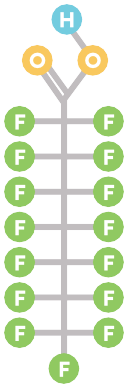
Summary

Preventing PFAS pollution

Background



- Pollution prevention (P2) approaches are designed to **reduce exposure** to toxic chemicals and **prevent the need for expensive treatment and remediation efforts**.
  - P2 approaches can be **regulatory or voluntary**. Examples include manufacturers reformulating products to eliminate or minimize use of toxics or consumers purchasing products with safer, less persistent alternatives.
- P2 approaches are especially important for managing PFAS: all PFAS are resistant to environmental degradation or transform to PFAS that are persistent in the environment.
  - Continued use of PFAS results in **increased loading to the environment**, making it more likely that, over time, PFAS reach levels associated with toxic effects in humans and damage to ecosystems.
  - PFAS **concentrate in effluent, biosolids, landfill leachate, and composting contact water**. Removing PFAS using **treatment technology** requires cutting-edge, complex, multi-step processes that are often **cost prohibitive** for the businesses and municipalities that operate waste facilities.
  - Because **PFAS are resistant to destruction**, treatment and management strategies often remove PFAS from one media only to transfer them, along with their risks and potential liabilities, to another.
- Chemical use regulations mainly occur at the federal level. EPA regulates chemicals under the **Toxic Substances Control Act** (TSCA), which was passed in 1976 and significantly amended in 2016. The TSCA amendments were intended to place responsibility on chemical producers to prove new chemicals are safe **before** they can be registered for use.
  - Many PFAS were registered prior to the 2016 TSCA amendments, and **limited to no data on toxicity** to humans or ecosystems are available. However, even under the new TSCA rules, many PFAS are **continuing to be registered for use** without publicly available environmental safety information.
- There are many **challenges** in implementing P2 policies for PFAS.
  - PFAS is a broad class of compounds used in many industries – some estimate **thousands could exist in the environment** – and available analytical methods measure only a small portion of total PFAS.
  - Toxicity, use, and release data for many PFAS are considered "**confidential business information**," and are often not available to the public.
  - **Some PFAS uses are essential** for functions in society (for example, PFAS uses for protective equipment used by medical professionals), increasing the importance of nuanced and tailored regulatory approaches.

What is Minnesota doing now?

- Minnesota has banned the use of PFAS-containing firefighting foams for training or testing purposes, and is working with fire departments and others to encourage use of fluorine-free firefighting foams (F3) during emergencies.
- MPCA has amended state contracts (used by agencies, universities, cities, counties, municipalities, and non-profits) to **remove compostable products containing PFAS**.

What are remaining gaps and opportunities for action?

Filling gaps to better support preventing PFAS pollution would require legislative action for agencies to gain new authorities or secure additional resources. The opportunities described below are ideas – based on successes implemented in the past for other compounds (DDT, Polychlorinated biphenyls (PCBs), etc.) or implemented for PFAS in other states and international agencies – that would require additional planning and discussion before they could be moved into action.

- **Gap**: In many cases, PFAS are not providing an essential purpose and could be banned without significant impact to society (i.e., PFAS used in ski wax or food packaging).
  - **Opportunity**: Lawmakers could ban PFAS uses that are currently known to be non-essential, such as PFAS used for food packaging. Additionally, MPCA could create a workgroup that would further define "essential," "substitutable," and "non-essential" uses of PFAS. With the recommendations of this workgroup, legislators or regulators could more easily devise a strategy for tackling PFAS pollution prevention based on the "essential use" framework.
- **Gap**: Currently, many businesses and consumers are using PFAS-containing products but are not aware that they are doing so, or are not aware of the potential health risks and liabilities associated with them.
  - **Opportunity**: MPCA could consider proposals for mandatory labeling of PFAS in products, which would help business owners and individuals make environmental, health-conscious, and business-friendly purchases while encouraging manufacturers to pursue alternatives to PFAS.
  - **Opportunity**: MPCA could provide technical and financial assistance to business to reduce PFAS pollution. Existing frameworks (e.g. MnTAP, Small Business Grant Program) could be expanded to implement PFAS reduction strategies.
- **Gap**: Government agencies and other groups using state purchasing contracts have significant spending power and can model environmentally-friendly supply chain practices. Many materials purchased using these contracts contain PFAS.
  - **Opportunity**: Minnesota could remove all products with PFAS serving a non-essential use from state purchasing contracts.

How does this work benefit human health and the environment?

- Discouraging PFAS use subsequently **reduces opportunities for PFAS exposure**, which improves the health of humans and the environment.
- Pollution prevention techniques **improve health of workers** in businesses with PFAS use and reduces exposures in other vulnerable groups with the highest pollution burdens.

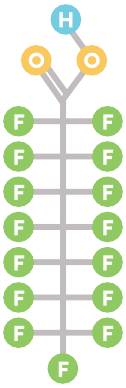
How does this work benefit Minnesota's economy?

- P2 strategies reduce liability for businesses and reduce the need for costly site clean-ups.
- PFAS alternatives may be better and cheaper, potentially improving profitability for businesses.
- Waste facility operators have limited ability to control PFAS inputs. P2 measures decrease loading of PFAS to waste facilities, and ultimately to the environment.
- Farmers across the country have been burdened with PFAS contamination of milk, livestock, and produce despite having no intentional PFAS uses on their land. P2 measures protect farmers by reducing PFAS levels in biosolids, animal feed, surface water, soil, and groundwater.

Summary

Measuring PFAS effectively and consistently

Background



- The first step in managing pollution is understanding which pollutants occur in the environment, where, and at what levels. This work requires **effective sampling techniques** and **established analytical methods**.
- If methods are not available or if detection limits make it impossible to determine if PFAS are exceeding protective levels, it presents **challenges to risk assessment and regulation**.
- Although early focus on PFAS method development was on drinking water, **there are now PFAS methods for multiple media** -- several new EPA methods are also in development.
  - The **Public Health laboratory** at MDH is capable of measuring PFAS in multiple media, including biological matrixes, soils, and water.
  - Agencies can also contract with private **commercial labs** to run analyses for PFAS.
  - Costs associated with PFAS analysis are generally **$300** - **$400 per sample**.
- Despite progress in method development, it is not possible to quantitatively measure the vast majority of PFAS – **available methods represent less than 1% of all PFAS in the environment**.
  - **Knowing what to look for**: Many new PFAS are currently being designed by chemical companies and registered for use at the EPA – information about these compounds is often considered "confidential business information" and not publicly available.
  - **Designing new approaches**: Developing new PFAS methods is time consuming and uncertain. Some new ideas and techniques are successful, but many fail. It can be difficult to predict how much time developing a new method will take and the detection limits a method will be able to achieve.
  - **Measuring at levels relevant to human and environmental health**: As toxicologists learn more about PFAS toxicity, health protective concentrations have decreased, sometimes to levels below what analytical methods can reliably detect.

What is Minnesota doing now?

- MDH's Public Health Lab (PHL) continues to **develop and improve** PFAS analytical methods.
  - PHL developed a simple PFAS method for **drinking water** and **groundwater**, created PFAS methods for **dust**, **soil**, and **vegetables**, and developed and improved methods to measure PFAS in **blood serum**, **plasma, and breastmilk**.
  - PHL **validated the newest EPA drinking water method** for PFAS (EPA Method 533), which will allow PHL to support testing for the next round of EPA-mandated drinking water monitoring (UCMR5).
- MPCA and MDH have multiple efforts underway to ensure consistent and accurate PFAS analytical results, whether work is done by Minnesota staff or others.
  - MPCA is collaborating with EPA Office of Research and Development (ORD) on **PFAS sample collection strategies**.
  - MPCA continues revising the **PFAS Analytical Guidance document**.
  - MPCA and MDH are considering changing the way that labs are accrediated for PFAS in the MDH lab accreditation program (MNELAP).

What are remaining gaps and opportunities for action?

- **Gap**: With potentially thousands of PFAS occurring in the environment, the vast majority of PFAS are not currently included in analytical methods. Further, it is difficult to know which PFAS should be targeted for method development – companies are not required to report the PFAS they produce or use in all cases, and if the information is reported to EPA, it is often protected as "confidential business information" and not released.
  - **Opportunity**: A technique called non-targeted analysis allows researchers to identify hundreds of chemicals in a sample at one time. Increasing availability and accessibility to non-targeted methods in public labs would help prioritize method development, improve site investigations, and generally improve the understanding of the entire landscape of PFAS mixtures present in environmental media.
  - Non-targeted analysis requires technical and laborious data processing, as well as instruments that are in high demand for many competing projects. Increasing capabilities for non-targeted analysis could require purchasing or renting additional instruments and hiring of staff with expertise in non-targeted methods for PFAS.
- **Gap**: The current toolbox of analytical methods is effective at measuring a discrete number of PFAS at low detection limits. Other tools may be more cost-effective and efficient in contexts where precise measurements of many PFAS analytes are not necessarily required.
  - **Opportunity**: Minnesota could consider researching and possibly adopting screening methods for PFAS in public labs.
  - Aggregate PFAS methods measure groups of PFAS and have been applied in scenarios like screening-level analysis of environmental media or in rapid analysis to determine if PFAS is present in a consumer product. Examples of aggregate PFAS methods include total organic fluorine (TOF) analysis and particle induced gamma emission analysis (PIGE). Total oxidizable precursor (TOP) analysis measures the increase in some terminal PFAS degradate concentrations in a sample after precursors are chemically transformed, which provides total PFAS precursor concentrations for those terminal degradates.
  - Another option for PFAS screening methods could involve developing simple PFAS methods that are faster and cheaper to run at scale than existing methods, but look for a small number of PFAS likely to be risk-drivers in a given site (often analytes like PFOS, PFOA, and PFHxS).

How does this work benefit human health and the environment?

- The ability to measure PFAS allows MDH and MPCA to **identify exposures,** which is necessary to protect human health and prevent negative environmental outcomes.

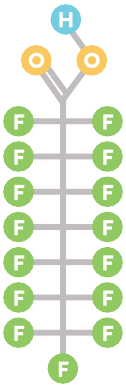
How does this work benefit Minnesota's economy?

- In-house method development allows Minnesota agencies to **design methods relevant to the state**, which can save time and money during research projects or site investigations.
- Getting ahead of issues of environmental releases by monitoring for PFAS with advanced methods would allow MPCA to be **proactive**, potentially preventing PFAS emissions before costly remediation efforts are needed

Summary

Quantifying PFAS risks to human health

Background



- **Risk assessments** are needed to ensure that the regulations or interventions controlling levels of contaminants in water, soil, air, or other media are protective of the community's health.
- Many PFAS occurring in environmental media **do not have enough toxicity data** to conduct risk assessments – EPA and other international regulators have allowed persistent compounds like PFAS into commerce without first requiring chemical producers to conduct and report sufficient toxicity testing or even publicly reveal the chemical structure.
- Despite challenging data limitations, **MDH developed health-based values for five PFAS** (PFOA, PFOS, PFHxS, PFBA, and Perfluorobutane sulfonate [PFBS]) and is currently reviewing a sixth, PFHxA.
- Existing risk assessments for PFAS have indicated they have **many toxic effects**, impacting **multiple organ systems**. Toxic effects can occur during sensitive life stages like pregnancy and early-life development. These effects have been observed in laboratory-based animal studies and epidemiological studies conducted in exposed communities.
- Health-based values derived by MDH for drinking water assessments are also used by MPCA to develop risk assessments for other media, such as **surface water, fish tissue, and soils**.
- There are many **challenges** to conducting additional risk assessments for PFAS.
  - Many PFAS do not have widely available **analytical methods** to quantify their concentrations in water, soil, sediment, or air.
  - Most PFAS have **significant data gaps** in toxicological information that preclude the derivation of risk-based values.
  - The **scientific literature regarding PFAS toxicity and occurrence is evolving rapidly**; MDH is conducting ongoing literature searches to identify if new data warrant revising existing risk assessments. This is a significant effort.

What is Minnesota doing now?

- MDH **continues to revise** the existing PFAS toxicity assessments as new information becomes available.
- MDH is also evaluating exposure and toxicity data availability for **new PFAS nominated through the Contaminants of Emerging Concern (CEC) Initiative** process.
- MDH has established formal **collaborations with scientists from EPA's Office of Research and Development** to identify how New Approach Methodologies (NAMs) could potentially advance our understanding of PFAS risks to humans.
  - Collaboration includes **developing alternative risk assessment methodologies** and testing these methods to see if they are useful in providing risk context for data-poor PFAS that may be occurring in Minnesota.
  - NAMs can be used to **prioritize PFAS for review** and to conduct **screening-level toxicity or exposure assessment**.
- Staff from Minnesota continue to **collaborate with risk assessors in other states** through the Great Lakes PFAS Taskforce and other inter-state information sharing organizations to leverage each other's work on quantifying PFAS risks to humans.

What are remaining gaps and opportunities for action?

- **Gap**: PFAS are found in air. There are currently no health-based air guidance values from federal agencies and a limited number from state sources. Inhalation-based PFAS studies are limited; the absorption, distribution, metabolism, and elimination of volatile PFAS are poorly understood.
  - **Opportunity**: MDH could conduct systematic literature reviews every six months to compile data relevant to PFAS inhalation routes and determine if inhalation risk assessments are possible with the remaining data gaps.
- **Gap**: Repeat-dose animal studies for most PFAS are not available. Similarly, there are not sufficient exposure data for most PFAS to understand the likelihood of exposure from various routes, such as through drinking water, fish, other food, products, or air.
  - **Opportunity**: New authorities to request data from entities using or producing PFAS could help fill gaps in exposure and toxicity information. These new authorities would require legislative action.
  - **Opportunity**: Continuing to partner with multiple teams of scientists in EPA's Office of Research and Development could help MDH capitalize on new research projects to understand PFAS toxicity and exposure.
- **Gap**: Though previous studies measured PFAS levels in the blood of East Metro residents exposed through drinking water, MDH has not conducted an epidemiological study aimed at understanding how PFAS exposure relates to adverse health outcomes.
  - **Opportunity**: Funding for MDH to conduct an epidemiological-based health study in the East Metro.

How does this work benefit human health and the environment?

- Understanding the thresholds at which adverse effects from PFAS exposure are unlikely to occur allows for **health-protective guidance and regulation**. This guidance or regulation can then be implemented to ensure that interventions take place if there are potential health risks to the community.
- Minnesota has **in-house expertise** to develop risk-based values – this allows agencies to develop guidance for contaminants that are specifically relevant in our state and not to wait for the many years that it often takes for EPA to publish new risk assessments.
- Given the lack of toxicity and exposure data for nearly all PFAS found in the environment, exploring new approach methodologies for **contextualizing PFAS risk** will help prioritize PFAS for additional research and potentially allow for development screening-level toxicity assessment.

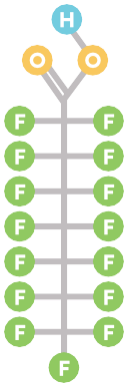
How does this work benefit Minnesota's economy?

- **Preventing adverse physical health outcomes** associated with PFAS exposure and **preventing negative mental health outcomes** associated with concern over exposure to these compounds is financially beneficial for families and individuals.

Summary

Limiting PFAS exposure from drinking water

Background



- **Minnesotans value safe and sufficient drinking water** – when PFAS pollution is discovered, the first questions from the community are frequently about the safety of their drinking water.
- Historic disposal of PFAS waste in the East Metro caused PFAS contamination of drinking water, affecting over 174,000 Minnesotans. Temporary treatment systems were put in place to reduce PFAS concentrations at impacted drinking water supplies -- efforts to remediate this contamination and implement long-term drinking water supply plans are ongoing.
- Over time, decreases in detection limits for PFAS and improved understanding of PFAS toxicity have contributed to the realization that many PFAS are **ubiquitous in the environment** and that some PFAS are **toxic at low doses**.
- PFAS **contamination in drinking water is not limited to waste sites associated with PFAS manufacturers** – drinking water impacts associated with use of PFAS-containing firefighting foam and industrial activities have been discovered.
- Federal and state regulations align to protect water consumers. On the federal level, drinking water monitoring and regulation falls under the SDWA.
  - Though MDH has health-guidance values for five PFAS, there are currently **no federal or state drinking water standards for PFAS** (i.e. Maximum contaminant level [MCLs]).The process for federal rulemaking under SDWA has begun for PFOA and PFOS. Based on statutory deadlines in SDWA, implementation of the proposed regulations would likely begin in 2025.
  - Because there are no SDWA standards for PFAS, water systems may not be prioritized by the **Drinking Water Revolving Fund**, which provides below-market-rate loans and grants for improving or constructing treatment systems.

What is Minnesota doing now?

- MDH is prioritizing **monitoring drinking water** for PFAS – this effort fills gaps left by federally-required monitoring for PFAS.
  - MDH has planned and ongoing monitoring efforts in place that will cover **at least 90% of people served by community water systems by 2025**. This effort is expected to require at least $10-15 million in resources for sampling, analysis, and follow-up action.
  - MPCA and MDH work with property owners to **test private wells** in areas with known groundwater PFAS contamination. Minnesota has collected over 20,000 samples from approximately 4,000 private wells and continues to receive requests for sampling.
- If concentrations of PFAS are found in drinking water that exceed MDH guidance values or the Health Risk Index based on guidance values, MDH works with drinking water systems or private well owners on appropriate **next steps to reduce exposure**.
- MDH **continuously updates communication materials** related to PFAS and drinking water to ensure clear, complete, and up-to-date scientific information is included.
- MPCA has included PFAS in two rounds of monitoring in the Ambient Groundwater Well Network, which provides an **early warning system for PFAS migration into drinking water aquifers**.
- MPCA and MDH are continuing to collaborate on potential drinking water impacts at known or likely PFAS-contaminated sites.

What are remaining gaps and opportunities for action?

- **Gap**: Reducing or eliminating ongoing sources of PFAS to waterbodies used as drinking water supplies prevents the need for costly interventions like installing drinking water treatment systems for PFAS.
  - **Opportunity**: MPCA can revise the Class 1 Water Quality Standards, which protect drinking water sources from pollution, to include PFAS. These revisions would allow MPCA to set limits for permittees discharging PFAS to waters used as a source for drinking water.
- **Gap**: The past and ongoing initiatives to monitor drinking water systems for PFAS will capture at least 90% of all community water consumers by 2025, but not all consumers.
  - **Opportunity**: Expanding drinking water monitoring to all community water systems or monitoring planned systems faster would require additional funding and lab capacity.
- **Gap**: Twenty-one percent of Minnesotans (~1.2 million people) get drinking water from a private well, and currently private well monitoring only occurs near sites with known PFAS groundwater contamination.
  - **Opportunity**: As the Pilot PFAS Inventory Project (*see* the Remediation PFAS-Contaminated Sites Issue Paper) and drinking water monitoring efforts identify new PFAS plumes, additional funding may be needed to identify impacted private drinking water wells. Funding to include PFAS in annual monitoring of the Ambient Groundwater Monitoring Network would additionally help identify impacted or vulnerable aquifers.
- **Gap**: There are not currently drinking water standards (MCLs) for PFAS.
  - **Opportunity**: MDH could evaluate options for managing risks from federally unregulated contaminants, including PFAS. Federal rulemaking for PFAS drinking water standards has begun, but would not be completed until 2025.

How does this work benefit human health and the environment?

- Monitoring for PFAS in drinking water has the direct benefit of promptly **reducing PFAS exposure** with appropriate interventions if levels exceed those thresholds and **reducing consumer anxiety** about exposure if levels are below health-based thresholds.
- Drinking water monitoring **informs investigations** into sources of PFAS, which can sometimes result in cost recovery from parties responsible for the pollution.
- Reducing PFAS emissions to source waters for drinking water prevents harmful exposure to humans, but also **reduces exposure for fish and wildlife** using those waterbodies.

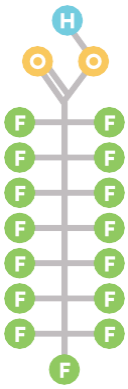
How does this work benefit Minnesota's economy?

- Well-developed regulations for PFAS ideally **place the cost burden of PFAS controls with polluters** rather than imposing those costs on drinking water utilities and the general public.
- Safe and trusted drinking water is crucial **to business development** in Minnesota and growth in the **housing market**.
- **Preventing adverse physical health outcomes** associated with PFAS exposure and **preventing negative mental health outcomes** associated with concern over exposure is financially beneficial for families and individuals.

Summary

Reducing PFAS exposure from consuming fish and game

Background



- **Hunting and fishing are cherished activities** in Minnesota, with long-standing cultural significance for many populations. In some cases, locally harvested fish and game are relied on as healthy sources of protein and a **key component of a family's diet**.
- Nearly all of Minnesota is ceded territory, and members of **tribal nations retain hunting, fishing, and gathering rights**.
- Continued research on PFAS in fish and wildlife has indicated that some PFAS can **accumulate in commonly consumed tissues of fish and game**, potentially to levels causing health concerns for those consuming the meat.
- Several agencies in Minnesota participate in **monitoring** PFAS in fish and game, **providing consumption advice**, and **regulating PFAS discharges** with the intention of removing the need for consumption advice in the future.
    - The Fish Contaminant Monitoring Program (FCMP) is an inter-agency group including staff from MDH, MPCA, and DNR that collects fish from lakes and rivers throughout Minnesota. The resulting fish tissue data is used to inform **scientific understanding of accumulation patterns** in fish, issue fish **consumption advice**, and develop **water quality standards** protective of fish consumers.
    - MDH is responsible for providing **statewide** and **site-specific fish consumption advice**.
    - Statewide advice is developed based on mercury and PCB levels found in fish harvested around the state. Site-specific advice is developed if local levels of PCB, mercury, or PFOS contamination warrant more restrictive consumption advice than would apply statewide.
    - MPCA can develop **statewide water quality standards** and **site-specific water quality criteria** protective of fish consumers under the CWA.
    - There are no statewide water quality standards for PFAS, but there are site-specific water quality criteria in waterbodies with known PFAS contamination, including in the East Metro region.
    - The DNR can conduct monitoring of PFAS in commonly consumed game, as funding and capacity allows.

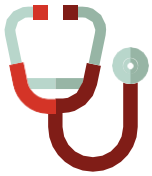
What is Minnesota doing now?

- **Monitoring**: The FCMP has monitored for PFAS in fish from 178 lakes and 12 rivers, but does not include PFAS as part of routine analysis of fish collected in the monitoring program. Additionally, the DNR is conducting a pilot project to monitor PFAS levels in deer harvested in regions with known PFAS surface water contamination.
- **Advice**: The MDH has provided site-specific fish consumption advice for PFOS in some waterbodies.
- **Regulation**: MPCA has issued site-specific water quality criteria for PFOS protective of fish consumers applicable to waterbodies with known PFAS surface water contamination.

What are remaining gaps and opportunities for action?

- **Gap**: The Interagency FCMP collects fish from lakes and rivers throughout Minnesota. Though this group has conducted some PFAS analyses through this monitoring program, funding has not been available to routinely include PFAS widely in monitoring efforts.
  - **Opportunity**: Sustained ongoing funding for monitoring PFAS in fish would provide updated fish contaminant data for the impaired waters inventory (MPCA) and fish consumption guidance (MDH).
- **Gap:** There is limited information about PFAS concentrations in edible tissues of game, especially game harvested near areas with surface water or soil PFAS contamination.
  - **Opportunity**: DNR could continue the existing pilot monitoring project underway for PFAS in deer. DNR, MDH, and MPCA would work together to determine the need for consumption advisories depending on the result of this monitoring work.
- **Gap:** Despite efforts to phase some PFAS, such as PFOA and PFOS, out of production, discharges of these PFAS and others continue.
  - **Opportunity**: MPCA could consider the need for a statewide water quality standard for PFAS, prioritizing PFAS that are especially bioaccumulative and toxic to humans.
    - After development of a standard, implementation needs to be considered – particularly for pollutants like PFAS that are difficult to treat and where standards are likely to be very stringent.

How does this work benefit human health and the environment?



- Understanding PFAS levels in fish and game, providing advice to consumers about safe levels of consumption, and applying regulations to dischargers to prevent further contamination all contribute to **ensuring that people are not exposed to harmful levels of PFAS**.
- Work done to protect human consumers of fish and game has the **ancillary benefit to helping to prevent wildlife exposures**.
- **Fish consumption is beneficial for our health** – regulations on dischargers of bioaccumulative pollutants like PFOS help encourage consumption of fish by ensuring surface waters used for fish harvesting are free of harmful levels of toxins.

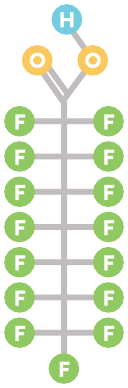
How does this work benefit Minnesota's economy?

- The **commercial fishing and game industries** in Minnesota benefit from work done to ensure fish, deer, and waterfowl do not accumulate harmful levels of PFAS.
- **Tourism related to recreational hunting and fishing** also supports some to local economies, which would benefit from ensuring safe consumption of fish and game.
- Fishing and hunting provide a **healthy and inexpensive source of food** for many families.
- **Preventing adverse physical health outcomes** associated with PFAS exposure and **preventing negative mental health outcomes** associated with concern over exposure to these compounds is financially beneficial for families and individuals.

Limiting PFAS exposure from food

Summary

Background



- Minnesotans should have confidence that their food is **free from harmful toxins**.
- Data collected by the Food and Drug Administration (FDA) and others indicate that widespread PFAS contamination of food products is not occurring in the US. However, if the environment where food is grown or raised has PFAS contamination, this **PFAS can accumulate into vegetables, grains, meat, and dairy products**.
  - Generally, foods with the highest PFAS concentrations are fish and game (especially organ meat) harvested from areas with PFAS contamination. For this reason, there is a separate issue paper on ensuring safe consumption of fish and game harvested in Minnesota. **This paper focuses on PFAS in food systems broadly**.
  - There is a wide range of potential exposure to PFAS from food based on individual consumption habits and geographic proximity to PFAS sources.
- There are multiple avenues by which PFAS can contaminate food. PFAS can accumulate in produce and livestock from **contaminated water, biosolids, air, soil, or animal feed** or migrate into food from **PFAS-coated cookware** and **food packaging**.
  - Though most produce, meat, and dairy does not contain detectible levels of PFAS, there have been several examples of **farms around the US forced to shut down** operations after realizing that PFAS contamination on their property was resulting in accumulation in food.
  - FDA's **regulation of food contact materials considers direct exposure** due to migration of the PFAS from the food contact material to the food – it does not consider risks associated with environmental releases (including releases to farmlands) following disposal of such food contact materials.
- After public concerns over exposure to the PFAS 6:2 fluorotelomer alcohol FTOH, FDA recently negotiated a phase-out of its use in food packaging.
  - Containers used to store and transport pesticides can contain PFAS. Pesticide active ingredients and inert materials used in Minnesota are not known to contain PFAS.

What is Minnesota doing now?

- Assessed risks from produce grown in home gardens
  - MPCA partnered with MDH to conduct a study of PFAS levels in exterior tap water, garden soil, and garden produce of homes in the East Metro to determine the extent to which current or past use of contaminated water for irrigation influenced levels of PFAS in garden soil and homegrown produce. This study concluded that there were no health risks associated with consuming homegrown produce.
- Investigated the presence of PFAS in pesticides used in Minnesota
  - In 2007, the MDA examined pesticide active and inert ingredients as a potential source of PFAS. Based on the information received from the EPA and the Minnesota pesticide registration database, MDA concluded that pesticides are not a significant source of PFAS. MDA was not aware of and did not consider any potential contribution from the pesticide containers.

What are remaining gaps and opportunities for action?

- **Gap**: Recent research shows that high levels of PFOS in milk may be possible if avenues of exposure to PFOS for dairy farms, and the animals on those farms, are not controlled. Because this is a relatively new discovery, livestock producers and associated industry stakeholders are not always knowledgeable about PFAS, including PFOS, and the potential paths of exposure to farms.
  - **Opportunity**: MDA could work with MPCA to identify and limit PFOS pollution in agricultural areas so that impacts to farms are limited. Voluntary free testing of feed, biosolids, or other potential upstream PFAS sources could encourage farmers to help proactively identify potential pathways for contamination. The goals of this work are not regulatory, but rather to expand knowledge and identify areas for future interventions that would protect farmers and food systems.
- **Gap**: While land application of biosolids has benefits for farming, land application has potential to contribute PFAS to groundwater, soil, surface water, crops, and, in some cases, livestock. These gaps in knowledge about PFAS fate and transport in biosolids make it difficult to proactively manage biosolids in a way that prevents contamination of food systems and protects farmers against the financial burdens associated with PFAS contamination.
  - **Opportunity**: With funding, MPCA could implement an existing proposal to 1) to evaluate and characterize PFAS concentrations in land-applied biosolids; leaching from those wastes; and subsequent movement of PFAS into water and food, and 2) to analyze alternative disposal and treatment options.
- **Gap**: Many studies have indicated that food packing is a source of PFAS exposure through food, but these products continued to be used around the country.
  - **Opportunity**: FDA has begun working with manufacturers to take voluntary steps to remove some PFAS from food packaging materials, Congress has banned the use of PFAS in food packaging for military meals, and many states and international groups have already mandated phase-outs of PFAS in food packaging. Minnesota could consider legislative action to ban the addition of PFAS to packaging, leveraging the policy research already completed by the Toxics in Packaging Clearing House and the existing laws in other states. These considerations could be part of a larger effort to review PFAS uses in consumer products or could be a standalone effort.

How does this work benefit human health and the environment?

- Collaborating with farmers to understand the ways that PFAS may be incorporated into food and **stopping PFAS loading from other industries to land and water used for agriculture** prevents PFAS concentrations from reaching levels that could result in significant accumulation in food.
- Preventing PFAS exposure from food packaging materials would have the direct benefit of **decreasing overall exposure to PFAS**, which lessens the likelihood of adverse health outcomes.

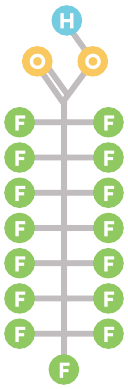
How does this work benefit Minnesota's economy?

- **Protecting agricultural businesses** from the financial impacts associated with PFAS contamination ensures that these businesses do not bear the burden of PFAS pollution caused by other industries.
- **Preventing adverse physical health outcomes** associated with PFAS exposure and **preventing negative mental health outcomes** associated with concern over exposure to these compounds is financially beneficial for families and individuals.

Summary

Understanding risks from PFAS air emissions

Background



- **Clean air is essential** for maintaining health of our communities, thriving ecosystems, and a sustainable economy.
- PFAS can exist in the air in multiple forms: PFAS can be a gas or attached to particulate material suspended in the air. Particulate and gaseous PFAS can transport long distances.
- PFAS emissions to air result in concerns over **toxicity to humans from inhaling PFAS** and **transfer of PFAS from air to other environmental media like soil, surface water, and fish**.
  - There is currently limited information about toxicity of PFAS from air exposure, and there are no PFAS screening values available from MDH or EPA.
  - There are multiple examples from Minnesota and other states of facilities emitting PFAS to the air that goes on to contaminate soil, surface water, and other media. For example, a recent study of PFAS emissions indicates that a single facility in New Jersey resulted in PFAS soil contamination as far away as New Hampshire.
  - New site-specific criteria for PFOS developed under the CWA indicate that very low levels of PFOS in surface water can result in PFOS accumulating in fish to concentrations exceeding health-based values – this generates concern that air emissions of PFOS could cause or contribute to water quality impairments for PFOS.
  - The ability of a single facility to pollute a widespread region with highly persistent and toxic compounds makes controlling PFAS emissions to the atmosphere an important element of the PFAS management strategy.
- The Clean Air Act (CAA) is the foundational law for protecting air quality in the US Under the CAA, EPA regulates emissions of 187 air toxics (called Hazardous Air Pollutants or HAPs).
  - PFAS are not included as HAPs under the CAA.
- Though there are currently no regulations on PFAS emissions to the air in Minnesota, there are mechanisms in the state and federal government to either **voluntarily request** or **mandate reporting on some PFAS emissions** from facilities that use or produce PFAS products.
- The federal Toxics Release Inventory (TRI) requires some facilities to report releases of listed contaminants. **PFAS were added to the TRI** list for reporting year 2020, but **exemptions will result in continued unreported PFAS releases**.
  - Emissions reporting is not required for PFAS considered “confidential business information,” and therefore the TRI only includes 172 PFAS.
  - Reporting is not required if the facility releases less than 100 pounds (~45,000 g) per year of PFAS-containing materials. (For comparison, it is estimated that 0.4 - 1 g/year of PFOS released from a metal plating site resulted in exceedances of a site-specific surface water criteria and a “do not eat” fish consumption advisory in a nearby lake).
  - Reporting is not required if the material released contains less than 1% PFAS or 0.1% PFOA.
  - Facilities employing fewer than 10 full-time staff are not required to participate in TRI reporting.
- MPCA requests that facilities **voluntarily provide emissions data every three years** on air toxics; MPCA uses this information to prepare the statewide air toxics inventory submittal to EPA’s National Emissions Inventory. This is separate from the federal TRI program.

What is Minnesota doing now?

- For reporting year 2020, **MPCA requested voluntary reporting of PFOS, PFOA, PFBS, PFHxS, and PFBA** to the Air Emissions Inventory as part of a larger request that facilities report on several contaminants not designated as HAPs under the CAA.
  - Not all facilities will participate in this voluntary reporting request for various reasons, which may include the costs associated with estimating emissions and preparing the report.
- MPCA is conducting a year-long PFAS monitoring project, which includes the collection of ambient air, wet deposition, and dry deposition samples at four sites across Minnesota.
  - One "background" air monitoring site is located in Grand Portage, and three urban sites (St. Louis Park, Eagan, and Duluth) are located near potential emission sources. These locations were chosen to increase our understanding of PFAS sources and atmospheric transport.

What are remaining gaps and opportunities for action?

- **Gap**: Despite recent progress in requiring mandatory reporting of PFAS releases to the EPA through the TRI, exemptions in this federal program will result in gaps in the PFAS release data.
  - **Opportunity**: MPCA could consider making air toxics (including PFAS) emission reporting mandatory.
  - **Opportunity**: MPCA could require permitted facilities to conduct performance tests for PFAS and report results.
- **Gap**: There is currently a lack of modeling capability to understand how PFAS emissions to the air influence surface water, soils, sediment, and fish in the surrounding region.
- **Opportunity**: Developing a model that includes cross-media considerations of exposure for persistent and bioaccumulative compounds, starting with PFOS, could be used to assess cross-media risks and fill gaps associated with unknown degrees of environmental loading from air.

How does this work benefit human health and the environment?

- Efforts to understand which facilities are releasing PFAS will help MPCA and MDH **prioritize investigations into drinking water, surface water, fish, and soil**.
- Having the tools to demonstrate how air emissions may cause exposures to humans through multiple routes may help MPCA develop future strategies to reduce emissions and health impacts.

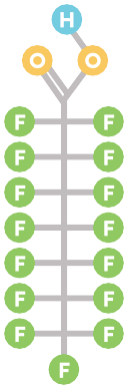
How does this work benefit Minnesota's economy?

- Reducing PFAS pollution by controlling PFAS releases from industrial sources **places the financial burden of PFAS controls with polluters.** This reduces the costs borne by waste and drinking water facilities -- many of which are publicly funded – who otherwise may need to manage and treat PFAS.
- Reducing PFAS pollution also prevents costs to consumers associated with decreased opportunities to harvest local fish and game that may be contaminated due to air emissions.
- Preventing adverse physical health outcomes associated with PFAS exposure and preventing negative mental health outcomes associated with concern over exposure to these compounds is financially beneficial for families and individuals.

Summary

Protecting ecosystem health

Background



- **Minnesotans value having healthy, diverse ecosystems** – protecting the environment includes protecting wildlife like birds, mammals, plants, and aquatic organisms against harmful pollution.
- Efforts related to PFAS pollution in Minnesota have **historically focused on protection of human health**, but there has been ongoing research into potential ecological impacts from PFAS contamination since the early 2000s.
- **Ecological risk assessments** establish levels of a contaminant in various ecological media that are unlikely to result in adverse impacts – the risk-based values derived in these assessments could be relevant to multiple sites.
    - EPA, Environment and Climate Change Canada (ECCC), MPCA, and other state agencies have conducted ecological risk assessments. For PFAS, ECCC has published an assessment for PFOS, and EPA has similar assessments underway for PFOA and PFOS.
    - MPCA Remediation Division programs' site investigations are conducted to determine the likelihood for adverse ecological effects. These investigations use risk-based values derived in ecological risk assessments, when available for PFAS, to compare against levels seen at the site. These risk-based values for ecological endpoints may be additionally used as clean-up values.
- MPCA also conducts ecological risk assessments as part of **standard or criteria development under the Clean Water Act** (CWA). The CWA is a federal law that allows states to protect surface waters by determining the beneficial uses of the waterbody and setting water quality standards (WQS) to protect those uses. Beneficial uses for waterbodies include sustaining aquatic life (**fish, aquatic insects, and aquatic-dependent wildlife**).
    - Deriving WQS protective of aquatic life and aquatic-dependent wildlife is generally not prioritized if values protective of other endpoints, like human health, would likely result in more protective WQS than those for aquatic life.
    - Should EPA publish the ecological risk assessment and corresponding recommended aquatic life criteria for PFOA and PFOS, MPCA would consider adopting those recommended criteria into Minnesota's WQSs.
- There are many **challenges** to conducting ecological risk assessments for PFAS.
    - With over 5,000 known structures in the PFAS family, **there are not ecological toxicity data for the vast majority of PFAS** that may be found in the environment.
    - For PFAS with ecological data available, conducting risk assessments using CWA methodologies requires **significant time from skilled staff**.
    - Outside of the CWA methodologies for conducing risk assessment for aquatic life, there are **not MPCA methods available** for risk assessments that derive risk-based values protective of **mammals or other non-aquatic wildlife** that could be impacted by PFAS releases to land or water.
- **New methods for ecological risk assessment** that rely on computational models or other predictive tools designed for the unique physical and chemical properties of PFAS are in development. These new computational methods could be an important resource for PFAS ecological risk assessment moving forward.

What is Minnesota doing now?

- MPCA has developed **site-specific WQC protective of aquatic life** under the CWA for PFOA and PFOS in Pool 2 of the Mississippi River.
- Minnesota has completed or provided funding for **multiple monitoring efforts** for PFAS in various ecological receptors.
  - MPCA monitored for PFAS in benthic invertebrates, which are important components of the aquatic food chain, along with fish, water, and sediment in Pool 2 of the Mississippi River. This data informed knowledge of **PFAS transfer from sediment and water into biota**.
  - MPCA provided funding for two separate studies monitoring **PFAS in birds**. One study measured PFAS levels in eggs of tree swallows nesting in Minnesota and Wisconsin and found that **increased PFAS levels were associated with decreases in reproductive success**. Another study monitored for PFAS in the blood of **Bald Eagle nestlings** in Minnesota.
  - MPCA is currently conducting analysis of **PFAS levels in aquatic animals, sediment, and surface water** as part of the work in the East Metro Area.

What are remaining gaps and opportunities for action?

- **Gap**: There is a lack of completed risk assessments for ecological health endpoints. The existing risk assessments that derived risk-based values for PFOA and PFOS protective of aquatic life in the Mississippi River were completed before new ecological toxicity data became available from federal agencies and academic researchers. Other PFAS do not have risk-based values available for use in WQS, Water Quality Criteria (WQC), or site assessment under the Superfund program.
  - **Opportunity**: The Aquatic Toxicity Profile (ATP) is a tool developed by MPCA to understand potential impacts of contaminants of emerging concern in the environment. MPCA could complete ATPs for as many PFAS as possible to prioritize complete risk assessment using CWA methodologies.
  - **Opportunity**: PFAS data collected by MPCA, MDNR, other state agencies, the EPA and international agencies like ECCC could be used to develop ecological risk screening values relevant to all local wildlife, not just aquatic organisms. These values would help guide clean-up efforts and inform the need for standards under the CWA.
  - **Opportunity**: Recent studies of what appeared to be naturally-occurring foams on surface water have revealed they contain high concentrations of PFAS. MPCA could investigate if PFAS-containing foam is causing acute ecological toxicity.

How does this work benefit human health and the environment?

- Conducting ecological risk assessment and site investigations provide the information needed to determine if there is potential for PFAS releases to cause adverse effects in wildlife, and react appropriately to protect those species.
- Healthy ecosystems improve the mental health and wellbeing of all Minnesotans.

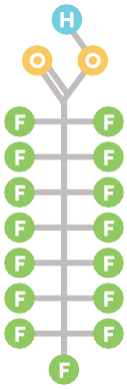
How does this work benefit Minnesota's economy?

- Healthy ecosystems provide opportunities for tourism and provide a strong basis for industries that rely on ecosystem services

Summary

Remediating PFAS contaminated sites

Background



- There are several state and federal programs that work together to identify sites with contamination, set remediation goals, and ensure that clean-up results in health-protective outcomes. These programs include the **federal Superfund** program, the **state Superfund** program, and the **state Brownfields** program.
- When it comes to PFAS investigation and remediation, **federal regulation is lacking**.
  - There has been **no action on the proposed EPA rule that would designate PFOA and PFOS as "hazardous substances"** under the federal Superfund law (CERCLA). Federal legislation designating all PFAS as "hazardous substances" has not advanced.
  - Though limited emission reporting requirements for PFAS went into effect for 2020 under the federal TTRI program, several exemptions allow **unreported PFAS emissions to continue**.
  - The **DoD would likely not accept Minnesota's health-based clean-up values for PFAS** as "applicable or relevant and appropriate requirements" (ARARs) at Department of Defense (DoD) sites in Minnesota unless they are promulgated in state rule – most of Minnesota's health-based clean-up values would not be considered as ARARs by the DoD.
- Under MERLA, PFAS meets the definition of a hazardous substance based on its properties – Minnesota currently has PFAS sites under investigation or in remediation and believes that there are **likely additional sites with PFAS contamination** due to historic or ongoing uses of PFAS.
- **Clean-ups are expensive and time consuming**. Efforts that stem PFAS pollution at the source can be expensive, but are essential for cost-effective management of PFAS in the environment.

What is Minnesota doing now?

- MPCA and MDH have **established health-based clean-up values** for several PFAS in multiple media.
  - MDH developed values for five PFAS that are protective of human health through groundwater exposure via **drinking water**.
  - MPCA developed site-specific water quality criteria for PFOS protective of human health through surface water exposure via **consumption of freshwater fish**.
  - MPCA developed values for five PFAS that are protective of human health through soil exposure via incidental **soil ingestion**.
- MPCA is **remediating sites associated with 3M disposal of PFAS**, including the widespread area of surface water and groundwater contamination in East Metro.
- MPCA is investigating and remediating sites associated with PFAS releases from **metal plating industries** and from uses of **PFAS-containing firefighting foam**.
- MPCA is collaborating with MDH on the **Pilot PFAS Inventory Project**.
  - This initiative aims to leverage existing monitoring data for PFAS, data on types of industrial activity occurring in Minnesota, and data on geologic susceptibility of aquifers to **prioritize sites for PFAS investigation**.

What are remaining gaps and opportunities for action?

- **Gap**: PFAS are not listed directly as hazardous substances under either CERCLA or MERLA.
  - **Opportunity**: Hazardous substance designation under CERCLA or MERLA would solidify existing authorities regarding PFAS to require responsible parties to clean up PFAS contamination and improve the state's ability to recover costs from responsible parties when they fail to act.
- **Gap**: There is incomplete data listing which entities use or produce PFAS that could be released to the environment.
  - **Opportunity**: Authority to allow the state to request information on environmental contaminants could help fill gaps in federal emission reporting requirements for PFAS.
  - **Opportunity**: Continuing to expand the Pilot PFAS Inventory Project would help identify the likelihood of finding PFAS contamination at existing sites and currently unknown sites.
- **Gap**: Though there are some existing health-based clean-up values for PFAS, additional guidance values would help ensure protective clean-up goals and prioritize sites for investigation.
  - **Opportunity**: MPCA could develop soil leaching to groundwater values and additional surface water values for PFAS with health-based values available.
- **Gap**: Some industries, like car washes and metal platers, may have widespread historic and ongoing uses of PFAS, and Minnesota may not have the resources to clean-up each impacted site.
  - **Opportunity**: Minnesota could explore options for ways to supplement the Remediation Fund should it be strained by an increase in PFAS sites without responsible parties.

How does this work benefit human health and the environment?

- Cleaning-up PFAS contaminated sites has the direct benefit of **reducing PFAS concentrations** in the water, soil, and sediments to safe levels for humans and wildlife.

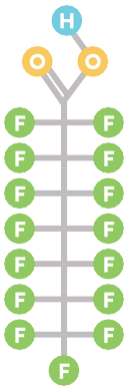
How does this work benefit Minnesota's economy?

- Conducting site investigations to determine responsible parties for contamination **places the cost burden of PFAS controls with polluters** rather than drinking water utilities and the general public, who would otherwise fund drinking water treatment or other remedial actions.
- Remediation and redevelopment of contaminated properties encourages **new businesses**, creates **jobs**, and results in an **improved tax base**.
- Drawing attention to the potential liabilities associated with PFAS release **encourages responsible use and management of PFAS,** which decreases the likelihood of continued environmental contamination and costly remediation efforts.
- **Preventing adverse physical health outcomes** associated with PFAS exposure and **preventing negative mental health outcomes** associated with concern over exposure to these compounds is financially beneficial for families and individuals.

Summary

Managing PFAS in waste

Background



- The term "waste" encompasses the things that we "throw out" or "wash down the drain" after they are no longer useful. Facilities collecting this waste, like composters, landfills, and wastewater treatment plants (WWTP), **also produce end products from treatment or disposal operations that must be managed**, such as leachate from landfills or biosolids from a WWTP.
- State and federal regulatory programs -- including the RCRA, the **Clean Water Act** (CWA), the **Clean Air Act** (CAA), and **Minnesota Solid Waste Rules** -- ensure that all waste is handled in a manner that minimizes damage to human health and the environment.
- Per- and polyfluoroalkyl substances (PFAS) pose challenges to our existing waste management systems. PFAS are **persistent** in the environment, **ubiquitous** in commercial and industrial products, **resistant to destruction**, and often **harmful to people** at low doses. There is not guidance regarding disposal of PFAS-containing waste.
- **Monitoring of PFAS** in leachate, ash, effluent, and biosolids shows that though these facilities do not use or produce PFAS, they can serve as a **conduit** for waste streams containing **high concentrations** of a **diversity of PFAS.** PFAS are often passed through to effluent, leachate, ash, and biosolids – the management of these pass-through end products can result in PFAS releases to the environment.
- Managing waste with PFAS is challenging because PFAS are resistant to degradation, causing them to **cycle between environmental media** and **waste management facilities**.
  - **Treatment technologies** used to remove PFAS **create new, concentrated PFAS end products**, which then need to be destroyed or landfilled. If PFAS are not completely destroyed, some PFAS will be released into the environment.
  - Treatment or destruction is more **difficult and expensive** when pollution is diffuse or combined with other co-contaminants -- treating leachate or effluent is generally more costly than treating concentrated PFAS waste from an industrial facility.
  - Manufacturers are not required to disclose if or how much PFAS are present in products, making it **difficult to track down sources** of PFAS in waste streams.
- Due to the propensity for PFAS to cycle through waste management facilities and the environment, the most strategic approach is to **prevent PFAS from entering waste streams** (*see* the Preventing PFAS Pollution issue paper).

What is Minnesota doing now?

- **Monitoring**: MPCA partnered with landfills, composting facilities, and WWTPs to conduct voluntary, one-time monitoring for PFAS (funded by MPCA). MPCA has also monitored for PFAS in the landfills managed by the CLP. If drinking water impacts are discovered during monitoring, MPCA takes remedial actions to reduce PFAS concentrations in drinking water to below the health-based values determined by MDH.
- **Research**: MPCA has approved a demonstration research project on landfill leachate treatment that is designed to remove PFAS before discharging treated leachate to a stormwater pond.
- **Regulation**: MPCA has required landfills and composting facilities land-applying leachate to monitor for PFAS. MPCA has issued site-specific Water Quality Criteria (WQC) for PFOS protective of fish consumers applicable to waterbodies with known PFOS surface water contamination – this will affect permittees discharging effluent to those waters.

What are remaining gaps and opportunities for action?

- **Gap**: Research is needed to understand the fate and transport of PFAS in land-applied biosolids and define the extent of known PFAS groundwater plumes at CLP sites.
  - **Opportunity**: MPCA could conduct a study to evaluate the fate and transport of PFAS contained in land-applied biosolids, which could provide the data needed to develop tools for making reasonable and responsible decisions regarding land-application of biosolids with detectable levels of PFAS.
  - **Opportunity**: Initial investigation of groundwater at closed landfills in the CLP showed PFAS levels exceeding health-based values at 55 locations – sometimes by a large margin. Access to funding sources would allow MPCA to fully investigate PFAS plumes to determine if remedial actions are needed.
- **Gap**: WWTPs, landfills, and composting facilities have struggled to identify and reduce PFAS sources to their facilities.
  - **Opportunity**: Identifying and reducing PFAS inputs to waste management facilities is a challenge. To address industrial sources, MPCA could support monitoring and discussions between WWTPs and their industrial PFAS sources, leveraging data from the industrial pre-treatment program in Michigan. To address PFAS loading to facilities from consumer products, pollution prevention policies are needed (*see* the Preventing PFAS Pollution issue paper).
- **Gap**: The science and regulatory status of PFAS is complex and rapidly evolving – there is limited guidance for facilities making management, treatment, and disposal decisions for products containing PFAS.
  - **Opportunity**: MPCA could develop guidance on options available for disposing of unused PFAS-containing firefighting foam and options for collecting and disposing PFAS-containing wastewater produced in an emergency.
- **Gap**: There is a lack of regulation regarding management of PFAS-containing waste.
  - **Opportunity**: Waste management facilities fall under various regulatory programs, and the "first step" in a process to begin assessment of and reductions in PFAS releases through permit conditions would also vary. MPCA could consider taking coordinated regulatory actions on PFAS in waste facilities, including:
    - Mandating monitoring of PFAS in groundwater at all permitted solid waste facilities, which would inform next steps to minimize PFAS in groundwater and surface waters.
    - Rulemaking to define PFAS as "hazardous waste" under RCRA, resulting in requirements on handling, storage, and disposal of concentrated PFAS.
    - Mandating monitoring of PFAS in effluent from WWTPs and conducting rulemaking to develop statewide WQS for PFAS, which would trigger the regular regulatory processes for development of effluent limits. MPCA would develop a path forward to assess, list, and address PFAS impairments.

How does this work benefit human health and the environment?

- Reducing PFAS discharges to surface water, groundwater, and soil from waste facilities **prevents harmful exposure** to humans and wildlife.

How does this work benefit Minnesota's economy?

- **Treating PFAS at the source** rather than in the outputs from (often publicly-owned) waste facilities places the financial burden with PFAS generators, encouraging innovative pollution prevention approaches and saving tax-payer money. These actions to limit PFAS releases from the source also **reduce Superfund liability** for businesses **and the likelihood of costly cleanups.**