



**REPORT TO THE
LEGISLATURE**

JANUARY 2024

Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) in Firefighting Turnout Gear

m MINNESOTA

Pollution Control Agency

Department of Health

Legislative charge

2023 Session Law, Chapter 60, Article 3, Section 32

(a) The commissioner of the Pollution Control Agency, in cooperation with the commissioner of health, must submit a report to the chairs and ranking minority members of the legislative committees and divisions with jurisdiction over environment and natural resources regarding perfluoroalkyl and polyfluoroalkyl substances (PFAS) in turnout gear by January 15, 2024. The report must include:

- (1) current turnout gear requirements and options for eliminating or reducing PFAS in turnout gear;*
- (2) current turnout gear disposal methods and recommendations for future disposal to prevent PFAS contamination; and*
- (3) recommendations and protocols for PFAS biomonitoring in firefighters, including a process for allowing firefighters to voluntarily register for biomonitoring.*

(b) For the purposes of this section, "turnout gear" is the personal protective equipment (PPE) used by firefighters.

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Foreword

Per- and polyfluoroalkyl substances (PFAS) are a class of thousands of manmade chemicals that have been widely used in industry and consumer products for several decades. They have attracted significant scientific and regulatory attention due to their ubiquity in the environment, resistance to breakdown, and adverse effects on human and ecological health. Because of the difficulty in treating PFAS or removing them from the environment, pollution prevention efforts are necessary to reduce human and environmental exposure to these chemicals.

The protective clothing worn by firefighters in Minnesota to enable them to perform their duties is commonly collectively known as turnout gear. Turnout gear currently in use in Minnesota and nationwide includes PFAS intentionally added to protect the turnout gear from degradation against certain exposures. Firefighters in Minnesota and nationwide have a higher incidence than the general public of adverse health effects that may be caused by exposure to PFAS. In 2023, the Legislature appropriated money to the Minnesota Pollution Control Agency and the Minnesota Department of Health to identify current turnout gear requirements, options for eliminating or reducing PFAS in turnout gear, current turnout gear disposal methods, recommendations for future disposal of turnout gear to prevent PFAS contamination, and recommendations and protocols for PFAS biomonitoring in firefighters, including a process for firefighters to voluntarily register for biomonitoring. The purpose of this project is to evaluate the risks of PFAS in turnout gear and develop implementable strategies to reduce those risks.

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Executive summary

Turnout gear currently in use in Minnesota and nationwide contains intentionally-added per- and polyfluoroalkyl substances (PFAS) that presents an exposure risk to firefighters during use and risk to the environment when disposed. In 2023, the Legislature directed the Minnesota Pollution Control Agency (MPCA) and the Minnesota Department of Health (MDH) to study turnout gear requirements and options for eliminating or reducing these risks, including consideration of voluntary biomonitoring of firefighters. The agencies divided this mandate between each agency's specialty knowledge, with the MPCA studying turnout gear standards and disposal and the MDH studying firefighter biomonitoring considerations.

The PFAS constituents of turnout gear currently in use in Minnesota and nationwide were added to enable the turnout gear to pass one test required under the current standards for minimum turnout gear performance. The standards for turnout gear performance were developed and implemented nationally through collaboration of sector representatives coordinated by a national consensus standards organization, the National Fire Protection Association (NFPA). Even if a state has not formally adopted the national consensus performance standards, the standards are recognized and nearly universally followed by firefighters, fire departments, and turnout gear manufacturers for reasons of safety, liability, consistency, and trust.

While not yet finalized, the current national turnout gear performance standards are being revised, with an expectation that the revised national standard will at least significantly reduce the need to use PFAS in turnout gear, and potentially may be able to be met by completely PFAS-free turnout gear. This revised standard is expected to be finalized in early 2024. The MPCA expects that turnout gear manufacturers will be able to implement the revised national standard soon after it is finalized, and that firefighters in Minnesota will reasonably be able to begin to purchase compliant turnout gear with significantly reduced levels of PFAS by 2024 or 2025. It is possible but not assured that compliant PFAS-free turnout gear might potentially be available in the same timeframe.

Under a separate current national consensus standard, turnout gear also has a limited service lifetime of only ten years. While not all fire departments in Minnesota are able to comply with that standard for funding reasons due to the high cost of each individual set of turnout gear, most do. The result is that, if fire departments purchase reduced-PFAS content turnout gear as it becomes available, under their normal replacement schedule, nearly all current PFAS-containing turnout gear will be phased out from Minnesota by 2035. The Legislature could choose to offer cost-sharing to accelerate the pace of replacement.

Legislative overview

In 2023, the MPCA received a onetime appropriation of \$500,000 from the Legislature to prepare a report, to include “...current turnout gear requirements and options for eliminating or reducing PFAS in turnout gear; and current turnout gear disposal methods and recommendations for future disposal to prevent PFAS contamination...”. Of this appropriation, \$250,000 could be transferred to the MDH to prepare “...recommendations and protocols for PFAS biomonitoring in firefighters, including a process for allowing firefighters to voluntarily register for biomonitoring...”. The Legislature did not at that time fund actual biomonitoring of firefighters.

This requirement is directed in the Laws of Minnesota 2023, Chapter 60; Article 1, Section 2, Subdivision 2, (r); and in Article 3, Section 32.

Background on turnout gear

Firefighters in Minnesota are exposed as an inherent part of their life-saving and property-protecting duties to environments that are immediately dangerous to life and health (IDLH) due to flame, heat, sharp and tearing elements, falling objects, toxic gases, vapors, fumes, liquid and solid chemicals, and environmental conditions. To enable them to perform the duties critical to the everyday safety and protection of the life and property of Minnesota's citizens, firefighters must wear personal protective equipment (PPE) uniquely designed, manufactured, and worn for maximum feasible protection against these risks.

Broadly for the purposes of this report, PPE worn by firefighters in Minnesota may be divided into three categories by the type of incident it is designed and worn for: structural firefighting, wildland firefighting, and special purpose firefighting and other incidents.

In reverse order, special purpose firefighting and other incidents includes aviation, refinery and major petrochemical manufacturing and terminal, military munitions, and hazardous materials. While any Minnesota firefighter may occasionally be called on to assist with these types of incidents, they are specialized enough that firefighters dedicated to these types of incidents will generally use PPE designed only for a particular type of hazard or firefighting in a particular incident. For example, the extremely high temperatures of burning aviation fuels combined with the need for working in or near an aviation crash results in a specialized PPE that protects the firefighter extremely well from radiant heat while being relatively lighter and less bulky than other firefighting PPE. However, these 'proximity suits' do not protect well against sharp or tearing elements, impact, or many liquid or solid chemicals, and are relatively less durable. Similarly, hazardous material entry suits protect the firefighter extremely well against liquid or solid chemicals and toxic gases, fumes, and vapors, but provide no protection against flame or heat. Collectively, PPE for special purpose firefighting and other incidents is worn by only a small minority of Minnesota firefighters for short but critical periods. While special purpose PPE could potentially contain PFAS in some levels, the MPCA was unable to find substantive research on this category. Combined with the relatively small amount of exposure that Minnesota firefighters have to this PPE, the MPCA believes that this category likely presents less immediate concern and was not included in this report.

Similarly, though most Minnesota fire departments engage in some wildland firefighting at some point during the year, wildland firefighting presents unique challenges met by its specified PPE, including light weight, ability to be worn continuously over extended periods, and suitability to be worn while performing many activities, while still providing flame resistance and protection from the elements. While wildland firefighting PPE could potentially contain PFAS in some levels, the MPCA was unable to find substantive research on this category. Combined with the relatively small amount of exposure that the large majority of Minnesota firefighters have to this PPE, the MPCA believes that this category likely presents less immediate concern and was not included in this report.

Structural firefighting, that is firefighting in and around buildings and similar situations, comprises the bulk of firefighting activity in Minnesota. The large majority of firefighters in Minnesota, including municipal, governmental rural, and volunteer non-profit organization-based fire departments, wear PPE for structural firefighting for nearly all their firefighting duties. Structural firefighting PPE, properly collectively titled the 'protective ensemble for structural firefighting', may sometimes be referred to as bunker gear, or most commonly in Minnesota, *turnout gear*, the term that will be used for this report.

Components of turnout gear and relative sources of PFAS

Turnout gear comprises multiple components to completely cover the firefighter and provide needed protection: coat, pants, boots, hood, helmet, gloves, and mask. Research to date nationally has focused primarily on turnout coats and pants. That data indicates that the primary known use of PFAS in turnout gear and thus source of related exposure to firefighters is in the coat and pants, which will be the focus of the remainder of this report. However, the National Institute of Standards & Technology (NIST) is currently investigating the prevalence and mobility of PFAS in firefighting gloves and hoods.

Today's turnout gear coats and pants have evolved to be very complex, multilayer and multifunctional protective suits. They are composed of three functional layers, two of which, the moisture barrier and thermal liner, are commonly permanently combined by sewing or bonding into a combined structural element. That combined structural element is then mechanically attached by zippers, snaps, and hook-and-loop fasteners inside the remaining layer, the outer shell, which functions as its own structural element.

For ease of critically-important cleaning after use and for maintenance, the two structural elements can be taken apart and reattached frequently during the lifetime of the turnout gear.

Outer shell

The outer shell shields the firefighter from flame and flash, as well as providing about one quarter of their protection against heat, mainly radiant. The outer shell protects against abrasion and sharp edges and provides splash protection from water, chemicals, and bloodborne pathogens.

Moisture barrier

The moisture barrier provides penetration protection from water, chemicals, and bloodborne pathogens, while retaining some breathability. It is relatively thin and fragile, and is typically sewn or bonded to the thermal liner below.

Thermal liner

Together with the moisture barrier, the thermal liner provides about three quarters of the firefighter's protection against heat, mainly conductive and convective. The thermal liner is also responsible for wicking sweat from the firefighter's skin and providing padding against impacts.

Each of these functional layers is then constructed of multiple sublayers, with varying materials and composition, depending on the manufacturer and preferences of the purchasing fire department:

Outer shell

Outer shells may be composed of one or a blend of many different high-strength, fire-resistant synthetic structural fibers, including Kevlar™, PBI™, Nomex™, and others. While these fibers do not typically include PFAS materials, many outer shells have PFAS-containing coatings applied to them, to increase chemical and bloodborne pathogens splash protection to the firefighter and provide ultraviolet (UV) exposure protection to the shell itself, which otherwise may degrade the structural fibers.

Moisture barrier

Moisture barriers may have a wide range of different constructions, but usually include a thin synthetic substrate of Kevlar™, PBI™, Nomex™, or similar fibers on which a barrier layer, often of Teflon™ or other heat-resistant PFAS-containing polymer, is bonded. They may also include the same or other nonwoven synthetic fibers either as an additional layer or embedded into the polymer. Finally, similar to the outer shell, some moisture barriers may also be treated with PFAS-containing coatings to increase the water, chemical, and bloodborne pathogen resistance of the moisture barrier.

Thermal liner

Thermal liners usually consist of a woven or pressed filament facecloth sewn to nonwoven batting or spun lace. The facecloth, which lies against the firefighter's skin, may often be composed of a mix of hydrophobic and hydrophilic fibers, to increase sweat wicking, oriented for low friction so entire turnout gear can slide over the body and not bind and bunch when firefighters need to move quickly. Most thermal liners do not contain any PFAS when new, but may absorb PFAS constituents from the upper layers during use and turnout gear cleaning.

The type and concentration of PFAS in new turnout gear varies with the manufacturer and materials selected. Current research suggests that PFAS may move around among the layers during the turnout gear's lifetime as a result of UV exposure, heat, physical wear, and cleaning.

Most fire departments in Minnesota use specialized cleaning equipment called 'extractors' that are very efficient at removing from the turnout gear dangerous toxins and carcinogens like smoke, soot, and liquid chemicals the firefighter may have been exposed to. Extractors do not remove PFAS intentionally incorporated into the construction of the turnout gear.

Based on a review of current turnout gear testing and performance information, PFAS intentionally included in firefighter turnout gear may perform some critical functions and significantly enhance the vital protection the turnout gear provides to firefighters, particularly against chemical splash and bloodborne pathogens.

Turnout gear requirements – NFPA Standards

Turnout gear design, manufacturing, and performance standards in Minnesota are established by a combination of federal regulation, adopted under Minnesota Rules, and national consensus standards adopted by the firefighting service nationwide.

Most standards for the firefighting service are through the National Fire Protection Association (NFPA). The NFPA does not itself set standards, but acts as a neutral coordinator of volunteer committees composed of firefighters, firefighting equipment manufacturers, safety advocates, building and construction experts, federal government agency representatives, and the general public to develop proposed consensus standards. The NFPA then posts the committees' proposed consensus standards for public comment, and publishes the final revised standards. This process is somewhat similar to, but wholly separate from, the rulemaking process performed by government agencies at the state or federal level. There are currently more than 300 NFPA standards, covering firefighting-related topics ranging from turnout gear performance to fireworks display setup to furniture flammability rating.

NFPA standards may then be either directly adopted by reference by legislative bodies through legislation, by government agencies through rulemaking, or be used as model text for restated or copied-in-part statutes or rules. Though by themselves, NFPA standards do not have the force of law, the overwhelming majority of fire departments and firefighters comply to the greatest extent possible with NFPA standards applicable to their work regardless if adopted and enforced by law, because those NFPA standards are regarded as the best learned approach to protect the lives and safety of both firefighters and the general public. As such, whether a fire department is compliant with applicable NFPA standards may be considered by insurance providers when offering worker's compensation and liability coverage to municipalities, non-profit organizations like volunteer fire departments, and businesses operating fire departments such as petroleum refineries. In addition, any litigation involving a fire department regarding any situation potentially addressed in an NFPA standard will likely involve investigation of whether the applicable NFPA standard was followed.

NFPA 1971

Turnout gear design, manufacturing, testing, and performance are delineated in NFPA 1971, 'Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting'. The current NFPA 1971 was revised and published in 2018. This standard is currently being reviewed and revised, but will be incorporated into the new NFPA 1970, 'Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel and Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS)', which will consolidate five existing NFPA standards into one for easier reference and improved clarity. The new NFPA 1970 standard, incorporating changes to the current 1971 standard that addresses turnout gear, is expected to be finalized in early 2024.

The NFPA standard was first published in 1975, and has been revised at roughly 5-year intervals since; in 1981, 1986, 1991, 1997, 2000, 2007, 2013, and the most recent, 2018. The intervals of revision varied as the structure of the NFPA-convened committees and their respective assignments evolved. Constant revision of NFPA standards is considered essential in the fire service since both the direct risks and resulting fire environment that firefighters face is constantly changing. For example, the dramatically increased prevalence of advanced plastics in our everyday living environment means that the smoke firefighters and their turnout gear are exposed to in structure fires is far more toxic today than just a few decades ago. Finally standards must be revised in light of our ever-increasing knowledge regarding the health effects of both acute and chronic chemical exposure.

One of the relevant provisions of the current turnout gear standard that is expected to change from the 2018 to the 2024 version involves Section 8.62 of NFPA 1971, which is a mandatory test for turnout gear requiring extended exposure of the moisture barrier material to intense UV light. Though the moisture barrier should in normal use only be exposed to sunlight or other UV light sources for extremely brief periods, this test, which was adopted in the 2007 version of NFPA 1971, was meant to simulate the effects of general long-term weathering of turnout gear.

Many involved parties have pointed to the UV exposure test in Section 8.62 of NFPA 1971 as one among many drivers of intentional PFAS inclusion in turnout gear, as it may be difficult for materials without PFAS to pass this mandatory test. This claim that the UV exposure test was overly rigorous was made by the International Association of Fire Fighters (IAFF), the largest union of firefighters worldwide, in a lawsuit filed against the NFPA in March of 2023. Studies, including the recent May 2023 findings of the National Institute of Standards and Technology (NIST), a division of the U.S. Department of Commerce, have shown that one of the highest concentrations of PFAS found in both new and used turnout gear is in the moisture barrier. However, turnout gear manufacturers have also pointed out that PFAS-containing materials perform many of the critical functions of the moisture barrier significantly better than most non-PFAS alternatives. Manufacturers have also stated that simple substitution of non-PFAS-containing moisture barriers might both alter the performance of the other, interrelated layers of turnout gear as well as directly reduce the firefighter protection afforded by current standards.

The first draft of the new NFPA 1970 that will replace the current NFPA 1971 released for initial public comment in 2021 appeared to retain the original UV exposure test. However, the second draft released in 2023 would subject only the outer shell material to UV exposure. Turnout gear should not require inclusion of PFAS to pass this new test. The revised standard is also expected to contain a process or standard for certification of turnout gear as containing no intentionally-added PFAS.

Compliance with the modern NFPA 1971 by turnout gear manufacturers in North America is considered universal. Compliance by fire departments in Minnesota has not been directly measured. However, based on informal discussions with fire departments and staff from the State Fire Marshal Division (SFMD) of the Minnesota Department of Public Safety (DPS), compliance with the modern NFPA 1971 by Minnesota fire departments is expected to be extremely high.

NFPA 1851

Among other requirements, NFPA 1851, ‘Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting’ establishes the standard for the allowed lifetime of turnout gear. Section 10.1.2 mandates that turnout gear be retired no later than ten years after manufacture. This strict limit was promulgated in 2008 for two reasons. First, that turnout gear more than ten years old would have been designed, manufactured, and tested to meet expectations that would by then have been revised twice due to developments in firefighting exposure and technology and healthcare knowledge as discussed above. Second, that even little-used turnout gear, would necessarily have been stored, cleaned, and extensively handled over ten years, and the protective performance of the turnout gear after this time would be uncertain at best, and based on firefighter experience, more likely significantly compromised.

Compliance with the ten year turnout gear use limit by fire departments in Minnesota is unknown, but likely is similar to trends nationwide. In 2020, 64% of responding fire departments nationwide reported using some PPE for longer than ten years due to budget constraints.

Turnout gear requirements – Federal & Minnesota Regulation

Safety standards for Minnesota employers, including under Minnesota statute government employees such as municipal firefighters, are established by the Minnesota Occupational Safety and Health Administration (MNOSHA) division of the Minnesota Department of Labor and Industry (DOLI).

Minnesota, by MNOSHA rulemaking and statutes passed by the Legislature, has in turn adopted the federal safety standards established for industry by the Occupational Safety and Health Administration (OSHA) division of the U.S. Department of Labor and applied them to all Minnesota employers.

The federal, and therefore the Minnesota, regulatory standard applicable to firefighter turnout gear was promulgated in 1980. This regulatory standard adopted the 1975-year version of NFPA 1971 by reference.

Though it has been nearly 50 years since OSHA adopted the 1975-year NFPA 1971 standard, OSHA has not updated this adoption reference, and thus the federal requirement only applies the 1975 version, not the current NFPA 1971. In 2004, OSHA acknowledged that many of its regulatory standards that were based on national consensus standards, such as those established through the American National Standards Institute (ANSI), the International Code Council (ICC), and, as the case here, the NFPA, were functionally obsolete. However, OSHA also reiterated that it could only revise them through individual notice-and-comment rulemakings. Though OSHA at that time announced its intention to review and update references to national consensus standards throughout its regulations as expeditiously as possible, this process is laborious and the federal OSHA regulations relevant to fire brigades, including the mandate for employers to comply with the obsolete 1975 version of NFPA 1971 remains as yet unmodernized.

Regarding enforcement, OSHA has emphasized that national consensus standards are not equivalent to federal regulation, and when the two differ, it must inspect to the regulatory rather than the consensus standard, even if that regulatory standard was based on a since-superseded predecessor of the current consensus standard. Over the years, though, OSHA has also repeatedly stated that, when a regulated party complies with a national consensus standard that differs from federal regulations, as long as that consensus standard provides an equivalent or superior level of employee protection, then OSHA must cite the noncompliance, but will consider them as ‘de minimus’ violations not subject to penalties or publication.

Compliance by Minnesota fire departments with the 1975 version of NFPA 1971 rather than the current version would be both imprudent from a safety and liability perspective. In practice, it would also be likely impossible, since no turnout gear manufacturers make available turnout gear constructed to that obsolete standard. As noted, the UV exposure test discussed in the previous section of this report was added to NFPA 1971 in 2007. Thus, though that test is therefore not required under federal or Minnesota regulation, Minnesota fire departments effectively comply with the current NFPA 1971 that does require the test, at least until the NFPA standard is replaced in 2024. As discussed previously, compliance by Minnesota fire departments with the current NFPA 1971 has not been directly measured, but is expected to be universal or nearly so.

In 2023, the Legislature passed ‘Amara’s Law’, codified at Minnesota Statute § 116.943. Among other actions related to PFAS in specified products and required notifications, the law, starting in 2032, prohibits sale, offer for sale, or distribution for sale in this state any product that contains intentionally added PFAS, unless the commissioner of the MPCA determines by rulemaking that the use of PFAS in a particular product is a ‘currently unavoidable use’. Turnout gear containing intentionally added PFAS is not excluded from this law. However, this law does not require early retirement of PFAS-containing products such as turnout gear already sold and in use prior to that year.

In late December, 2023, OSHA announced that it would be proposing significant updates of the federal regulations related to emergency response workers, including firefighters, under Docket OSHA-2007-0073, including amending its references to various NFPA standards, among them the NFPA 1851, NFPA 1970, and NFPA 1971 discussed in this report. Publication of OSHA’s newly Proposed Rule is expected sometime in January, 2024, subsequent to the date this report is due to the Legislature.

Turnout gear disposal

Unlike the explicit cross-reference to and adoption of the 1975 turnout gear design, manufacturing, and performance standards of NFPA 1971 found in federal OSHA regulations, there is no federal adoption of the turnout gear lifespan limit contained in NFPA 1851. However, for the reasons discussed previously, the MPCA believes that Minnesota fire departments consistently make every effort possible within their available budgets to only use turnout gear and other structural firefighting protective ensemble elements for ten years and then retire and dispose of them. There is no required or requested reporting to the MPCA or SFMD for turnout gear retirement or disposal in Minnesota. However, informal discussions with fire departments in Minnesota support this conclusion.

The NFPA has since 2001 conducted a nationwide assessment of needs and practices in the fire service approximately every five years. While in the 2020 survey, only 36% of fire departments reported complete compliance with the ten-year turnout gear lifetime limit for all PPE, this is an increase from the 28% of fire departments that reported complete compliance just five years earlier.

These numbers also do not specifically apply to turnout coats and pants. While no nationwide or Minnesota data is available just for the turnout coat and pants retirement that is the primary consideration of this section of this report, supplementary narrative information collected by the NFPA and through informal discussions by the MPCA with fire departments in Minnesota clarify that firefighter protective ensemble items other than turnout coats and pants, particularly helmets and boots, comprise the majority of PPE retained in use beyond ten years for most fire departments. Neither of those items, in the data found by the MPCA, are significant contributors to PFAS exposure for firefighters. Compliance for turnout coats and pants is therefore expected to be much higher.

In addition, the nationwide data shows a nearly direct relationship between fire department size in terms of population served and relative compliance with an across-the-board retirement of all firefighter protective ensemble items, including turnout gear; the larger the fire department, the more likely turnout gear is to be retired within ten years. Since fire department served-community size is typically related to available budget, the reasonable conclusion is that retirement of turnout gear within ten years of manufacture is heavily dependent on the funds available for the purpose.

Not surprisingly, replacement costs for turnout gear are high, given the complex construction required, the high potential liability and therefore necessary time-consuming quality control incurred by the manufacturers, and the limited and specialized consumer market for the products. Currently, turnout coat and pants range from approximately \$3,000 for a basic compliant set 'off the shelf' to nearly double for the custom-fit higher-protection turnout gear worn by most larger municipality firefighters. This cost, however, impacts smaller fire departments relatively much more severely than larger departments. Smaller fire departments in Minnesota are much more likely to rely primarily on part-time, paid-on-call, or volunteer firefighters, while larger fire departments employ mostly full-time firefighters. Each part-time, paid-on-call, or volunteer firefighter must be fully and properly equipped with their own turnout gear to ensure the department can respond en masse to major emergencies. However, over a year, these essential firefighters usually work, and thus wear their individual turnout gear, far fewer average hours than a full-time firefighter.

This difference is also borne unusually heavily by Minnesota's 785 fire departments in comparison to other states, since Minnesota has the second highest proportion of volunteer and paid-on-call firefighters in the nation, calculated by the U.S. Fire Administration (USFA) division of the U.S. Department of Homeland Security (DHS), at more than 97% against a national average of about 65%.

Due to the increasing complexity of turnout gear, its cost has also increased substantially faster than inflation, beyond even the rising costs of other firefighting equipment such as fire engines and fuel. This increase again disparately impacts smaller fire departments, as their population served and available budget may not increase on pace with their relative costs. Turnout gear retirement is influenced by these same factors, meaning that the smaller the fire department, the less likely turnout gear is to be retired within ten years.

Unlike other firefighting equipment such as fire engines, retired turnout gear has effectively no resale value to offset replacement cost. There is no mandatory reporting regarding turnout gear retirement or disposition to the SFMD or MPCA, but informal discussions with Minnesota fire departments indicate that much retired turnout gear that is not discarded due to damage or contamination is donated through charity organizations to underequipped rescue services outside the United States and Canada, primarily in Central and South America. Recently, substantial amounts of retired turnout gear have also been sent to rescue services in Ukraine, many of which have lost equipment as a result of conflict.

Turnout gear that is not donated is currently disposed into municipal solid waste (MSW), destined in Minnesota for MSW landfills or waste-to-energy facilities (WTEs). Approximately 4,000 pounds of turnout coats and pants are estimated to be retired in Minnesota annually. Even if all this mass was not donated and was instead disposed into Minnesota landfills or burned for energy recovery in Minnesota WTE facilities, this would only be about two tons of waste turnout gear disposed annually. Carpeting can have nearly equivalent PFAS levels to turnout gear. Approximately 130,000 tons of carpeting are disposed in Minnesota every year. Thus, carpet disposal in Minnesota likely presents a PFAS risk tens of thousands of times greater than the risk from turnout gear disposal.

At present, PFAS-containing wastes as a chemical class are not listed as regulated hazardous wastes in Minnesota. Wastes containing chemicals that are not listed as a class are regulated as hazardous waste only if they exhibit specific physical or chemical behavior. In general, PFAS potentially meet only one of these criteria, the Minnesota-specific Lethality Characteristic, when present in industrial grade concentrations. The concentrations of PFAS in turnout gear are roughly 1,000 times lower than the regulatory hazardous waste threshold. Therefore, under the current regulations, turnout gear, like carpeting, both with similar potential PFAS levels, is not regulated as a hazardous waste in Minnesota. Turnout gear, like carpet, may be disposed into MSW landfills or WTE facilities if a facility chooses to accept it, though some facilities may choose not to knowingly accept PFAS-containing wastes.

The MPCA recognizes that any source of PFAS into Minnesota MSW landfills or WTE facilities is concerning, and may ultimately result in some PFAS constituents being released into the environment.

The MPCA has considered the potential of regulating some or all PFAS wastes as hazardous waste through rulemaking. However, the MPCA expects that it will be extremely complex to determine which specific PFAS chemicals to regulate as hazardous waste, and then at what concentrations to regulate each of those specific PFAS chemicals. The MPCA believes that appropriately balancing environmental risks and reasonable precautionary requirements with burdens to the public will take at a minimum several years just to properly propose draft requirements. By that time, the MPCA believes that expected evolution of turnout gear will likely drastically reduce the PFAS content and thus risk of the turnout gear.

In addition, if PFAS at concentrations found in turnout gear were to be regulated as hazardous waste across the board, the volume of waste generated in Minnesota requiring mandatory hazardous waste disposal would increase by many orders of magnitude from the present. Nationwide, hazardous waste incinerators, hazardous waste landfills, and, when suitable for specific wastes, hazardous waste chemical treatment facilities, are operating at or near capacity for the presently regulated hazardous wastes. New hazardous waste facilities typically take a minimum of several years to gain requisite approvals and permits, and then additional time to construct and 'come on line'. There are currently no hazardous waste disposal facilities in Minnesota that could receive solid PFAS-containing wastes. Because of this, no major new hazardous waste disposal capacity would likely be available to absorb newly-regulated PFAS-containing wastes from Minnesota in any significant volume for the foreseeable future.

Unfortunately, there are no intermediate waste options available between fully regulated hazardous waste and MSW.

The MPCA currently recommends disposal of PFAS-containing retired turnout gear as MSW. In its published guidance for firefighting foam management, however, the MPCA recommends managing PFAS-containing discarded firefighting foam concentrate as equivalent to hazardous waste. The minimum concentrations of PFAS found in the subject firefighting foam concentrates are over 100 times higher than the maximum concentrations of PFAS found in turnout gear. In addition, firefighting foam concentrate is a flowable liquid, which may easily spread PFAS contamination if improperly managed, while the PFAS in turnout gear is integrated into fibers, resistant to release.

Note: The MPCA is aware of sometimes significant confusion among both the fire service and regulators alike regarding when certain products such as turnout gear and firefighting foam do or do not contain PFAS. Early attention among the public and environmental regulators was initially focused on long-chain PFAS chemicals, consisting of eight or more carbon atoms bonded to fluorine and other atoms, sometimes referred to as 'C8s'. The two most common long-chain PFAS, C8s, are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). It is this latter chemical and its acronym that are the partial root of the confusion.

In response to public and user concerns, manufacturers began phasing out many long-chain PFAS constituents from products like turnout gear and firefighting foam, replacing them with shorter-chain PFAS, such as 'C6s' that were believed safe or at least safer. These shorter-chain PFAS-containing products were then labeled as 'PFOS-free' or bore statements such as 'contains no PFOS'. These labels and statements are technically correct but are practically misleading. Newer health data has now shown that shorter-chain PFAS chemicals such as C6s may present nearly-equivalent risks as the more well-known C8s.

Worse, 'PFOS-free' and 'contains no PFOS' have often been misread to mean 'PFAS-free' or 'contains no PFAS', which is drastically different. Many fire departments and even regulators have as a result incorrectly believed that certain products such as turnout gear or firefighting foam do not contain PFAS when in fact those products do contain PFAS, sometimes nearly the same amount as they did before.

Eliminating or reducing PFAS in turnout gear

Changes to the national consensus turnout gear performance standard (the new NFPA 1970) and pressure from firefighters and unions nationwide are expected to shortly result in PFAS-free or significantly-reduced PFAS turnout gear being available on the market that is able to comply with the revised NFPA national consensus turnout gear performance standard. The MPCA believes such turnout gear may be available to Minnesota fire departments by the end of 2024, however it may possibly take some years longer, depending on if the new NFPA standard is not finalized in early 2024. No further action by Minnesota is needed for this outcome.

As long as PFAS-free or significantly-reduced PFAS turnout gear meets the new NFPA performance standard, to ensure it will be safe for and protect Minnesota firefighters, the MPCA recommends education to the Minnesota fire protection community.

- **Education**

The MPCA, in partnership with the SFMD and MDH, could prepare and distribute training materials on the availability of NFPA-compliant PFAS-free turnout gear, when available.

As noted in the section on Turnout gear requirement – NFPA standards, the national consensus standard is that turnout gear be retired no later than ten years after it was manufactured. It appears likely that OSHA may adopt this standard as enforceable regulation in its impending rulemaking action. If NFPA-compliant PFAS-free turnout gear is available in 2024 as expected, and no other actions in Minnesota are taken, then PFAS-containing turnout gear could be expected to be significantly phased out by 2034.

However, if it is determined desirable to accelerate that process, the Legislature could provide funding for early turnout gear retirement.

- **State funding**

The Legislature could provide directed conditional grant funding for Minnesota fire departments to retire PFAS-containing turnout gear prior to its mandatory ten-year lifespan. Funding could be directed for use only for purchase of NFPA-compliant PFAS-free turnout gear. The Legislature could condition funding on a one-to-one basis of retirement and replacement of a single set of PFAS-containing turnout gear. The total cost to retire and replace turnout coats and pants for every firefighter in Minnesota would be approximately \$75 million dollars.

Note: This total is estimated from current average turnout gear purchase cost. However, it is possible that PFAS-free turnout gear may command a premium cost or be subject to limited supply. Either possibility could increase this cost. In addition, many larger fire departments need to provide their full-time firefighters with more than one set of turnout gear, to enable rapid turnaround and continuous readiness to respond to incidents ‘back-to-back’. Only a single set per firefighter was calculated here.

The total funding could be a one-time block, or could be spread over several years. However, the longer the total is spread over, the less effect it will have, since the natural lifetime of existing PFAS-containing turnout gear will continue to run.

The MPCA stresses that any mandate to purchase either PFAS-free or reduced-PFAS turnout gear must hinge on that turnout gear being compliant with NFPA national consensus standards.

Recommendations and protocols for PFAS biomonitoring in firefighters

Because neither agency has internal capacity or expertise to complete a report on recommendations and protocols for PFAS biomonitoring in firefighters, MDH is in the process of preparing a request for proposals (RFP) for an expert report. We believe that meeting the legislative directive through an RFP will provide the best outcome for Minnesota firefighters because there are local experts who may apply to the RFP in environmental and occupational health that can more efficiently and effectively report on recommendations and protocols for PFAS biomonitoring. Additionally, local occupational health experts already have strong relationships with firefighter groups across Minnesota, which provides the strongest foundation for voluntary biomonitoring registration process recommendations.

An additional component of the RFP provides for respondents to conduct baseline PFAS biomonitoring with Minnesota firefighters. Including baseline biomonitoring as a deliverable in the RFP mechanism can ensure that local experts with biomonitoring experience, laboratory capacity, and exiting relationships are able to leverage this tremendous opportunity to implement best-practice science and contribute to baseline understanding of PFAS exposures in firefighters.

The MDH is drafting the RFP and will be the lead agency for reviewing applications and ensuring deliverables meet legislative requirements and timeline. The MDH proposes the following timeline to fulfill the Legislative requirement:

- Release RFP January 2024
- Submit required report on recommendations and protocols for PFAS biomonitoring in firefighters by December 1, 2024
- Final reporting on voluntary baseline biomonitoring in Minnesota firefighters by June 30, 2025

The MPCA and MDH agree that this proposed approach most effectively leverages the tremendous opportunity and one-time investment toward understanding and addressing PFAS exposures among firefighters. Questions regarding the RFP can be directed to Sarah Fossen Johnson, MDH Environmental Surveillance and Assessment Manager, via e-mail at Sarah.Fossen.johnson@state.mn.us or by telephone at 651-201-4080.