result in increased temperatures (during the summer and winter, at night) and more extreme weather in Minnesota, such as increased precipitation (frequency, amount), heat waves, drought, and wild fires.**
 - Increased precipitation will either evaporate (due to hotter temperatures), making precipitation less effective for sustaining habitats, or run off (as aquifers become full), leading to flooding.
 - Climate patterns will shift north, making current northern Minnesota landscapes more similar to southern US landscapes.
 - Invasive species populations will increase while native species populations will decrease. In part, this is due to overuse of fertilizers and fossil fuels that have increased air pollution. Some species, such as birds, may change their migratory patterns to adapt to climate change.
 - While some habitats and species will tolerate climate shifts, others will not. Increased temperatures and changes in precipitation patterns will impact wildlife populations, vegetation communities, and will increase pollution of surface waters due to runoff.
 - Climate change may lead to new species composition in a habitat (e.g., increases in invasive species such as EAB, Eastern Larch Beetle, etc, shifting forest communities northward). Some have suggested that these new species should be considered part of that habitat, rather than a species to be eradicated.
- **Climate change will have economic and safety impacts.**

- Changing temperature and precipitation will put public safety, water resources, and biodiversity at risk.
- Increased heat waves have impacted agricultural and energy supplies and the increase in severe weather has impacted homeowner insurance premiums and the repair costs of public facilities.
- Flooding in Duluth (2012) resulted in dam failures, cave-ins at bridge and water crossings, zoo animals escaping or drowning, and more than \$100 million in damages to homes.
- Rains and tornadoes in southern Minnesota (2017) caused mudslides and extensive damage to infrastructure and crops.
- Lack of frozen ground can impact timber harvest; and fewer days of ice cover on lakes can have widespread economic, biological and recreational impacts.

Goals

- Maintain and improve ecosystems so that they continue to serve Minnesota's environmental, social, [and economic] needs.
- Increase community and environmental resilience.
- Identify and develop mitigation and adaptation strategies and tools to address climate change
- **Reduce Minnesota's greenhouse gas emissions, and improve air quality.**
 - Reduce the use of fossil fuels, particularly as it relates to the largest area of consumption: transportation.
- Manage materials in a manner that will protect the environment and public health, reduce greenhouse gas emissions, conserve energy and natural resources, and reduce toxicity and exposure to toxics.

Strategies

Capital projects for the preservation and protection of unique natural resources

- Invest in urban and rural forests, wetlands, peatlands, and prairies to maintain and expand long-term carbon storages which mitigate/defer global warming.

Education, awareness, and understanding

- **Improve knowledge and understanding of climate effects [on human health]**
- **Provide guidance on how to reduce impacts of floods and droughts, invasive species risk reduction, and other biological stressors.**

Foundational data collection and analysis

- Continue to collect, analyze, and publish information on Minnesota's changing climate.
- Develop additional monitoring systems as needed and collect more granular data when possible for better local planning.
- Use data and leverage partnerships to better understand the impacts of climate change on economic, biological (human and non-human), and recreational levels.
- Identify populations that are at risk [of poor health outcomes]/ vulnerable to impacts of climate change.

Implementation of programs and activities

- Reduce our use of fossil fuels for transportation, electricity, and heating, and improve green business practices.
- Manage materials more effectively to reduce environmental impacts (and improve public health).
- Help plants and animals adapt to climate change. Conservation strategies should be built on how plant and animal species use small habitats, whether for time-limited habitation under poor climate conditions, or for shifting migratory movements to new areas where conditions are more favorable.
- Support existing or emerging energy markets where conservation of natural resources also reduces the carbon footprint.
- **Renewable energy and recycling policies and efforts should be promoted.**
 - Increase the demand for recyclable materials to strengthen the recycling market and conserve energy.
 - Promote renewable energy and conservation.
 - Re-examine Minnesota's renewable energy and energy efficiency policies to ensure the state meets its greenhouse gas reduction goals.

Research

- Improve knowledge and understanding of climate effects [on human health] and identify and develop mitigation and adaptation strategies and tools to address climate change [and public health].

Fish

Sources: DNR, EQB, Friends of the Mississippi River, Minnesota Aquatic Invasive Species Research Center, Minnesota Invasive Species Advisory Council, MPCA, Minnesota Prairie Plan Working Group, National Park Service

Issues

- Fishing as a recreational activity significantly contributes to Minnesota's economy through retail sales, job creation, and tax revenues.
- Climate change poses significant threats to biological diversity and contributes to a loss of habitat.
- People are encroaching on fish habitats, creating fewer spaces in which they can survive.
- Some segments of the population are engaging in fishing for recreational purposes at higher rates, which may impact the fish population overall.
- Invasive species decrease native populations of fish and biodiversity.

Goals

- Protect Minnesota's aquatic habitats so that they may be enjoyed for generations to come.
- Aquatic Management Areas should be accessible to all Minnesotans for non-motorized recreation, regardless of land ownership.
- **Restore the health of degraded lakes, wetlands, rivers, grasslands and forests.**
 - Increase the percentage of Minnesota's rivers and streams with healthy fish communities, as measured by the Index of Biotic Integrity

- Manage lands and waters in ways that foster healthy habitats and boost the ability of fish and wildlife to cope with change.

Strategies

Capital projects for the preservation and protection of unique natural resources

- **Acquire more land to protect fish populations (e.g., vulnerable, rare, endangered species) and habitats, or place habitats (e.g., shallow lakes, shorelines, areas rich in biodiversity) under protection.**
- Address conservation efforts holistically (consider factors such as biodiversity, local economies, agriculture, eco-tourism, geodiversity, health benefits, social benefits).

Education, awareness, and understanding

- Continue to provide education and increase awareness among stakeholders (e.g., riparian and non-riparian land owners, fisheries, anglers) about conservation efforts, resource management, and invasive species.

Foundational data collection and analysis

- Complete evaluations or assessments of the following:
 - factors that affect the habitat of certain fish,
 - the impact of human interactions with the environment
 - the history and future of certain lakes,
 - species of greatest conservation need.
 - Use findings from evaluations or assessments to inform current and future programs (e.g., conservation, management).

Implement programs and activities

- Improve connectivity between bodies of water for native species and create barriers for invasive species.
- **Use best practices and work with stakeholders to prevent and manage the spread of invasive species (e.g., carp, spiny water flea) that occupy fish habitats without damaging native species.**
- Detect invasive species more quickly.
- Develop a system for Minnesotans to report sightings of invasive species.
- Support efforts to reduce invasive species
- Create guidelines around the use of hatchery-reared fish.

Wildlife

Conservation of habitat and wildlife

Sources: DNR, EQB, Upper Mississippi River and Great Lakes Region Joint Venture

Issues

- Land use change, invasive species spread, wildlife disease, pollution and changing climate cumulatively are threatening the health of Minnesota's wildlife populations
- Biological diversity is critical to healthy lands and waters, social and economic vitality, and the quality of life for Minnesotans.
- Fishing and wildlife recreational spending contributes to Minnesota's economy with sales and jobs in fishing and hunting bringing millions in revenue.
- Economic incentives often motivate the installation of wind turbines in grassland areas due to their currently lower real estate value. However, turbines are potential threats to wildlife

Goals

- **Conserve and enhance Minnesota's waters, natural lands, and diverse fish and wildlife habitats, with a focus on species that are rare, declining, or vulnerable to decline.**
- Restore the health of degraded lakes, wetlands, rivers, grasslands, and forests.
- Enhance opportunities to enjoy Species in Greatest Conservation Needs (SGCN) and other wildlife in Minnesota.
- Manage lands and waters in ways that foster healthy habitats and boost the ability of fish and wildlife to cope with change.

Strategies

- Provide opportunities for the public to enjoy, learn about, and participate in the conservation of Minnesota's biological diversity.
- Work with state, county, federal and private land managers to protect biological diversity and enhance resilience.
- Provide leadership and guidance to prevent and manage invasive species.
- Implement research projects to identify causes of wildlife population decline, especially SGCN.
- Improve knowledge of status, distribution, conservation needs of wildlife in Minnesota.
- Maximize management of shallow lakes for waterfowl and wildlife habitat that are Designated Wildlife Lakes or are located completely within public lands.

Waterfowl/ Birds

Sources: DNR, Upper Mississippi River and Great Lakes Region Joint Venture, Partners in Flight, North American Waterfowl Management Plan?

Issues

- Human population impact and the associated intensive land use have caused long-term loss and degradation of birds and waterfowl habitat.
- Loss and degradation of grassland habitat has led to decline of many grassland bird species.
- Changing climate with increased temperatures, more extreme weather events, changing moisture levels and rising sea levels affect ecological processes which impact wildlife including birds.

Goals

- **Develop conservation efforts around waterfowl habitat and population management.**
- Guide regional conservation that results in habitat to support populations of priority waterfowl.

Strategies

- Develop science based calculations to support waterfowl habitat and population conservation.
- Establish improved performance measurement and evaluation protocols.
- Habitat protection
- Fully assess habitat of Minnesota's shallow lakes and document resource condition, determine management potential, and evaluate results of management activities on the subset of shallow lakes that are actively managed.
- Maximize management of shallow lakes for waterfowl and wildlife habitat that are Designated Wildlife Lakes or are located completely within public lands.
- Manage shallow lakes with public access to enhance migration habitat and hunting opportunities.

Invasive species

Sources: DNR, MN Invasive Species Advisory Council

Issues

- Invasive aquatic species (AIS) decrease native populations and biological diversity, affect recreational use of Minnesota land and waters, and impacts businesses that depend on healthy lands and waters.
- Minnesota's native prairies and associated habitats face a host of invasive plant species that often out-compete native plants.

Goals

- **Prevent the spread of aquatic invasive species (AIS) within Minnesota.**
 - Seek inter-jurisdictional and watershed-wide cooperation and approaches to prevent potentially invasive species into watersheds.
- Prevent and manage terrestrial invasive species to protect and/or restore habitats for wildlife species, especially those species in greatest conservation need.
- Prevent or limit the negative impacts on Minnesota's ecology, economy and human health that can result from terrestrial invasive species such as Oriental bittersweet, wild parsnip, buckthorn, garlic mustard, earthworms, emerald ash borer and gypsy moth.
- **Detect new invasive species populations and develop comprehensive system for reporting presence of high priority nonnative species within Minnesota.**
- Transform non-native plant communities to native plant communities, in units with statutory mandates and selected sites in other units, excluding use areas or sites planned for development.

Strategies

Education, awareness, and understating

- **Increase public awareness about AIS, and provide the public with clear actions to prevent the introduction and spread of AIS through an understanding of the laws and recommended practices.**
- Improve understanding of the ecology and management of invasive aquatic plants, and review and revise best management practices for herbicide treatment of aquatic plants.
- Train and educate commercial entities to increase compliance with invasive species regulations.

Foundational data collection and analysis

- Analyze data, develop protocols, and secure equipment to administer AIS checkpoints safely and effectively.
- Assess the risk of AIS and nonnative invasive aquatic plants,
- Monitor the distribution of AIS and invasive aquatic plants within the state.

Research

- Improve technological options and strategic approaches, and work to implement appropriate standards that will help prevent introductions of invasive species into the state or connected watersheds.

Land

Sources: BWSR, DNR, EQB, MDA, Minnesota Forest Resources Council, Minnesota Invasive Species Advisory Council, Minnesota Prairie Plan Working Group, MPCA, Prairie Pothole Joint Venture, The Nature Conservancy, Upper Mississippi River and Great Lakes Joint Venture

Issues

- **Prairies, grasslands, and wetlands are declining.**
 - The loss of grasslands also means the loss of the water storage and filtration capacity of these grasslands and the soils supporting them.
 - About X acres of remaining Y acres of high-quality native prairie or savanna in private ownership was converted to agriculture and housing developments between x and y. In some areas, housing may be as great a threat as agriculture because many of the remaining prairies are on hilltops or similar scenic areas.
- **The cumulative effects of land use change, invasive species spread, pollution and a changing climate are combining in new ways to threaten the health of Minnesota's natural lands and waters.**
 - Changes in the global market, Minnesota's human population and associated increases in land development and intensified land use can disrupt watersheds, reduce water quality, decrease and contaminate water supplies and other natural resources, and reduce biological diversity.
 - Row crop production leaves soils bare from fall until spring, making it easy for rain and snowmelt to wash soil and nutrients into nearby waters. Cover crops can reduce both erosion and nutrient loss.
- Opportunities exist to better align working lands and conservation outcomes.
 - Season-long, moderate-to-heavy-stocking density of cattle results in a relatively uniform, low grass height and leaves relatively little 'tallgrass' habitat.
 - Over-grazing of cattle on a continuous basis without rest period results in loss of native plant diversity, increased potential for erosion, and higher susceptibility to invasive species.

- Broadcast spraying with herbicides to remove broad-leaf plant is done to improve pastures for livestock and control the weeds that are left after continuous grazing, however this also contributes to grassland decline.
- Demand for mineral development is increasing, with increased interest in Minnesota’s iron, copper, nickel, platinum, gold, other precious metals and silica sand.
- A newly recognized threat to prairies is the increased level of biologically-active nitrogen entering prairie systems from the air. Rates are two to seven times pre-industrial levels because of agricultural fertilization and the combustion of fossil fuels. Chronic low-levels of increased nitrogen result in a reduction of native species in prairie.

Goals

- **Minnesota’s waters, natural lands, and diverse fish and wildlife habitats are conserved and enhanced.**
- **Conserve remaining natural areas and working lands containing important habitats — especially habitats in jeopardy, such as native prairies, wetlands, shallow lakes and shorelines.**
 - **Enroll marginal cropland in long-term habitat conservation programs.**
 - **Reduce invasive species.**
 - Preserve existing high-quality natural resources
 - Protect the native prairie and prairie complexes, selected other grasslands, and associated habitats such as wetlands, riparian areas along streams, and shallow lakes.
 - By the end of the 21st century (2099), the state aims to protect, approximately 300 SNAs statewide comprising about 325,000 acres (about 0.6 % of the state). This means designating 136,000 more acres of SNA over the next 85 years, or an average (mean) of 1,600 additional acres of SNA per year.
 - Permanent protection through the acquisition from willing sellers of fee title or easement of native prairies, wetlands and other habitats (including land to be restored): about 222,100 acres in core areas, 82,000 acres in corridors, and 547,300 acres elsewhere.
 - Connect fragments of high-quality habitat.
 - Create a network of connected habitats across the landscape that can withstand external pressure and disturbance.
 - Five occurrences of each existing native plant community are within designated SNAs within each ecological subsection.
 - Three occurrences of each existing species of plant and animal are within designated SNAs within each ecological subsection.
 - One of each type geological feature in the state is within a designated SNA.
 - Ten percent of the state’s high priority conservation areas are protected through SNAs, (orange and red areas depicted on the Conservation Prioritization Results Map); other landowners and managers conserve the natural heritage within high priority conservation areas.
 - SNAs contribute ecological values in key watersheds.
 - The SNAs natural features and public benefit are sustained over time.
- **Minnesota’s waters, natural lands, and diverse fish and wildlife habitats are conserved and enhanced.**
 - Increase the capacity for enhancement work (i.e., active management) and focus these efforts in priority landscapes.
 - Enhance priority wetlands and grasslands via prescribed fire, conservation grazing, haying and invasive species control in core areas, corridors, and beyond.

- Enhancement of existing wetlands and shallow lakes through control of invasive species and intensive water level management.
- Maintain or enhance habitat in Conservation Focus Areas.
- Maintain and enhance the resilience of the habitats upon which Species in Greatest Conservation Need (SGCN) and other wildlife depend.
- **Restore the health of degraded lakes, wetlands, rivers, grasslands and forests.**
- Restore and protect grasslands and embedded wetlands prioritized but not limited to targeted landscapes.
- Restore and protect grassland and wetlands in core areas, corridors, and beyond.
- Restore natural areas that have been degraded.
- Manage lands and waters in ways that foster healthy habitats and boost the ability of fish and wildlife to cope with change.
- **Reduce invasive species.**
 - Place a priority on controlling the spread of invasive species.
- Create an environment that is open and flexible to accommodate new and emerging nature-based recreation uses.
- Provide safe, high-quality park and trail experiences by regular re-investment in park and trail infrastructure, and natural resource management.

Strategies

Capital projects for the preservation and protection of unique natural resources

- Conserve remaining natural areas and working lands containing important habitats — especially habitats in jeopardy, such as native prairies, wetlands, shallow lakes and shorelines.
- Enroll marginal cropland in long-term habitat conservation programs.
- Invest in urban and rural forests, wetlands, peatlands, and prairies to maintain and expand sequestered carbon. These investments will also protect Minnesota’s air, water, recreation opportunities, and wildlife habitat.
 - Accelerate the acquisition of private in-holdings and add lands to existing parks and protected areas to enhance resource protection and recreational opportunities.
- Shoreland should be protected through both fee title acquisitions and easements by public agencies and nonprofit organizations.
- Acquire land for designation as new SNAs and additions to existing SNAs
- **Increase the conservation value of public lands through strategic land acquisitions, sales and exchanges.**
 - Acquire exceptional one-time opportunities of unique, high-quality natural resources that meet critical needs outside of regional centers.
 - Focus acquisition of new state parks on high-quality natural resource areas, particularly where ecological subsections are not represented by the state park system or substitute.
- Create a network of connected habitats across the landscape that can withstand external pressure and disturbance.
- **Improving the local connectedness of a site is an achievable strategy in many places, and much more feasible than improving topographic diversity at a meaningful scale.**
 - Restore landscapes by connecting and buffering the native prairie and other protected habitats.
 - Increase the connectivity and/or size of SNAs to enhance ongoing viability and resiliency.
- Provide and improve access to public and private lands and waters for compatible recreation.
- Ensure that the public land and water base is easily available and accessible to citizens.

- Development and redevelopment (of state park land?) should focus on densely populated areas, underrepresented areas, and areas that serve tourists as well as local residents.

Education, awareness, and understanding

- Develop a communication plan linking grass-land and wetland protection, restoration, and management to water quality issues.
- Develop Prescription Burn Associations to encourage private lands burning.

Foundational data collection and analysis

- Evaluate the value of current (and potential) non-breeding habitat for waterbirds. Assessment will include testing the assumption that breeding habitat is of greater importance to priority species compared to non-breeding habitat.
- Identify lands and waters at greatest risk from pressures such as land use change, pollution, climate change and invasive species. Set priorities for protecting and managing resources under greatest threat.
- Collect and analyze important data on the biological diversity of Minnesota’s lands and waters.

Implementation of programs and activities

- Ensure better coordination of public land asset management among state agencies, nonprofit organizations, counties and other partners
- Expand the capacity of staff dedicated and equipped for grassland and wetland habitat management.
- Ensure sufficient resources to maintain and manage EWR-administered lands.
- Stimulate small business creation so there are more contractors able to conduct enhancement and restoration projects.
- Increase native seed production capacity for grassland and wetland plant species to supply diverse local ecotype seed mixes.
- Provide technical assistance to private land-owners, NGOs, and conservation agencies for wetland management (e.g., water level, vegetation, fish, and moist soil management).
- Use the full range of approaches to establishing SNAs: a) designate SNAs on existing public lands (as secondary units on state lands, through transfer, and buying out school trust status when in the interest of the trust), b) acquire fee interest or conservation easement via purchase and gift, and c) explore establishing more SNAs through DNR leases.
 - Strive for establishing SNAs with reasonable management needs and the resources necessary to sustain the site’s natural features and public benefits.
- Enhance natural disturbance regimes on Minnesota’s native prairie.
- Incorporation of conservation into “working lands” to contribute directly to local economies via “grass-based” agriculture and agricultural lands in turn provide some natural resources benefits as a result of applying using the full range of conservation practices.
 - Rotational grazing using high-intensity, short-duration regimens can simulate the grazing patterns once provided by large bison herds and may offer a beneficial means of achieving both conservation disturbance goals while supporting a local grazing industry.
 - Develop grazing cooperatives.
 - Increase and maintain living cover across watersheds.
 - Use a working lands approach to manage landscapes as a whole instead of individual parcels.
- Focus resources on important landscapes that have the greatest influence on waterfowl populations and those who hunt and view waterfowl.
- Strengthen efforts to transform land use patterns and mass transit systems to reduce reliance on single occupancy, internal combustion engine vehicles.

Research

- Continue research on grassland and wetland restoration methods and monitoring of wildlife responses to different treatments.
- Determining essential ecosystem services provided to forest economies and their vulnerability to changes in future forest conditions.

Forest conservation

Issues

- Forests provide economic value through jobs, tourism, and sustainable supply of wood resources, while creating recreational value to Minnesotans and habitat for wildlife
- Changing climate, diseases and spread of invasive species are a threat to forests in Minnesota.
- Many of our natural resources are influenced by different conditions across the forested landscape.
 - Determining how these conditions vary within a forest is possible with new technologies, but understanding how they influence resources requires more research.
- We understand many of the causes of forest changes, but we still do not have a firm grasp on how changes will impact our forest resources, and which aspects of forests may be most susceptible or which changes will have greatest effect on society.

Goal

- Achieve optimal forest management for healthy, productive forests that support jobs, provide sustainable supply of wood resources, and create the foundation for outdoor recreation, tourism, biodiversity and clean water.

Strategies

Foundational data collection and analysis

- Use transformative methods for the collection and interpretation of forest and forest resources data (field and remotely-sensed) across ownerships and scales.

Implementation of programs and activities

- Manage invasive species such as Emerald Ash Borer which has killed more than 50 million ash trees in the U.S.
- Encourage healthy forest management such as prescribed fires, to control woody plant encroachment which impact biodiversity in Minnesota.

Research

- Conduct an economic assessment of alternative management strategies to increase [forest products] and environment and natural resource benefits of forest harvest.
- How leaving varying amounts of residual basal area after timber harvesting within riparian forests may affect such factors as the composition, growth and productivity of the residual forest and biological diversity.
- How leaving large dead trees on the ground after timber harvesting within riparian forests may affect such factors as the composition, growth and productivity of the residual forest and biological diversity.

- How varying levels of riparian forest reserves (including residual basal area, crown closure and width of the riparian management zone) may, over time, affect such factors as bank stability; reduction in overland flow of sediment; ability to remove chemicals (including nitrogen and phosphorus) from overland flow; maintenance of moderate water temperatures through shading; provision of coarse woody debris; and the production of fine litter.

Water as habitat

Sources: DNR, EQB, Minnesota Invasive Species Advisory Council, MPCA, North American Waterfowl Management Plan (multinational), Upper Mississippi River and Great Lakes Region Joint Venture

Issue

- Development pressure on lakeshores is having a negative impact on fish habitat.
- Habitat damage most often tends to occur through the cumulative effects of many small impacts rather than large catastrophic impacts
 - The regulatory framework for conserving lakes and streams has not been adequate to prevent this and changes are hampered by strong, constitutionally based property rights.
- **Climate change and warmer water temperatures have many negative impacts on fish, aquatic vegetation, and waterfowl.**
 - More variation in rainfall timing and amounts could increase runoff, adding pollution to surface water and warming shallow lakes.
 - Increased summer water temperatures can exacerbate internal phosphorus loading in lakes.
 - Warm water temperatures directly and indirectly lead to die-offs for ciscoes (also known as tulibeas, or lake herring in Lake Superior). Ciscoes provide a high-energy food for walleye, northern pike, muskellunge, and lake trout. Changes in land use and climate have led to declines in cisco populations in the past 30 years.
 - More research is needed to better understand how climate may affect invertebrate populations and aquatic vegetation.

Goals

- **Wetlands and related habitats are sufficient to sustain waterfowl populations at desired levels, while providing places to recreate and ecological services that benefit society. Other examples include:**
 - Preserve existing high-quality natural resources and restore those that have been degraded.
 - Manage lands and waters in ways that foster healthy habitats and boost the ability of fish and wildlife to cope with change.
- Place a priority on controlling the spread of invasive species.
- Establish Landscape Scale Conservation Zones.
- **Conserve remaining natural areas and working lands containing important habitats — especially habitats in jeopardy, such as native prairies, wetlands, shallow lakes and shorelines.**
- **Restore the health of degraded lakes, wetlands, rivers, grasslands and forests.**
 - Increase the percentage of Minnesota’s rivers and streams with healthy fish communities, as measured by the Index of Biotic Integrity,
-

Strategies:

Education, awareness, and understanding:

- Increase awareness and protection of unique lakes, including those containing measurable stands of wild rice.
- Improve understanding of motivations to enable wetland conservation

Foundational data collection and analysis

- **Develop tools to assess and monitor early presence and identification of invasive species, including invasive carp population sizes, range expansion, and reproduction.**
- Fully assess habitat of Minnesota's shallow lakes and document resource condition, determine management potential, and evaluate results of management activities on the subset of shallow lakes that are actively managed.
- Accelerate water and habitat assessments to evaluate projects that might affect trout streams.

Implementation of programs and activities

- **Conserve a habitat system with the capacity to maintain long-term average levels of waterfowl populations, to periodically support abundant populations, and to consistently support resource users at objective levels.**
- Manage shallow lakes with public access to enhance migration habitat and hunting opportunities.
- Maximize management of shallow lakes for waterfowl and wildlife habitat that are Designated Wildlife Lakes or are located completely within public lands.
-

Research

- **Improve technological options and strategic approaches, and work to implement appropriate standards that will help prevent introductions of invasive species into the state or connected watersheds.**
- Quantify the value of ecological goods and services potentially provided by strategically placed wetland bird habitat, including benefits and tradeoffs associated with geographic placement of conservation projects to achieve biological and social objectives.
- Collect and analyze important data on the biological diversity of Minnesota's lands and waters.

Other

- Seek inter-jurisdictional and watershed-wide cooperation and approaches to prevent introductions of potentially invasive species into watersheds that include Minnesota (e.g., Asian carp in other states; barriers in Illinois waterways).
- Lake management approaches must consider biological interactions occurring in lakes if the management goal is related to waterfowl, fish or water quality.

Wetland and riparian waters

Sources: BWSR, DNR, MPCA, EQB, Minnesota Prairie Plan Working Group, Minnesota Forest Resources Council, MDA, MnDOT, Upper Mississippi River and Great Lakes Region Joint Venture

Issues

- Wetlands naturally filter pollutants from water, reduce flood damage, and provide wildlife habitat.
- Over 5.5 million acres of wetland have been lost since the early 1900s. Approximately 12.2 million remain
- Land conversion and development contributes to loss of wetland and riparian waters.

Goals

- Design and produce better wetland restorations in core areas, corridors, and elsewhere.
- **Protect the native prairie and prairie complexes, selected other grasslands, and associated habitats such as wetlands, riparian areas along streams, and shallow lakes.**
- Improve our ability to protect, improve, and restore riparian habitat.
- **Restore environmental benefits lost due to wetland conversion or degradation.**
- Wetlands and related habitats are sufficient to sustain waterfowl populations at desired levels, while providing places to recreate and ecological services that benefit society.

Strategies

- Invest in urban and rural forests, wetlands, peatlands, and prairies to maintain and expand sequestered carbon.
- Maintain or enhance habitat in Conservation Focus Areas.
- Establish Riparian Management Zone management guidelines (Riparian management zones are areas of special concern along streams, lakes and open water wetlands)
- Improve the integration of social objectives into wetland and waterbird conservation within the context of implementing continental conservation plans with Human Dimensions goals.

Themes from administrative goals and strategies

Sources: BWSR, DNR, EQB, MDH, Met Council, MPCA, Thrive MSP, Upper Mississippi River and Great Lakes Region Joint Venture, Water Resources Center

Issues and strategies

- About one third of these strategies referred to increasing or incentivizing collaboration, partnerships, and organizations among agencies and organizations, including state government, local government, nonprofit organizations, communities, and academic institutions for more holistic, efficient, or impactful outcomes.
- Another third referred to improving internal processes, including investing in staff, development more inclusive practices, improving marketing, and creating more robust databases and information technology systems.
- The rest of the strategies involved improving communication, such as improved website and better utilization of market research to reach the target audience, with a small subset including improved stakeholder engagement.

- It is challenging to communicate effectively about complex science and statutes. When we ignore this challenge, we can leave people feeling confused, frustrated and upset. When we embrace it, we can help people feel informed, respected and engaged.

Plans reviewed

<placeholder>

Acronyms

TO BE DEFINED AT A LATER DATE

ADA

AIS

AMT

BMPs

BOD5

BWSR

CEC

Chl-a

DNR

EQB

EWR

FC

HRL

MDA

MDH

MnDOT

MPCA

MSP

NGO

NH3

NPS

RMZ

SGCN

SNA

SWCD

TP

TSS

2020-2026 Strategic Planning – Scan Documents

Entity	Document Title
BWSR	Strategic Plan 2017 Refresh
BWSR	Wetlands Restoration Strategy: A Framework for Prioritizing Efforts in Minnesota (2009)
DNR	Minnesota State Parks and Trails: Direction for the Future 2011
DNR	Minnesota State Management Plan for Invasive Species (2009)
DNR	Invasive Species 2018 Annual Report
DNR	Minnesota's Wildlife Action Plan 2015-2025
DNR	Scientific and Natural Area Strategic Land Protection Plan 2014
DNR	Minnesota's State Comprehensive Outdoor Recreation Plan 2014-2018
DNR	Groundwater Management Program Strategic Plan 2013
DNR	Division of Parks and Trails Strategic Plan 2012-2022
DNR	Ecological and Water Resources Division Strategic Plan 2018-2028
DNR	North American Waterfowl Management Plan (2018)
DNR	MN Wildlife Action Plans 2015-2025
DNR	Managing Minnesota's Shallow Lakes for Waterfowl and Wildlife (2010)
DNR	Fisheries Management Long-Range Plan 2005
DNR	Fish Habitat Plan 2013
DNR	Aquatic Management Area Acquisition Plan 2008-2033
DNR	Minnesota Prairie Conservation Plan 2013
DNR	DNR 10 year Strategic Conservation Agenda (2015-2025)
DNR	Parks and Trails Legacy Plan 2011
EQB	Five Year Strategic Plan (2018)
EQB	2015 EQB Water Policy Report
EQB	Climate Solutions and Economic Opportunities
EQB	Environment and Energy Report 2019
Freshwater Society	Minnesota's Groundwater: Is our use sustainable? (2013)
Freshwater Society	Water Reuse Workshop Proceedings Report (2016)
Friends of the Mississippi River	State of the River Report 2016
MDA	Minnesota Pesticide Management Plan: A Plan for the Protection of Groundwater and Surface Waters (2007)
MDA	Minnesota Nitrogen Fertilizer Management Plan 2015
MDA	Minnesota Noxious Weed Advisory Committee
MDA	Minnesota Nitrogen Fertilizer Management Plan (2015)
MDH	Protecting groundwater-sourced drinking water (2016)
MDH	Advancing Safe and Sustainable Water Reuse in Minnesota 2018 Interagency Report on Water Reuse
MDH	Lead in Minnesota Water: Assessment of Eliminating Lead in Minnesota Drinking Water (2019)
MDH	The Minnesota Climate and Health Strategic Plan 2019

Entity	Document Title
Metropolitan Council	2040 Regional Parks Policy Plan
Metropolitan Council	2040 Water Resources Policy Plan
Minnesota Aquatic Invasive Species Research Center	MAISRC Strategic Plan 2015-2025
MN Forest Resources Council	Priority Research to Sustain Minnesota's Forest Resources (2019)
MnDOT	Minnesota GO 50-year Vision for Transportation (2011)
MPCA	Minnesota non point source management Program Plan 2013
MPCA	Nitrogen in Minnesota's Surface Waters 2013
MPCA	Minnesota Nutrient Reduction Strategy 2014
MPCA	Metro Solid Waste Management Policy Plan 2016-2036
MPCA	Minnesota's Clean Water Roadmap 2014
MPCA	MPCA Strategic Plan 2018-2022
Partners in Flight	Landbird Conservation Plan 2016
Prairie Pothole Joint Venture	2017 Prairie Pothole Joint Venture Implementation Plan
The Nature Conservancy	Resilient Sites for Terrestrial Conservation in the Great Lakes and Tall Grass Prairie Region (2018)
The Nature Conservancy	Mississippi Headwaters Multiple Benefits for People and Nature
Upper Mississippi River and Great Lakes Region Joint Venture	Waterbird habitat conservation strategy 2018
Upper Mississippi River and Great Lakes Region Joint Venture	Waterfowl Habitat Conservation Strategy 2017
Water Resources Center	Minnesota Water Sustainability Framework (2011)
Water Resources Center	Water Resources Center Strategic Plan (2018)
Water Resources Center	Stormwater Research Roadmap for Minnesota (2018)