# Tech Tuesday: Environmental Issues with ITM

(Participation Guide)

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# Aqueous Film-Forming Foam (AFFF)

## 1 Introduction

### 1.1 What is AFFF?

Aqueous film-forming foam (AFFF) is highly effective foam intended for fighting high-hazard flammable liquid fires. AFFF products are typically formed by combining hydrocarbon foaming agents with fluorinated surfactants. When mixed with water, the resulting solution achieves the interfacial tension characteristics needed to produce an aqueous film that spreads across the surface of a hydrocarbon fuel to extinguish the flame and to form a vapor barrier between the fuel and atmospheric oxygen to prevent re-ignition. This film formation is the defining feature of AFFF.

There are two major classes of firefighting foams: Class A and Class B. Class A foams were developed in the 1980s for fighting wildfires. They are also used to fight structure fires. Class B foams are any firefighting foams that have been designed to effectively extinguish flammable and combustible liquids and gases; petroleum greases, tars, oils and gasoline; and solvents and alcohols. Class B foams can be synthetic foams, including aqueous film-forming foam (AFFF) or alcohol-resistant aqueous film-forming foam (AR-AFFF), or protein foams. This fact sheet focuses on AFFF as these foams contain fluorosurfactants and they are widely used. Per- and polyfluoroalkyl substances (PFAS) are the active ingredients in fluorosurfactants.

All Class B foams are not the same. Although not usually categorized this way from a fire protection viewpoint, they can be divided into two broad categories from a per- and polyfluoroalkyl substances (PFAS) perspective: Fluorinated foams that contain PFAS and fluorine-free foams that do not contain PFAS.

ITRC has developed a series of fact sheets that summarize the latest science and emerging technologies regarding PFAS. This fact sheet is targeted to local, state, and federal regulators and tribes in environmental, health, and safety roles as well as AFFF users at municipalities, airports, and industrial facilities.

The purpose of this fact sheet is to outline how to properly identify, handle, store, capture, collect, manage, and dispose of AFFF.

The fact sheet is not intended to replace manufacturer specifications, or industry guidance for AFFF use, or discuss alternatives in detail. It is only intended to educate users on AFFF use to reduce and eliminate potential harm to human health and the environment.

For further information, please see the ITRC Technical and Regulatory Guidance Document for PFAS dated April 2020.

The vast majority of Class B firefighting foam that is currently in stock or service in the United States is AFFF or AR-AFFF. All AFFF products contain PFAS. This applies to foams used in the past and those being sold today. Foam currently in stock or new foam that is labeled as AFFF or AR-AFFF, contains perfluoroalkyl or polyfluoroalkyl substances, or both, as active ingredients (DOD 2018; Darwin 2004).

AFFF is used where there is a significant flammable liquid hazard present, including but not limited to the following locations:

- chemical plants
- flammable liquid storage and processing facilities
- merchant operations (oil tankers, offshore platforms)
- municipal services (fire departments, firefighting training centers)
- oil refineries, terminals, and bulk fuel storage farms
- aviation operations (aircraft rescue and firefighting, hangars)
- military facilities

Most AFFF products sold and currently stocked in the United States are either listed by Underwriters Laboratory (UL) based on conformance with UL Standard 162, "Foam Equipment and Liquid Concentrates" or have been tested by the U.S. Naval Research Laboratory (NRL) and qualified as meeting the requirements of the U.S. Department of Defense (DOD) Military Specification (MILSPEC), MIL-PRF-24385, "Fire Extinguishing Agent, Aqueous Film-Forming Foam" (DOD 2017). AFFF foams that meet the MILSPEC are required for use in military applications and at Federal

Perfluoroalkyl substances are fully fluorinated (perfluoro-) alkane (carbon-chain) molecules. Their basic chemical structure is a chain of two or more carbon atoms with a charged functional group attached at one end.

Polyfluoroalkyl substances are not fully fluorinated. Instead, they have a non-fluorine atom (typically hydrogen or oxygen) attached to at least one, but not all, carbon atoms, while at least two or more of the remaining carbon atoms in the carbon chain are fully fluorinated.

More information is included in the ITRC *Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet.

Aviation Administration (FAA) regulated airports. All other AFFF foams are specified to UL Standard 162 (UL 2018) or other specifications for applications outside of military and FAA applications. DOD maintains an online qualified products database (QPD) that lists all the AFFF foams that have been qualified to meet the MILSPEC (DOD 2018).

## 1.2 Human Health and Environmental Concerns with AFFF Use

All Class B foams have the potential to create an adverse environmental impact if released uncontrolled to the environment, particularly if the foam solutions reach drinking water sources, groundwater, or surface waters. Discharge of foams to surface waters, including fluorine-free foams, may potentially harm aquatic life due to excessive biological and chemical oxygen demand and, in some cases, acute toxicity, and may increase nutrient loading.

AFFF products (as well as other fluorinated foams, see Figure 1) are of concern because they contain PFAS. Some PFAS pose a risk to groundwater and surface water quality, but they are also highly persistent, may be highly mobile, and some bioaccumulate in organisms. PFAS are also not removed or destroyed by conventional wastewater treatment processes unlike many other hazardous substances.

- Long-chain PFAS are defined as perfluoroalkyl carboxylates (PFCAs) with eight or more carbons, including perfluorooctanoate (PFOA), and perfluoroalkane sulfonates (PFSAs) with six or more carbons, including perfluorohexane sulfonate (PFHxS) and perfluorooctane sulfonate (PFOS).
- Short-chain PFAS are defined as PFCAs with seven or fewer carbons, such as perfluorohexanoate (PFHxA), and PFSAs with five or fewer carbons, such as perfluorobutane sulfonate (PFBS).

*Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet

The health effects of PFOS, PFOA, PFHxS, and perfluorononanoate (PFNA) have been more widely studied than other PFAS. Numerous animal and human studies have evaluated both non-cancer and cancer health effects related to exposure to a limited number of PFAS, including PFOA and PFOS. Little to no health-effects data are available for many PFAS. See the *Regulations, Guidance, and Advisories for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet for more detailed discussion of potential health effects related to PFAS.

To date there have been only limited studies of human health effects specifically related to use of AFFF. Glass et al. (2014) reported elevated rates of some cancers among more highly exposed firefighters, but their study was not designed to evaluate specific associations between these health effects and any particular chemical among the many chemicals to which firefighters may be exposed. Rotander et al. (2015) measured PFOA, PFOS, and PFHxS levels in firefighters' serum but did not observe any association with studied health effects. A limited study in Norway observed elevated PFOS and PFHxS serum levels in 10% of firefighters studied, (Kärrman et al. 2016), and suggested that use of personal protective equipment (PPE) may account for why elevated levels were not seen in more of the firefighters. Studies suggest that perfluoroalkyl acids like PFOS and PFOA are not well absorbed through the skin (ATSDR 2018), which is the most likely exposure pathway for AFFF foams. However, should the PFAS in AFFF enter the body they could cause health problems, so appropriate PPE should be used to prevent or minimize direct contact, ingestion, or inhalation of AFFF.

PFAS encompass a wide range of fluorinated carbon-chain compounds of differing carbon chain lengths, physical and toxicological properties, and environmental impacts. Long-chain PFAS are of particular concern and include PFOS and PFOA, which are recognized as persistent, bioaccumulative and toxic (PBT). Depending on when it was manufactured, AFFF may also contain fluorinated precursors, some of which are known as fluorotelomers, that can breakdown in the environment to PFOA or other PFCAs. See the *Naming Conventions and Physical and Chemical Properties and the History and Use of Per- and Polyfluoroalkyl Substances (PFAS)* fact sheets for more information.

## 1.3 Determining the Type of PFAS in AFFF in Current Inventory

Within these broad categories of Class B foams there are different types of foams. Figure 1 illustrates the categories of Class B foams and AFFF specifically. There are three possible types of AFFF products including:

- legacy PFOS AFFF
- legacy fluorotelomer AFFF (contain some long-chain PFAS)
- modern fluorotelomer AFFF (contain almost exclusively short-chain PFAS)

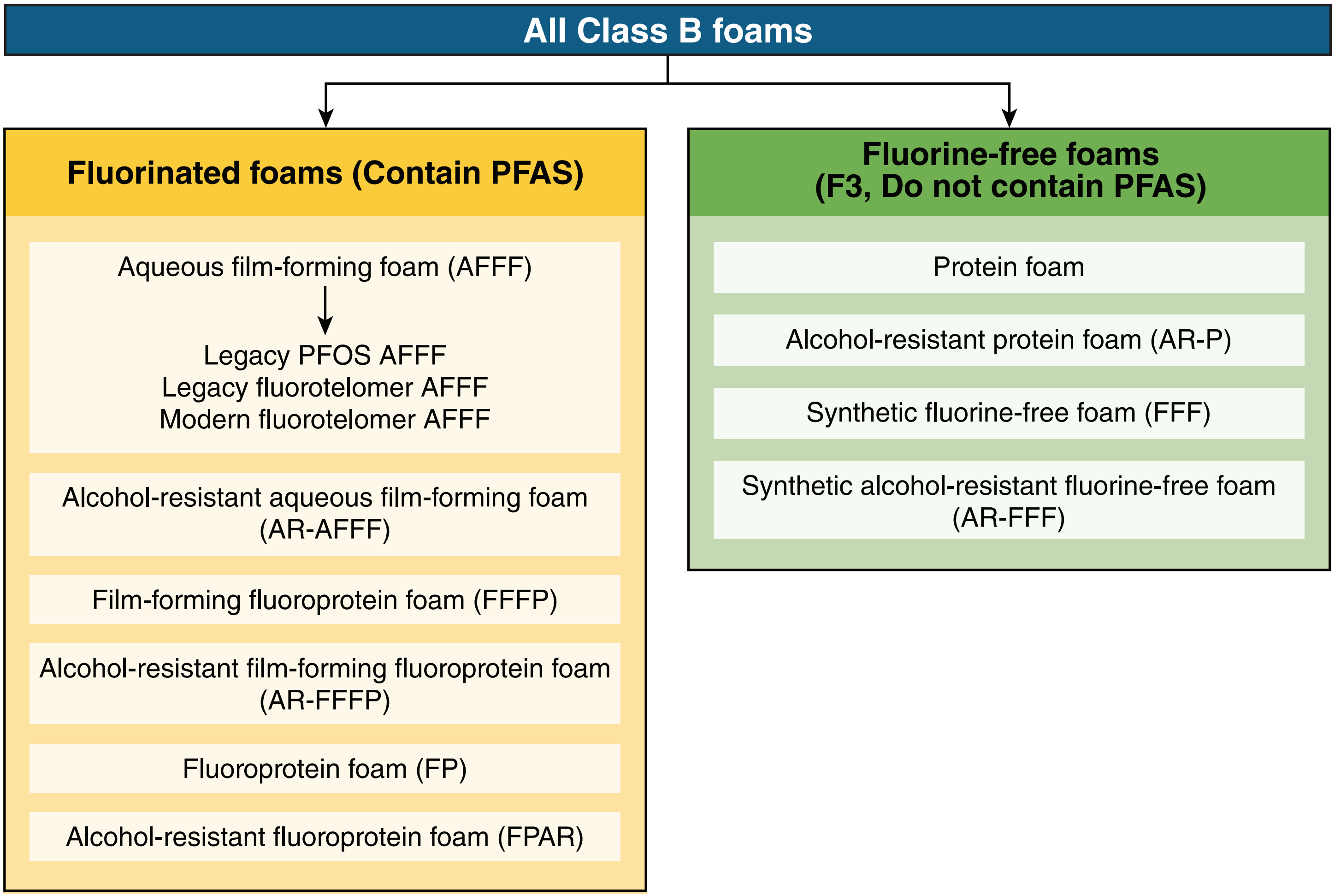


**Figure 1. Types of Class B foams**
*(Source: S. Thomas, Wood plc, used with permission)*

### 1.3.1 Legacy PFOS AFFF

These foams were manufactured in the United States from the late 1960s until 2002 exclusively by 3M and sold under the brand name “Lightwater” (DOD 2014). Lightwater AFFF contains PFOS and various precursors that could potentially break down in the environment to PFOS and shorter chain PFSAs such as PFHxS. Some of these PFSAs, including PFHxS, are also considered to be persistent. Older formulations may also contain PFOA as well as fluorinated precursors. The fluorinated precursors may also break down in the environment to PFOA and other perfluoroalkyl carboxylates (PFCAs) (Backe, Day, and Field 2013).

### 1.3.2 Legacy Fluorotelomer AFFF (contain some long-chain PFAS)

These foams were manufactured and sold in the United States from the 1970s until 2016 and encompass all other brands of AFFF besides 3M Lightwater (Schultz, Barofsky, and Field 2004). Although not made with PFOA, they contain polyfluorinated precursors (Backe, Day and Field 2013; Place and Field 2012) that are shown to degrade to PFOA and other PFCAs in the natural environment (Weiner et al. 2013; Harding-Majanovic et al. 2015). They may contain trace quantities of PFOA as an unavoidable byproduct of the manufacturing process. Legacy fluorotelomer-based AFFF foams have historically contained predominantly short-chain (C6) PFAS with formulations ranging from about 50–98% short-chains and the balance as long-chain PFAS. Importantly, the long-chain PFAS content of these foams has the potential to break down in the environment to PFOA and other PFCAs, but not to PFOS or other PFSAs (Weiner et al. 2013).

### 1.3.3 Modern Fluorotelomer AFFF (contain almost exclusively short-chain PFAS)

In response to the U.S. Environmental Protection Agency (USEPA) 2010/2015 voluntary PFOA Stewardship Program (USEPA 2015), most foam manufacturers have now transitioned to the production of short-chain (C6) fluorotelomer-based PFAS. These foams are referred to as “modern” to distinguish them from the legacy foams manufactured before the phase-out. Short-chain (C6) PFAS do not contain or breakdown in the environment to PFOS and other long-chained

PFAS such as PFHxS and PFOA (see below) and are currently considered lower in toxicity and have significantly reduced bioaccumulation potential compared to long-chain PFAS (USEPA 2018). However, foams made with only short-chain (C6) PFAS may still contain trace quantities (parts per billion [ppb] levels) of PFOA and PFOA precursors as byproducts of the manufacturing process. As documented in the Helsingør Statement: "although some of the long-chain PFAS are being regulated or phased out, the most common replacements are short-chain PFAS with similar structures, or compounds with fluorinated segments joined by ether linkages. While some shorter-chain fluorinated alternatives seem to be less bioaccumulative, they are still as environmentally persistent as long-chain substances or have persistent degradation products" (Scheringer et al. 2014). Concerns have been raised that "little information is publicly available on [the] chemical structures, properties, uses, and toxicological profiles" of these shorter-chain formulations and that "increasing use of fluorinated alternatives will lead to increasing levels of stable perfluorinated degradation products in the environment, and possibly also in biota and humans" (Blum et al. 2015). Under the recently published European Union Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation on PFOA and PFOA-related substances, foams based on short-chain PFAS can contain no more than 25 ppb PFOA and 1,000 ppb total PFOA-related substances to be sold in the European Union (EU) after July 4, 2020 (Commission Regulation (EU) 2017).

## 1.4 When to Use Legacy AFFF

The decision about whether to use legacy AFFF should be considered in the development of Best Management Practices (BMPs; see Section 3) and in fire response plans. The decision should be based on a site-specific evaluation that considers likely fire hazards and potential risks associated with use of legacy AFFF. These decisions should be made prior to an emergency where Class B AFFF would be used so that BMP equipment, procedures, and training are already in place. During an actual response to a fire, the final decision on whether to use any Class B AFFF should be made by the emergency manager (for example, fire chief, incident commander or terminal manager) based on federal, state and local laws and the nature of the emergency. Decisions regarding the use of any type of foam should consider the nature of the firefighting properties of the foam and the benefits they provide for preservation of life, public safety, and property protection versus the potential environmental, public health, and financial risks the use of such foam could pose.

Decisions about when and how to use PFAS-containing foams should be made before, not during, an emergency. The team should consider key factors such as these:

- The nature of the firefighting properties of the foam
- The nature of the emergency
- The risk to life, public safety, and property
- Potential environmental, public health, and financial liabilities of using the foam

Currrently, federal law does not prohibit the use of legacy AFFF remaining in existing stocks, whether containing PFOS or other long-chain PFAS. Efforts should be made to limit releases to the ground or water sources. Releases could impact water sources above USEPA drinking water health advisory levels or above more stringent state and local regulatory criteria. During emergency response planning, potential liabilities should be weighed against the cost of disposal and replacement of legacy AFFF, and maintaining an inventory of alternative foams (DOD 2014).

While the disposal cost of legacy PFOS AFFF or certain formulations of legacy fluorotelomer (polyfluoroalkyl compounds produced by the telomerization process) AFFF solutions may be much greater than the cost of purchasing modern, shorter-chain replacement foam, the potential risks of keeping and using this legacy foam may be even greater. Also, replacement of legacy AFFF with short-chain AFFF or other foams may require thorough flushing and possible modification of existing systems that could produce significant amounts of flush water containing PFAS that would require proper disposal. Despite these issues, serious consideration should be given to the continued use, storage, and disposal of legacy AFFF. Organizations that are considering replacing their legacy AFFF stocks should focus first on removing from service legacy PFOS AFFF. A release of legacy PFOS AFFF to the environment, that is not mitigated, is likely to result in PFOS impacts to soils and possibly groundwater and surface water.

Legacy AFFF should only be used for emergency purposes in cases where insufficient amounts of short-chain AFFF or other foams are available and where there is a risk to human life, public safety or property. Where no regulation exists to the contrary, use of legacy AFFF containing PFAS remaining in inventory may depend on whether the facility can contain, collect, and treat the wastewater generated fighting the fire, and on the sensitivity of the surrounding environment. Use of alternative firefighting materials (for example, Class B fluorine-free foams) or Class A foams for smaller fires should be strongly considered whenever possible (FFFC 2016).

Firefighting industry best practice for Class B foams calls for the use of fluorine-free foam (FFF) for testing and training (FFFC 2016; Lastfire 2016). If the authority having jurisdiction requires testing of foam equipment or training of firefighters with AFFF, then only modern fluorotelomer AFFF should be considered for this purpose and any foam discharge should be collected and disposed of properly (see Table 1, Disposal).

## 1.5 Regulations Affecting the Sale and Use of AFFF

In the United States, 3M voluntarily ended production of PFOS-based AFFF in 2002. The USEPA subsequently restricted the future manufacture and import of most PFOS-based products, including firefighting foams, through two Significant New Use Rules (SNURs) (40 CFR 721.9582, Final Rules published 03-11-02 [13 PFAS] and 12-9-02 [75 PFAS]). In 2006, USEPA instituted the 2010/2015 voluntary PFOA Stewardship Program that resulted in the elimination of PFOA and other long-chain PFAS production by eight major fluorochemical manufacturers by 95% by 2010 and entirely by 2015. As a result, foam manufacturers have transitioned to the production of modern fluorotelomer AFFF (based on short-chain [C6] PFAS) and other fluorinated Class B foams. In 2007, USEPA issued amendment to 40 CFR 721.9582 regulating another 183 PFAS (SNUR on 10-09-07). In 2015, USEPA proposed a SNUR for PFOA and other long-chain PFAS as a regulatory follow-up to the voluntary PFOA Stewardship Program (USEPA 2015); the SNUR has not been finalized. The SNURs subject specific PFAS chemicals to reporting requirements, but do not restrict the use of existing stocks of legacy AFFF containing those PFAS chemicals.

Currently, the DOD and FAA-regulated airports must meet the requirements established in the military specification MIL-PRF-24385 for AFFF formulations (DOD 2017; FAA 2004). Only AFFF formulations containing fluorosurfactants currently meet the MILSPEC, but the DOD is actively evaluating fluorine-free foams to determine if any can meet the MILSPEC performance requirements (SERDP-ESTCP 2017).

In addition to federal efforts for managing AFFF, several state governments have regulations or other programs that address the use of PFAS-containing foams. Organizations should check with their state and local government for regulations or policies that could impact their use and disposal of AFFF and other Class B foams. Examples of state regulations and policies are included in the following sections.

### 1.5.1 New York

State regulation 6 NYCRR Part 597 identifies PFOS and PFOA as hazardous substances. The release of more than 1 pound of PFOS and/or PFOA must be reported to the state. (For legacy fluorotelomer AFFF, it would normally require a release of thousands of gallons of foam concentrate to result in release of 1 pound of PFOA.) (New York State 2017).

### 1.5.2 Washington

In March 2018, the state of Washington passed a new law (Washington State 2018) that restricts the sale and use of Class B foams that contain PFAS. As of July 1, 2018, PFAS-containing foams may not be discharged or otherwise used in the state of Washington for training purposes. Beginning on July 1, 2020, PFAS-containing foams may be sold or distributed in the state only for the following specific uses:

- applications where federal law requires the use of a PFAS-containing firefighting foam, including but not limited to the requirements of 14 CFR 139.317 (such as military and FAA-regulated airports)
- petroleum terminals (as defined in RCW 82.23A.010)
- oil refineries
- chemical plants (WAC 296-24-33001)

## 1.6 Legacy Foam Replacements

Several states have implemented take-back programs for AFFF products. For example, in May 2018, the Massachusetts Department of Environmental Protection, in partnership with the Massachusetts Department of Fire Services, implemented a take-back program to assist fire departments in the proper disposal of legacy firefighting foams that could impact water resources (MA DEP 2018). Vermont has also announced a take-back program (VT 2018). Users should contact their state regulatory agency for information on available take-back programs.

### 1.6.1 Synthetic Fluorine-free Foam

Organizations should determine whether a Class B fluorine-free foam (FFF) can achieve the required performance specifications for specific hazards as part of their pre-planning for replacement materials (FFFC 2016). Most foam manufacturers now produce Class B FFF. The performance of these foams has improved significantly over the last decade and is expected to continue to improve in the future. Purchasers of Class B foams, especially those not required to use MILSPEC AFFF, should investigate whether a Class B FFF will meet the site-specific requirements and should continue to review the performance specifications of FFF products as they make future purchasing decisions.

### 1.6.2 Modern Fluorotelomer AFFF

If it is determined that the performance of a fluorinated Class B foam is required for a specific hazard, or where federal regulations require AFFF use (for example, military applications and FAA-regulated airports), then organizations should purchase foams that consist of short-chain (C6) PFAS, modern fluorotelomer AFFF. U.S. foam manufacturers have switched over to using short-chain (C6) PFAS so it is likely that any AFFF bought today would meet that requirement (Tyco 2016). Users should confirm with their supplier. There is likely to be some designation on the label and the Safety Data Sheet that the foam contains short-chain (C6) PFAS, but even then, there will be a small amount of longer-chain (C8) impurities as stated in Section 1.3.3.

## 2 Best Management Practices (BMPs) For Class B AFFF Use

Firefighting foams are an important tool to protect human health and property from flammable liquid fire threats. Proper management and usage strategies combined with the current refinement of environmental regulations will allow an informed selection of the viable options to sustainably use firefighting foams.

BMPs should be established for the use of any firefighting foam to prevent possible releases to the environment that can lead to soil, groundwater, surface water, and potentially drinking water contamination. The discharge of firefighting foam to the environment is of concern because of the potential negative impacts it can have on ecosystems and biota due to the presence of chemicals such as PFAS. For example, for AFFF, the amount of PFAS from foam that may enter groundwater depends on information such as the type and amount of foam used, when and where it was used, the type of soil, and the depth to groundwater. AFFF is typically discharged on land but can run off into surface water or stormwater or infiltrate to groundwater. A more detailed description of the fate and transport of PFAS is included in the ITRC PFAS *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet.

BMPs are particularly important when Class B foams are used near sensitive environmental areas where impacts from chemicals present in foams have potential for lasting damage. Example sensitive areas:

- wetlands
- surface water bodies (particularly those used for water supplies like reservoirs or rivers with municipal water supply intakes)
- sensitive or endangered species habitat
- areas close to public and private drinking water supply wells
- sole source aquifers
- groundwater recharge areas

BMPs start with pre-planning and deciding which foam to keep in stock. The team should consider key factors such as these:

- Whether fluorine-free foams can meet site-specific performance requirements
- Site-specific evaluation of likely fire hazards and potential risks for life, public safety, and property
- Potential environmental, human health, and financial liabilities associated with AFFF releases
- Site constraints, including existing equipment retrofit requirements to adapt to alternate foams

BMPs are key to fostering the safest use of AFFF in an environmentally responsible manner with the goal of minimizing risk from its use. It is important to establish BMPs before an emergency where AFFF would be used so that BMP equipment, procedures, and training are already in place. Although firefighting personnel may be aware that the foams they are using contain chemicals, they may not be aware of the potential environmental effects of AFFF use. Training of firefighting personnel is important to ensure BMPs are discussed and employed consistently and effectively.

Table 1 gives a summary of example BMPs. Users should follow BMPs to protect themselves, others, and the environment when using AFFF. Further BMP guidance can be found in other documents, such as the *Best Practice Guidance* developed by the Fire Fighting Foam Coalition (FFFC 2016), the US National Fire Protection Association's NFPA 11 (2016), and the Airport Cooperative Research Program's *Use and Potential Impacts of AFFF Containing PFASs at Airports* (ACRP 2017). Users at DOD facilities have other BMPs to follow and other requirements to meet MILSPEC, which would be followed in those circumstances.

**Table 1. BMPs for Foam Selection, Storage, Use, Planning, Mitigation, and Disposal**

| Foam Selection |
|---|
| Evaluate whether a Class B fluorine-free foam (FFF) can provide the required performance for the specific hazard. "Alternative techniques and agents must be evaluated well in advance of an emergency situation" (FFFC 2016). |
| Use AFFF and other fluorinated Class B foams only in situations of significant flammable liquid hazard with risk for public safety or significant property loss, where the performance of other foams has not been demonstrated to date. |
| Consider adopting a two-foam approach with FFF used to respond to small incidents and AFFF kept as emergency backup for major incidents. Ensure that proper labeling is in place and personnel are trained when multiple inventories exist at one facility to avoid comingling of foams. |
| **Storage** |
| Develop a foam inventory and stock tracking system documenting the foam composition, brand, and manufacturer. |
| "Obtain and follow manufacturers' recommendations for foam concentrate and equipment" (FFFC 2016). The amount of foam in the system should be at least sufficient for the group of hazards that simultaneously need to be protected against. |
| Designate transfer areas and store fluorinated Class B foam concentrate in a covered area with secondary containment. |
| Design storage tanks to minimize evaporation of concentrate, label clearly to identify the type of concentrate and its intended concentration in solution. Keep foam within the temperature limitations provided by the manufacturer. |
| Properly maintain foam systems to ensure minimal accidental discharges. It is important to recognize the nature of the foam concentrates; small leaks of concentrate can create environmental impacts. Conduct regular inspections of tanks, storage containers, and any associated piping and machinery. Ensure that leaks are addressed promptly. |
| Consider the materials used for storage and handling. Corrosion is generally not an issue with foam concentrates, but some exceptions do exist. Manufacturers recommend stainless steel, high-density polyethylene (HDPE), or polypropylene containers for AFFF storage. Avoid using aluminum, galvanized metal, and zinc in storage tanks, piping, and handling equipment for foam concentrates (Angus 2017). |
| Ensure compatibility of foams before change-outs. Do not mix different types or brands of foam concentrates. |
| **Use** |
| Eliminate the use of AFFF products and other fluorinated "Class B foams for training and testing of foam systems and equipment" whenever possible (FFFC 2016). Instead, use specially designed non-fluorinated, PFAS-free training foams and surrogate liquid test methods available from most foam manufacturers. |
| If the authority having jurisdiction requires testing of foam equipment or training of firefighters with AFFF, then avoid the use of legacy AFFF and instead use modern AFFF that contains only short-chain (C6) PFAS whenever possible. |
| Evaluate if Class B foam is needed to fight a fire or if a Class A foam or just water can succeed in fighting the fire. |
| Provide containment, treatment, and proper disposal of foam solution. Avoid direct release to the environment to the greatest possible extent. |
| Collect, treat, and properly dispose of runoff/wastewater from training events or live fire events to the greatest extent possible. |
| Use appropriate personal protective equipment (PPE) when handling and using AFFF, and identify how to decontaminate materials and gear that comes into contact with foam. |
| "Follow applicable industry standards for design, installation, maintenance, and testing of foam systems" (FFFC 2016). |
| Keep records of when and where foam is used to respond to incidents, including foam type, manufacturer and brand, and amount used. |
| Make note of sensitive receptors (for example, streams, lakes, homes, areas served by wells) identified in the vicinity of foam use and report to environmental agencies as required. |
| Consider firefighter and public safety first. |

| Planning and Mitigation |
|---|
| Develop and communicate documented processes for a facility or installation with the stakeholders and regulatory agencies before a release occurs. |
| Develop runoff collection plans, equipment, and training processes specific to fluorinated Class B foam use. |
| Develop mitigation plans for uncontrolled releases of foam concentrate or foam solution to minimize environmental impacts. |
| Quickly and thoroughly clean up contaminated materials after an AFFF release. |
| Design new firefighting systems, when needed, to accommodate FFF products, considering their different properties, mode of action, and effectiveness. |
| Prioritize proper education, training, preplanning, and actions at an incident to ensure the most efficient use of the foam and equipment. |
| **Disposal** |
| Dispose of expired or unneeded Class B fluorinated foam concentrate at a Resource Conservation and Recovery Act (RCRA) permitted incinerator or another alternative incinerator that can ensure complete destruction of the PFAS. See *Remediation Technologies and Methods for Per- and Polyfluoroalkyl Substances* (PFAS) fact sheet for details on thermal destruction of PFAS. |
| Monitor developments in new disposal technologies. |
| Discontinue expired or unneeded AFFF concentrate donation programs (for example, donation to fire training school). |

The ACRP developed a macros-enabled Microsoft Excel™ workbook screening tool that allows users to "better integrate BMPs into the AFFF life cycle at their facilities, identify and manage potential risks associated with historical or current AFFF use at their site, and prioritize where resources need to be allocated to address concerns regarding AFFF and PFAS" (ACRP 2017). Owners of AFFF stocks should consider evaluating this tool to see if it can assist them in implementing BMPs for their specific situation.

## 3 AFFF Releases and Recommended Investigative Actions

After a release of AFFF and firewater containing AFFF, immediate cleanup of AFFF followed by an environmental investigation may be needed to determine the type and extent of environmental impacts and whether additional response actions are needed. Users should identify if there are state or local environmental agency requirements for notification that apply to their site and circumstances.

### 3.1 Immediate Cleanup of Standing Foam and Foam-Impacted Materials

One of the most effective and least expensive methods of minimizing human health or environmental impacts of an AFFF release is to quickly and thoroughly clean up contaminated materials. Cleanup may include recovering standing flammable liquids, foam or capturing water used during firefighting operations with a vacuum truck, pumps, or hand-held equipment (for example, shovels, mops, other absorbent materials). Once cleanup is completed, if a large amount of foam soaked into the ground, removal of soils saturated with the foam should be considered. In all of these initial cleanup efforts, response personnel should use proper PPE (for example, turnout gear, Tyvek, gloves, boots) during handling of contaminated media. This task may require temporary stockpiling of these soils (on a liner with a cover) before final disposal or treatment can be arranged. For more information, see the *Remediation Technologies and Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet.

### 3.2 Information Gathering After a Release of AFFF

For new releases, it is important to start the information gathering process as soon as possible after a discharge has occurred to maximize the quality of the information gathered and to be protective of human health and the environment. Questions to ask first responders or others with information related to the released AFFF include:

1. Based on readily available information (for example, Safety Data Sheets [formerly MSDSs], applicable MILSPECs), what are the active ingredients (name, concentration, proportions), brand, and manufacturer of the released foam? What volume was discharged?
2. What areas of the site were affected and are there drains, ditches, stormwater drainage systems, or other structures that could cause off-site migration of the foam?

3. Did the release occur inside a building (such as an airport hangar)? If so, it may be beneficial for the personnel to leave the structure until the AFFF has been removed from the building. The owner of the building may consider having the indoor air tested before the building is reoccupied. For more information, see the *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC, 2018).

## 3.3 Surface Delineation (Visual) After New Releases

Site delineation can be performed immediately after a discharge occurs by using visual observations of foam and standing water, as a guide. Site delineation becomes harder to conduct as time passes, so it is important to conduct an initial site evaluation and delineation effort as soon as it can be safely performed. Photographic documentation of the affected areas and the use of markers (for example, survey tape, lath, pin flags) to identify the location of where AFFF was released can help to ensure that the continued characterization effort will provide accurate results and fewer resources will be spent assessing unaffected areas.

## 3.4 Field-Screening for First Responders After Releases

Currently, field-screening methods are limited to visual observation as described above as well as placing AFFF-contaminated media (add a little water if medium is solid) in a clear container and shaking the container, looking for resulting foam. Foaming in the container would qualitatively indicate that the media in this area may contain residual levels of AFFF that may require cleanup. Screening for released AFFF in the field using mobile instrumentation may soon be a practical alternative and could provide a way to quickly delineate affected surface soils and groundwater. Sensor-based technologies are under development (Chen et al. 2013), as well as inexpensive high-throughput screening tools such as particle-induced gamma emission that quantifies total fluorine on surfaces (Shaider et al. 2017; Ritter et al. 2017) and is being modified for quantifying total fluorine in groundwater.

If field screening during the initial delineation indicates significant surficial and near-surface contamination is present, removing and stockpiling soils should be considered, in consultation with environmental professionals and consistent with regulatory requirements, to minimize potential leaching to groundwater or runoff to nearby surface water. Confirmatory sampling may be needed after removal of contaminated material or after screening if no contaminated material is observable. If concentrations are less than applicable actions levels (check with the individual state authorities to determine the site-specific action levels), then no additional remedial activities may be necessary. Knowledge regarding the volume released, the concentration of PFAS in the released product, whether it was a mixture or concentrate, and the area affected is important. If only a small volume of AFFF concentrate is released in combination with a large amount of fresh water and is dispersed over a large area, the concentration in soil may not warrant cleanup. The initial cleanup actions (capture of AFFF and standing water) and collection of confirmation samples may be all that is needed for site closure. The *Regulations, Guidance, and Advisories for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet includes more information.

## 3.5 Determining the Need for Further Actions

It is important to establish a working relationship with relevant stakeholders, including local or state regulatory agencies, preferably before, but at least immediately after a release of AFFF to determine the need for investigation and remedial activities. Developing and communicating documented processes for a facility with the stakeholders and regulatory agencies before a release occurs should be considered a best practice. The environmental media (for example, surface soil, subsurface soil, surface water, groundwater, sediment, biota) to be sampled are determined by identifying the potential media affected and in consultation with environmental professionals and consistent with regulatory requirements. The required site characterization effort will often become more involved and expensive as the time between release, discovery, and potential remedial actions increases. If a release is discovered immediately and remedial actions are taken promptly, the need for sampling activities is often reduced because fewer environmental media will be affected and potential impacts are more limited and easier to identify. Additional information about sampling and site characterization are included in the *Site Characterization Considerations, Sampling Precautions and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet. Additional information about remediation methods is included in the *Remediation Technologies and Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet).

## 3.6 Sampling After Discovery of a Historical Discharge

The sampling methods used, and locations investigated after an AFFF discharge, will depend on both the amount and type of foam released, as well as site-specific characteristics such as topography, affected media, land use, potential infrastructure, and presence or absence of environmentally sensitive areas. Information about sampling, precautions, equipment, and laboratory analysis methods, are included in the *Site Characterization Considerations, Sampling Precautions and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet. PFAS migration within and between different environmental media is influenced by many processes. The *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet includes more information on these processes. Except for conducting an initial sampling effort to confirm or refute a release of AFFF, entities collecting samples to delineate the degree and extent of PFAS should prepare and follow a detailed site sampling plan.

If a historical release of AFFF is suspected, it may be difficult to use visual observations to determine where to begin the delineation or characterization effort. Environmental professionals and state or local regulatory agencies should be consulted to determine investigation strategies and relevant regulatory requirements. For example, if a release occurred from a permanent structure (such as a tank or hangar fire-suppression system), the topography of the adjacent landscape, potential drainages or preferential pathways, or surface depressions may indicate where to begin a sampling effort. Gathering information from historical records (for example, internal incident reports or summaries, historic aerial photos, various documents available through a local regulatory agency) or interviewing individuals with knowledge of AFFF use and events at a facility may aid location of potential source areas.

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40 CFR 721.9582 Code of Federal Regulations, Part 721 – Significant New Uses of Chemical Substances, Section 712.9582 – Certain perfluoroalkyl sulfonates. https://www.gpo.gov/fdsys/granule/CFR-2011-title40-vol31/CFR-2011-title40-vol31-sec721-9582

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April 2020

U.S. Fire Administration
**Working for a fire-safe America**

COFFEE BREAK BULLETIN

# The Hidden Dangers in Firefighting Foam

Posted: Feb. 11, 2020

**Per- and polyfluoroalkyl substances (PFAS) are a large family of man-made chemical compounds found in a wide range of consumer products such as nonstick products, polishes, waxes, paints and cleaning products. Two PFAS compounds, perfluorooctane acid (PFOA) and perfluorooctanesulfonic acid (PFOS), may be present in firefighting aqueous film forming foam (AFFF) solutions.**

## Dangers

Certain PFAS can accumulate and stay in the human body for long periods of time. Long-term exposure to PFAS/PFOA/PFOS, in high concentrations, causes a buildup in the body. This buildup may have negative health effects like a risk of thyroid disease and testicular, kidney and bladder cancers.

### Prevent exposure to dangerous chemicals in AFFF

https://www.youtube.com/embed/vrxXdVfNLSc

## Protection against exposure

## Protection against exposure

PFAS/PFOA/PFOS may be orally ingested, absorbed through the skin or inhaled through exposure in the atmosphere. Personnel at departments that use firefighting AFFFs with PFAS/PFOA/PFOS should practice the following controls to stay safe from exposure:

- Replace older AFFF stocks with fluorine-free foam solutions.
- Contain and manage AFFF and water runoff.
- Wear personal protective equipment (PPE) and a self-contained breathing apparatus (SCBA) whenever handling AFFF.
- Properly remove and bag contaminated PPE prior to transporting.
- Use cleaning wipes on your face, neck and hands immediately after exposure.
- Clean contaminated PPE and SCBA before its next use.
- Shower within one hour of returning to the station or home.

### If you believe that you were exposed

See your occupational healthcare provider and document the PFAS/PFOA/PFOS exposure. Tell your provider about any concerns during your annual medical exam.

## Further reading

American Cancer Society (2016). Teflon and perfluorooctanoic acid (PFOA) .

Legislation impacting firefighting foam continues to evolve (September 2021)

The state of research on firefighter PFAS exposures (November 2021)

U.S. Agency for Toxic Substances and Disease Registry (2018). Per- and polyfluoroalkyl substances (PFAS) and your health: What are the health effects?

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A MESSAGE FROM WISCONSIN DNR & WISCONSIN STATE FIRE CHIEFS ASSOCIATION

# Firefighting Foam & PFAS in Wisconsin

PFAS (perfluoroalkyl and polyfluoroalkyl substances) are a group of synthetic chemicals used in industry and consumer products worldwide since the 1950s. They do not break down in the environment for extremely long periods of time and they accumulate in the human body. Exposure to certain PFAS substances may cause adverse health effects. For the purpose of this document, the terms 'PFAS foam' and 'PFAS-containing foam' mean 'foam with intentionally added PFAS.'

Some firefighting foams currently used to extinguish Class B and A/B (flammable liquid) fires include intentionally added PFAS. Effective Sept. 1, 2020, state law limits when these foams can be used to ensure protection of human health and the environment. (See 2019 Wisconsin Act 101 and Wis. Stat. § 299.48.) The DNR has been directed to promulgate emergency and permanent rules on this topic.

## When PFAS Foams Can & Cannot Be Used

### PROHIBITED:

**TRAINING with foams that include intentionally added PFAS is prohibited by law effective Sept. 1, 2020. On this date, the following exemptions and requirements apply:**

### ALLOWED:

- **PFAS-containing foams CAN BE USED for EMERGENCY firefighting & fire prevention operations.**
  - » Take measures to prevent discharge into lakes, streams, rivers & sewers, per NR 708.
  - » Safety Data Sheets from the foam manufacturer must be acquired, retained & available.

- **PFAS-containing foams CAN BE USED for TESTING purposes.**
  - » Testing facilities must contain, store, treat & dispose of foam appropriately.
  - » **Flushing or draining foam into storm or sanitary sewers is PROHIBITED.**

When PFAS foam is discharged to the environment, immediately call* the **24-hour Emergency Hotline:**

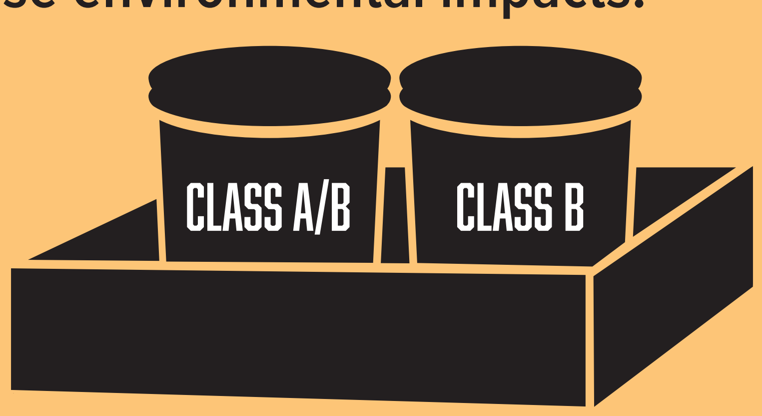
**1-800-943-0003**

*Without hindering firefighting or fire prevention operations.

## WHEN PFAS-CONTAINING FOAM IS USED FOR EMERGENCIES OR TESTING

### Storage

**Use secondary containment when storing foam.** Even small leaks can cause environmental impacts.




### Emergencies

Work with the DNR and responsible parties to **contain** deployed foam, **limit** environmental impacts to the extent practicable, and **immediately report the discharge**.

### Disposal


Develop a disposal plan for foam containers and recovered foam solutions with **environmental and hazardous waste disposal contractors**.

**SAFEGUARDING WISCONSIN'S COMMUNITIES & NATURAL RESOURCES**


RR-0118-E | Wisconsin Department of Natural Resources

# Best Practices for
# Fire Protection Water Discharge

**History - Colorado State**

In 2009 the Colorado Department of Health & Environment CDPHE created additional rules and regulations for fire water discharge. State licenses with fees became a requirement from fire protection contractors for fire water discharge. Along with the fees came fines for those that did not abide with the new state requirements. Only a few responsible contractors pursued the required permits to avoid punitive measures and fiscal penalties. A fire water discharge task group was created with assorted stake holders to address the new criteria. In the end, the criteria for permits for fire water discharge did go away. To avoid future state requirements, it is strongly recommended that contractors engaged in testing and maintaining fire protection systems develop and utilize best practices.

For the latest information from CDPHE, check out the guidance for discharges associated with fire suppression systems dated December 31, 2014 on their website. Additional information on water quality permitting policies can be found in area CW5 at
https://www.colorado.gov/pacific/cdphe/water-quality-permitting-policies

**Purpose**

Fire protection systems have proven very reliable in controlling fires and protecting lives and property. Although the water discharged from systems does not constitute a large percentage of storm water pollution, some activities can pose a threat to our health and the quality of water in our streams and aquifer. To ensure our life safety systems are dependable they should be inspected, tested, and maintained. This document was created to provide guidance regarding best practices to avoid and control possible contamination of Boulder County waters when inspecting, testing, and maintaining fire suppression systems to include fire hydrants.

**Definitions**

Potable water = Water that is safe to drink

Dark water = Was potable water before entering a fire protection system. The longer it is within a system, the worse the smell, the darker the water, and the greater the iron content.

Solutions = Potable or dark water with additives other than chlorine to make potable water.

**Scope**

- Discharges from water-based fire protection system acceptance testing.
- Discharges from periodic water-based fire protection system testing and maintenance.
- Discharges from Fire hydrant testing.
- Discharges from water-based fire protection system leaks and emergency repairs.

**Safety**

- Drain inlets are open and capable of handling the flow

- Water discharge will not cause flooding or damage
- Will not adversely impact vehicles, equipment, or pedestrians
- Will not create slick or unsafe conditions like ice during the colder months
- High concentrations of Glycerin and Glycol cab be flammable
- Additives to water based systems can be hazardous to our waters and aquatic life

**Discharges Types**

**Water without additives**

- City Water
- Open Source – Steams, Lakes

**Water with Additives**

- Glycerin - Typically used in plastic systems to prevent freezing and can be flammable in higher concentrations
- Glycol - Typically used in steel and copper systems to prevent freezing and can be flammable in higher concentrations – Not allowed in plastic pipe!
- MIC Additives - Additives to water to prevent microbiologically Induced Corrosion
- Foam Solutions – Typically proportioned to water to control fuel fires
- Concentrated Chlorine – Found on combined fire and domestic piping systems to disinfect and sanitize the system

**Water without additives**

Most testing of fire protection systems will typically discharge water without additives flowing clear water shortly after beginning the flow. Clear water is typically clean water with the lowest density of contaminants per gallon measured in parts per million (ppm).

**Large Flows**

The larger flows are typically clean and clear. Some examples of larger flows for testing and maintenance are as follows: Remove code reference?

- Flushing Underground – NFPA 13 – NFPA 24
- Main Drain Test – NFPA13
- Forward Flow Test of Backflow Preventer – NFPA 13
- Pressure Regulating Valve Testing – NFPA 13 – NFPA 14
- Standpipe Testing – NFPA 14
- Fire Pump Testing – NFPA 20
- Hydrant Testing – NFPA 13 – NFPA 24

**Large Flow Best Practices**

- Try to direct water toward grassy areas.
- Avoid discharge into sensitive areas like Boulder Creek as chlorine may not dissipate quickly and could endanger fish and other aquatic life.
- Consider erosion problems before flowing water so they can be avoided.
- Avoid creating quantities of sediment that could result in adverse impacts to aquatic animals

- Consider if water flow may pick up additional contaminants such as oil or contaminated soils.
- Consider curbs and ditches are adequate to handle the flow without creating a buildup of silt that cannot be contained and removed.
- Ensure water flows do not have solutions with like MIC additives, Glycerin, Glycol, or foam additives.
- Consider debris on road surfaces that may flow into sensitive areas
- Consider the temperature to avoid ice and safety liabilities.

### Dark Water

Dark water is found in existing systems that have not been drained for long periods. Dark water has a higher concentration of iron that naturally builds up within fire protection system piping. When tenant finish requires the draining of water within the pipe, we are likely to find dark water that can stain concrete.

### In Order of Preference

1. Sanitary sewer – Run hose to floor drain
2. Landscape areas – Infiltration, no discharge, deep groundwater
3. Landscape areas – Storm system, more than 1,000' from surface water
4. Storm sewer more than 1,000' from surface water
5. To nearby surface water (Capture and treat)

### Dark Water Best Practices

- Design systems to allow drainage to floor drain with air gap within water entry room that can be visually observed when operating drain valve to avoid flooding within the building. Dave, this is required in Seattle, Bellevue, and other cities in the Northwest
- When floor drains are incapable of handling main drain test, consider design allowance for adding hose on elbow at exterior wall allowing the water to be discharged to a floor drain for water treatment.
- If you can't direct water discharge to floor drain by hose, run hose so that runoff will flow over grassy vegetated areas prior to entering receiving waters or storm drains
- Or filter the storm drains that may be impacted to prevent the runoff from entering the storm drain system without flooding.

## Water with Additives

### Glycerin and Glycol

Previous to 2010 glycerin and glycol were commonly used in high concentrations to avoid freeze damage to life safety systems. The higher concentrations can be very combustible and recent codes limit their application. All solutions with glycerin or glycol should not be allowed to go to storm drains. Quantities less than 500 gallons should be directed to floor drains for water treatment. The water treatment plant should be contacted prior to disposal of larger quantities and they may require the discharge to be metered to lower the solution density for treatment. Never drain any subsystem with additives to storm drains.

**MIC Additives**
MIC additives burned a first responders eyes in West Metro and made National news. MIC additives in life safety systems are not allowed without prior approval of the AHJ. When signage is discovered MIC additives are within a system, the fire marshal shall be notified prior to draining system. Solutions with MIC additives must be captured for appropriate disposal. Do not assume MIC additives can go to floor drains without first contacting the water treatment plant. I assume Dave has modifications for this.

**Foam Solutions**
Foam solutions are typically found protecting hangars at airports and are commonly used to control fuel fires. Prior to testing foam systems, a plan should be created to address environmental concerns by capturing or containing the foam solution created. Annual testing creates foam solutions that even if dried can accumulate. Plan system testing so as to properly contain and dispose of foam solution created by the tests. Provide for containment, treatment, and proper disposal of foam solution – do not release directly to the environment.

Direct foam solution to lined evaporative containment ponds when possible.

Contact water treatment plant prior to directing toward any floor drain. Large releases of foam solution to a water treatment plant can kill the microorganisms required for waste disposal. One option may be to meter solution slowly toward water treatment plant.

It is recommended that the design of new fixed systems based on Class B foams also integrate the collection of runoff water.

**References:**


- Fire Fighting Foam Coalition – Best Practices Guidance – March 2016
- California Storm Water Best Management Practice Handbooks - 1993 & 2002
- California State Fire Marshal, Water-Based Fire Protection System Discharge Best Practices Manual – September 2011
- Department of the Army ETL for AFFF Disposal 1110-3-481 dated 31 March 1997


**Links:**
http://spillsource.net/STORMWATER/CATCH%20BASIN%20PROTECTION/STORMWATER_CATCH_BASIN.html

# GUIDANCE FOR DISCHARGES ASSOCIATED WITH FIRE SUPPRESSION SYSTEMS

*December 31, 2014*

This discharge guidance provides information regarding discharges associated with fire suppression systems, including potable water from distribution systems that supply the fire suppression systems and non-potable water from water-based fire suppression systems. Discharges addressed in this policy include all releases of water to state waters (including streams, lakes, wetlands, groundwater, etc.); to the ground; and to conveyances to surface water such as storm sewers, street gutters, and ditches.

This document provides guidance on requirements included in the following policies, and does not establish new policy or requirements.

- **Colorado Water Quality Control Division Implementation Policy Clean Water 5, Discharge from Water-Based Fire Suppression Systems, December 19, 2014.**
  - o Identifies discharges from water-based fire suppression systems for which the Water Quality Control Division will not seek application for CDPS permit coverage or take enforcement action against those operators that have not obtained permit coverage, and identifies limitations for those discharges.
- **Discharge of Potable Water Guidance under the Colorado Water Quality Control Division Water Quality Policy 27, Low Risk Discharges, August 2009.**
  - o Identifies discharges from potable water systems for which the Water Quality Control Division will not seek application for CDPS permit coverage or take enforcement action against those operators that have not obtained permit coverage, and identifies limitations for those discharges.

The two policies listed above identify discharges associated with fire suppression systems for which the Water Quality Control Division will not seek application for CDPS permit coverage or take enforcement action against those operators that have not obtained permit coverage. The policies address two different sources of water, discharge from water-based fire suppression systems (Section C, below) and discharges from potable water distribution systems (Section B, below). Between these two policies, most discharges associated with maintaining and testing fire suppression systems are addressed. Section A, below, provides information of some discharges associated with fire suppression that are not allowed under these policies.

## Definitions

- **Backflow Prevention Assembly or Device:** Any mechanical assembly or device installed at a water service line or at a plumbing fixture to prevent a backflow contamination event, provided that the mechanical assembly is appropriate for the identified contaminant at the cross connection and is an in-line field-testable assembly.
- **Operator:** The party that has operational control over the discharge, including the ability to meet the applicable limitations.
- **Potable Water:** Water suitable for human consumption in accordance with Colorado Primary Drinking Water Regulations (5 CCR 1002-11), or water intended for human consumption from a public or private supply system not subject to 5 CCR 1002-11.
- **Source Water:** The water that is used to supply the water based fire suppression system.
- **Water-Based Fire Suppression System:** Device, equipment, and systems used to extinguish or control a fire using water. The system also includes tanks or reservoirs used to contain supply water for the system.

## A. Discharges NOT allowed by division policies

**1. Types of discharges associated with fire suppressions not allowed by policy:**

i. **Non Potable Water Systems:** Water that is from a system not supplied by potable water (see definitions). Examples include, but are not limited to, fire-suppression systems and their associated supply systems that are supplied with pond water, reclaimed waste water, or from a non-potable well. Note that discharges from some systems supplied by tanks or reservoirs filled from a potable water source may still be allowed; refer to Part 1 of the Background section of Clean Water Policy 5.

ii. **Added Chemicals/Materials:** Any water for which chemicals or other materials are added. Examples include, but are not limited to, water from fire suppression systems where antifreeze, biocides to reduce microbial corrosion, extinguishing agents, or foaming agents have been added.

iii. **Water Used for other Purposes**: Any water that is used for an additional process other than supplying the fire suppression system. Examples include, but are not limited to, water that has been used for washing, heat exchange, manufacturing, or hydrostatic testing of pipelines not associated with the fire suppression system.

iv. **Discharges not Meeting Limitations:** Any discharge for which the limitations included in the Clean Water 5 or Potable Water Guidance under Water Quality Policy 27 has not been met. These limitations are summarized below under the allowable discharge sections.

2. **Guidance for disposing of water from these sources:**
Water that is not allowed under one of the policies must be disposed of by alternative means. This typically involves capturing the water or routing it to an alternative disposal location. Options for disposal include requesting authorization from the wastewater treatment facility operator to direct the water to a sanitary sewer, and injection back into the fire suppression system when allowable.

If the water will go to the sanitary sewer, contact the local wastewater treatment facility and collection system prior to discharge. This must be done to ensure that the collection system and facility is able to accept the flow and pollutants. System owners may grant blanket authorization to direct the water to their systems. Additional local approvals, restrictions, and guidelines may apply.

Individual discharge permit coverage may still be available from the division to discharge to state waters, but is not expected to be a solution for most operators and is therefore outside of the scope of this guidance.

## B. Allowed Potable Water Discharges (prior to the backflow prevention assembly or device):

The Low Risk Policy, Water Quality Policy 27, and the Potable Water Guidance address water from within a potable water distribution system that supplies a fire suppression system. This is the water prior to the backflow prevention assembly or device. This guidance refers to water from this source as potable water. Potable water that is discharged in accordance with the guidance is determined to have a low potential risk to water quality.

1. **Potable water discharges allowed by policy:** The discharge must be from a potable water distribution system, tank, or storage that has been maintained for potable water distribution use. Discharges from a distribution system, tank, or storage that is used for conveyance or storage of materials other than potable water are not authorized. The water must be prior to the back flow prevention assembly or device. For water downstream of the backflow prevention assembly or device, refer to Section C, below.

2. **Limitations:** (Note these limitations are also applicable to water from within the fire suppression system.)

   i. The discharge of cleaning materials or chemicals, including dyes, is strictly prohibited.
   ii. The water shall not be used in any additional process.
   iii. The discharge shall not cause erosion of a land surface. Erosion for the purpose of the policy is intended to address conditions that could cause pollution of the receiving water and includes visible erosion such as forming rills or gullies on the land surface. It is understood that minimal suspension of sediment is inherent to any water running across soils. However potential water quality impacts should be minimized through practices such as diffusing flows and avoiding flows across bare soils.
   iv. The discharge shall not contain solid materials in concentrations that can settle to form bottom deposits detrimental to the beneficial uses of the state waters or form floating debris, scum, or other surface materials sufficient to harm existing beneficial uses.
   v. All discharges must comply with the lawful requirements of federal agencies, municipalities, counties, drainage districts, ditch owners, and other local agencies regarding any discharges to storm drain systems, conveyances, ditches or other water courses under their jurisdiction. The guidance included in this document in no way reduces the existing authority of the owner of a storm sewer, ditch owner, or other local agency, from prohibiting or placing additional conditions on the discharge.
   vi. If the discharge is directly to a state surface water (any stream, creek, gully, whether dry or flowing), it must not contain any residual chlorine. The operator is responsible for determining what is necessary for removing chlorine from the discharge. If the discharge is to a ditch, chlorine content may be limited by the owner of the ditch. However, if the ditch returns flow to classified state waters, it must not contain any residual chlorine at the point where it discharges to the classified state water.
   vii. Best management practices should be implemented as necessary to meet the conditions below:
      - For discharge to the ground, the water should not cause any toxicity to vegetation. When discharging, allow the water to drain slowly so that it soaks into the ground as much as possible.
      - Removal of any residual chlorine must be done for any direct discharge to state surface waters, or for any discharge to a storm sewer or conveyance where the chlorine will not dissipate prior to reaching a state surface water. Dechlorination, if necessary, may be achieved by allowing water to stand uncovered until no chlorine is detected. The use of dechlorinators as best management practices to remove chlorine is allowed by the policies, and the proper use of chemicals as part of the operation of a dechlorinator is therefore allowed for. The operator must ensure proper quantities and rates are used based on the concentration of chlorine, that adequate mixing occurs, and that enough time is allowed prior to flows reaching a surface water for the dechlorination chemicals to react with the chlorine in the water.
      - The discharge should be conducted to minimize the potential to pick up additional suspended solids from the fire suppression system or as the water flows across surfaces such as pavement or vegetation.
      - When possible, a best management practice, or combination of practices, for filtering or settling suspended solids and other debris should be used to remove suspended solids or other debris. Examples of suspended solid removal practices include, but are not limited to, check dams, filter bags, and inlet protection. These devices should be used and maintained in accordance with the manufacturer's specifications.

C. **Allowable Fire Suppression System Water Discharges (downstream of the backflow prevention assembly or device)**

The Discharge from Water-Based Fire Suppression Systems policy, Clean Water 5, addresses water that is discharged from within a fire suppression system that is isolated downstream of a backflow prevention assembly or device for that system. This guidance refers to water from this source as fire suppression system water. Unlike potable water, fire suppression system water has a potential to result in water quality impacts as a result of the various metals that the system may contribute to this discharge. The potential is greater for discharges to surface water than it is to the ground water via a discharge to the ground. **Therefore, this guidance strongly encourages operators to dispose of the water into a sanitary sewer system when feasible and allowed, or to the ground.**

1. **Fire Suppression System discharges allowed by policy:**
   The discharge must be from a water-based fire suppression system for which the source water is potable water. Although discharges to surface waters are allowed, operators are strongly encouraged to minimize the need to discharge to surface water. Elevated metals in the discharge do have the potential to be detrimental to surface water quality and both aquatic life and drinking water uses. When surface water discharges do occur, please refer to the practices listed in subsection 3 to help reduce the potential for impacts.

2. **Limitations for Fire Suppression System discharges:**
   i. All limitations listed above in Section B.2 must be met in addition to the limitations listed below.
   ii. The source water used to supply the fire suppression system must be potable water.
   iii. The operator of the discharge must be registered (i.e. certified) by the Colorado Division of Fire Prevention and Control to perform the activity resulting in the discharge, including but not limited to registered fire suppression contractors, fire suppression inspectors, and backflow contractors.
   iv. The operator that is registered in accordance with limitation iii, above, shall keep records for every discharge event. The records shall include the purpose (e.g., type of test/maintenance being conducted), date, time, location, and estimated volume for every discharge to a state water, storm sewer, or to the ground.

3. **Additional Guidance to Minimize Water Quality Impacts**
   Although the following measures are not required, operators are encouraged to take these, and other, measures to try to reduce the discharge of pollutants to waters of the state and reduce the potential for water quality impacts.

   i. When feasible, avoid discharging to surface waters, or conveyances leading to surface waters. The operator should attempt to direct water to either a sanitary sewer system or to a location where it can soak into the ground. If the water will go to the sanitary sewer, contact the local wastewater treatment facility and collection system prior to discharge. System owners may grant blanket authorization to direct the water to their systems. This must be done to ensure that the facility is able to accept the flow and pollutants. Additional local approvals, restrictions , and guidelines may apply.
   ii. If it is not feasible to avoid a surface water discharge, try to minimize the quantity of water discharged if possible. Specifically, attempt to avoid discharges to surface water that are visibly more turbid, such as may occur at the beginning of the discharges.
   iii. Avoid discharges to sensitive surface waters. Specifically, wetlands and small streams or ponds that support aquatic life may be more susceptible to impacts due to the lack of dilution and flushing that may occur. Avoid discharge immediately upstream of water supply intakes.
   iv. Best management practices identified above (B.2.vii) can further help reduce the transport of pollutants to surface waters and should be used when possible.
   v. If sediment or other solids are deposited to the ground during the discharge, collect and dispose of these residual materials. This will help avoid the potential for future storm events to carry the materials to surface waters.

<table>
<tr><td rowspan="4">Water Quality Control Division<br><br>Implementation Policy<br><br>Colorado Department of Public Health and Environment</td><td>Implementation Policy Number: Clean Water 5</td></tr>
<tr><td>Statutory or Regulatory Citations:<br>Colorado Water Quality Control Act<br>Federal Clean Water Act<br>5 CCR 1002-31</td></tr>
<tr><td>Key Words: Colorado Discharge Permit System, Fire Suppression, Discharge, Low Risk, Compliance</td></tr>
<tr><td></td></tr>
<tr><td rowspan="4">Discharge from Water-Based Fire Suppression Systems</td><td>Approved By:<br>Richard Parachini Digitally signed by Richard Parachini DN: cn=Richard Parachini, email=dparachi@dphe.local, o=CDPHE-WQCD, l=Denver, CO Date: 2014.12.19 11:53:31 -07'00'</td></tr>
<tr><td>Approval Date: December 19, 2014</td></tr>
<tr><td>Effective Date: December 19, 2014</td></tr>
<tr><td>Scheduled Review Date: January 2, 2020</td></tr>
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## Purpose:

The purpose of this policy is:

1. To define a category of discharges of non-potable water from water-based fire suppression systems for which the Water Quality Control Division will not seek application for CDPS permit coverage or take enforcement action against those operators that have not obtained permit coverage.
2. To establish that the Water Quality Control Division will not issue general permit coverage for discharges from water based fire suppression systems.

## Authority:

In accordance with the Colorado Water Quality Control Act, and consistent with the federal Clean Water Act, no person shall discharge any pollutant into any state water from a point source without first having obtained a permit from the Water Quality Control Division. The Colorado Water Quality Act also includes provisions for oversight and enforcement of the requirements to obtain permit coverage for point source discharges. However, neither the act nor the implementing regulation for the act compels specific compliance or enforcement responses for discharges that occur without permit coverage. Responses to such occurrences are instead contained within implementing policies and procedures. Consistent with this process, this policy relies on the description provided in the act and regulation for the Water Quality Control Division to determine the appropriate response to the occurrences of unpermitted discharges.

## Definitions:

Backflow Prevention Assembly or Device: means any mechanical assembly or device installed at a water service line or at a plumbing fixture to prevent a backflow contamination event, provided that the mechanical assembly is appropriate for the identified contaminant at the cross connection and is an in-line field-testable assembly.

Operator: The party that has operational control over the discharge, including the ability to meet the limitations in this policy.

Potable Water: Water suitable for human consumption in accordance with Colorado Primary Drinking Water Regulations (5 CCR 1002-11), or water intended for human consumption from a public or private supply system not subject to 5 CCR 1002-11.

Source Water: means the water that is used to supply the water based fire suppression system.

Water-Based Fire Suppression System: Device, equipment, and systems used to extinguish or control a fire using water. The system also includes tanks or reservoirs used to contain supply water for the system.

## Applicability:

This policy is applicable to the point source discharge of non-potable water from water-based fire suppression systems that is not associated with an emergency fire fighting activity. For the purposes of this policy, water is non-potable when it is within a fire suppression system that isolated downstream of a backflow prevention assembly or device for that system. The policy is applicable to discharges to surface waters, storm sewers, and to the ground via land application.

This policy is not applicable to discharges of potable water that is directly from a potable water distribution system, tank or storage that has been maintained for potable water distribution use, or discharges from a fire suppression system where the system is installed as a portion of a potable water supply system in a multi-purpose system for which fire sprinkler heads are integrated into the potable water system. Discharges of potable water are addressed by the Water Quality Control Division's Low Risk Discharges Water Quality Policy 27 - Low Risk Discharge Guidance for Discharges of Potable Water.

This policy is not applicable to discharges to ground water subject to regulation by the EPA or by implementing agencies under Senate Bill 181, which includes discharges to facilities operating under a permit issued pursuant to the Underground Injection Control provisions of the Safe Drinking Water Act, 42 U.S.C. 300f and to Surface Impoundments or Other Engineered Units Subject to Colorado Solid Waste Rules 6 CCR 1007-2.

## Policy:

While regulations do require that operators of point source discharges obtain a CDPS permit, the Water Quality Control Division will not take enforcement action for those operators which have not obtained CDPS permit coverage for discharges from water-based fire suppression systems, providing that the operator can prove that all of the following limitations have been met:

1. The source water used to supply the water-based fire suppression system is potable water.
2. No chemicals or other materials are added to the fire suppression system or the potable source water.
3. The water to be discharged is not used for any additional process other than supplying the fire suppression system. Processes include, but are not limited to, any type of washing, heat exchange, manufacturing, and hydrostatic testing of pipelines not associated with the fire suppression system.
4. The operator of the discharge is certified by the Colorado Division of Fire Prevention and Control to perform the activity resulting in the discharge, including but not limited to certified fire suppression contractors, fire suppression inspectors, and backflow contractors.
5. The discharge shall not cause erosion of a land surface.
6. If the discharge is directly to a classified state surface water (e.g., a stream, creek, gully, etc., whether dry or flowing), it must not contain any residual chlorine. The operator is responsible for determining what is necessary for removing chlorine from the discharge. If the discharge is to a ditch that is an unclassified state water, the flow must not contain any residual chlorine contributed by the discharge at the point where the ditch flows into a classified state water. Note that chlorine content may still be limited by the owner of the ditch.
7. The operator that is certified in accordance with limitation 4, above, shall keep records for every discharge event. The records shall include the purpose (e.g., type of test/maintenance being conducted), date, time, location, and estimated volume for every discharge to a state water, storm sewer, or to the ground.

The Water Quality Control Division will develop and maintain guidance for operators discharging in accordance with this policy that includes control measures, in addition to those required to meet the conditions above, which are intended to be protective of the beneficial uses of receiving waters.

This approach to enforcement will not apply to criminal violations or in situations where there are egregious circumstances, such as those resulting in serious environmental harm, adverse impacts to the beneficial uses of state waters, or which pose an imminent or substantial endangerment to public health and/or the environment.

It should be noted that unpermitted surface water discharges could be subject to third-party or federal enforcement even where control measures are implemented. Operators wishing to obtain the additional legal protection provided by permit coverage can submit an individual permit application for these discharges to the Water Quality Control Division for processing.  The Water Quality Control Division has decided not to issue a general permit for discharges from fire suppression systems.

The issuance of this policy does not convey any property or water rights in either real or personal property, or stream flows, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights. All discharges must comply with the lawful requirements of federal agencies, municipalities, counties, drainage districts, and other local agencies regarding any discharges to storm water conveyances, or other water courses under their jurisdiction.

This policy in no way limits the Water Quality Control Division's authority to enter and inspect premises and records, as provided in the Colorado Water Quality Control Act (Section 25-8-306).

This policy is intended to provide operational direction to the Water Quality Control Division. Nothing in this policy shall be construed to preclude the authority of the Water Quality Control Division pursuant to any applicable state law or regulation under authority granted by Section 510 of the Clean Water Act.

## Background:

This policy documents the Water Quality Control Division's determination that it will not actively pursue permitting or enforcement against operators that have not obtained Colorado Discharge Permit System permit coverage for discharge of non-potable water that meet the conditions of the policy (referred to in this document as discharges within the scope of the policy).  Discharges of potable water associated with fire suppression systems are separately addressed by the Low Risk Discharge Guidance for Discharges of Potable Water in accordance with the division's Low Risk Discharges Water Quality Policy 27. The division will issue separate operator guidance outside of this policy to comprehensively address both types of discharges (discharges within the scope of this policy and discharges addressed in the low risk discharge guidance). This separate guidance will address practices for such discharges and alternative disposal methods for discharges that are not discussed in the scope of the two policies.

Water-based fire suppression systems are commonly installed in structures in Colorado. In the vast majority of cases, these systems are supplied from a potable water supply system and isolated by a backflow prevention assembly or device. These systems can either be "wet," meaning that water is maintained within the pipes downstream of the backflow prevention assembly or device, or "dry," meaning that water is only fed into the system when needed. The construction, maintenance, testing, and modification of these systems require water contained in the systems occasionally be released.

Discharges from water-based fire suppression systems are short term, infrequent-discharges of variable volume. Discharges from a single event are often of low volume, such as inspector tests which typically generate less than 50 gallons. Other more infrequent activities can generate higher volumes, such as leak tests and large system drain-downs that may generate 3000-4000 gallons from a single event. Multiple simultaneous discharges from these systems to the same storm sewers and/or the same stream segments may occur in areas with high concentrations of buildings, such as downtown urban areas with high-rise office buildings.

In some cases it is feasible for discharges to be either directed into a sanitary sewer or collected and subsequently discharged to the sanitary sewer. However, operators in Colorado have found that in many cases it is not practicable to prevent the discharge of water from these systems from reaching the ground or state surface waters (including discharges to storm sewers). When such discharges do occur to the ground or state waters, it is not currently industry practice to provide treatment for such discharges, and practicable on-site treatment options have currently not been identified.

Previous division practice has been to authorize discharges from water-based fire suppression systems under the CDPS general permit for Discharges Associated with Hydrostatic Testing of Pipelines, Tanks, and Similar Vessels, COG604000. Twenty-three permit certifications were issued under this general permit to operators for discharges from water-based fire suppression systems. Permit certifications were issued to cover multiple undefined outfall locations, and the majority of certifications authorized discharges from unlimited outfalls anywhere in Colorado. Numeric effluent limits in the general permit were based on end of pipe concentrations and did not account for available mixing within the receiving water. Only two of the permitted operators submitted Discharge Monitoring Reports (DMRs) associated with the discharges covered under these certifications. For those discharges for which DMRs were submitted, exceedances of the numeric effluent limitations for iron and total suspended solids were identified. It is assumed that discharges likely occurred under the other 21 permit certifications authorized by the division, but for various reasons, including a lack of understanding of permit requirements, monitoring and reporting including the submission of the DMRs did not occur. In addition, the 23 permitted operators represent only a small percentage of operators in the state performing similar activities resulting in discharges from fire suppression systems.

**Discharges of Potable Water versus Non-Potable Water**
This policy is one of two policies issued by the division to address discharges from water based fire suppression systems. This policy address discharges of non-potable water, while the Low Risk Discharge Guidance for Discharges of Potable Water under the Low Risk Discharges Water Quality Policy 27 addresses discharges of potable water. Potable water is water that is suitable for human consumption in accordance with Colorado Primary Drinking Water Regulations (5 CCR 1002-11), or water intended for human consumption from a public or private supply system not subject to 5 CCR 1002-11.

The division Low Risk Discharge Guidance for Discharges of Potable Water under the Low Risk Discharges Water Quality Policy 27 identifies discharges of potable water for which the division has conditionally determined it will not actively pursue permitting or enforcement. The Low Risk Discharge Guidance for Discharges of Potable Water addresses:

- water from a potable water system that supplies the fire suppression system via a backflow prevention assembly or device; and
- water from a multi-purpose fire suppression system that is integrated in with the potable water system.

Refer to the Low Risk Discharge Guidance for Discharges of Potable Water for additional conditions and guidance.

This policy addresses discharges of non-potable water associated with fire suppression systems that are outside of the scope of the potable water guidance. Water isolated downstream of a backflow prevention assembly or device is no longer maintained as potable water and therefore the Low Risk Discharge Guidance for Discharges of Potable Water is not applicable. Non-potable water in fire suppression systems has the potential to contain pollutants resulting from the conditions in the system (e.g., metals from pipe corrosion), or chemical additives. In some cases the quality of the water may not significantly differ from potable water. However, the potential for contribution of pollutants can vary widely depending on a number of variables, such as the length of time the water is present in the fire suppression system, and the nature of the pipes (e.g., composition, age, condition).

**Potential Pollutants in Water-Based Fire Suppression Systems Discharges**

1. **Potable Source Water**
   The Low Risk Discharge Guidance for Discharges of Potable Water documents the division's determination that discharges of potable water are, with proper management, not expected to contain pollutants in concentrations that are toxic or in concentrations that would cause or contribute to a violation of a water quality standard. The division maintains this determination regarding the potential for pollutant contributions associated with potable source water for fire suppression systems. This policy is consistent with the Low Risk Guidance for Potable Water in its incorporation of limitations and control measures to address chlorine as a potential pollutant associated with the potable water source.

   In some cases, potable water is routed for storage in a tank or reservoir for the purpose of supplying the fire suppression system. Because the stored water is not maintained as potable, discharges from the pond or supplied fire suppression system are not within the scope of the Low Risk Discharge Guidance for Discharges of Potable Water. However, because the original source water was potable, the fire suppression system would still be considered supplied by potable water supply systems (see condition 6 of the policy), and therefore would be within the scope of this policy as long as the remaining conditions are met. If fire suppression water that would meet the limitations of this policy is recirculated back into the storage system to augment the direct potable water source, water from that system can still be considered supplied by a potable water supply systems within the scope of this policy if it does not result in a measurable increase to concentrations of iron, zinc, lead, or copper. However, if the recirculation results in increased concentration of these pollutants, the conditions would be different from what was evaluated for potable water systems and discharges from the system would be outside of the scope of this policy.

2. **Non-Potable Source Water**
   Fire suppression systems can be supplied with non-potable water. Examples include fire-suppression systems supplied with pond water, reclaimed waste water, or from a non-potable well. Due to the variability of potential pollutants in such undefined water sources, this policy does not address discharges from systems supplied by non-potable water.

3. **Additives**
   Chemicals can be added to the fire suppression system or to the source water, including, but not limited to, antifreeze, biocides to reduce microbial corrosion, extinguishing agents, and foaming agents. Due to the variability of potential pollutants associated with additions to the system, this policy does not address discharges from systems containing chemical additives.

4. **Contributions from Pipes**
   Fire suppression systems may utilize a variety of materials for piping. The most common material is black steel. Copper and various plastic materials (e.g., polybutylene and chlorinated polyvinyl chloride) are also used.

   Black steel pipe used in fire suppression systems has the potential to corrode and can contribute iron and, in the case of galvanized pipes, zinc to discharges of water from the system. Zinc contributions may also occur from coatings applied to welds, and possibly from some valves and fixtures. Information on elevated concentrations of iron and zinc in water-based fire suppression systems was published in reports by Alleman, I.E.: Milke, J.A.; and Hickey, H.E. (1981) and Duranceau, Steven J., Jacquline V. Foster, and Jack Poole. (1998).

   Table 1 provides a summary of total zinc concentrations from main drain flushes that were identified in the Duranceau et al. (1998) report. Data from main drain flushes were evaluated because it is expected to be representative of discharges that would occur under this policy, as opposed to data drawn from specific locations within the system. The range of average and median values provided represent averages for different durations of the flushes provided in the report. It is of note that the maximum concentration identified was significantly higher than the second highest value of 4.73 mg/l and the third highest value of 1.92 mg/l. A total of 79 nationwide sites were included in the study and reported zinc data for system flushes.

| **Table 1: Summary of Zinc Data** (Duranceau et al., 1998) | | | |
|---|---|---|---|
| | Maximum | Average | Median |
| Total Zinc (mg/l) | 24 | 0.24 – 0.53 | 0.04-0.05 |

Total iron concentrations from main drain flushes that were identified in the Duranceau et al. (1998) report are identified in Table 2. The range of average and median values provided represent averages for different durations of the flushes provided in the report. Data indicated that highly elevated concentrations of iron occurred on a frequent basis; with seven sites exceeding 100 mg/l. A total of 79 nationwide sites were included in the study and reported iron data for flushes.

| **Table 2: Summary of Iron Data** (Duranceau et al., 1998) | | | |
|---|---|---|---|
| | Maximum | Average | Median |
| Total Iron (mg/l) | 351 | 15.0 – 25.1 | 2.90-4.76 |

The two studies reviewed by the division did not identify dissolved versus suspended forms of zinc and iron. However, the primary source of the zinc and iron is pipe corrosion resulting in particulate metals; therefore the division has assumed that the concentration is representative of the suspended form and that dissolved contributions are not significant. This assumption is supported by data from Duranceau et al. (1998) and Alleman et al. (1981) identifying that Total Dissolved Solids (TDS) is not significantly elevated in the systems tested. Additional support for this assumption is provided by data submitted to the division in DMRs, discussed below, for fire suppression systems that identified elevated Total Suspended Solids (TSS), but a very low occurrence of dissolved iron above the detection limit. Because the presence of elevated dissolved zinc in discharges could pose significantly different potential impacts to beneficial use, the division specifically intends to seek further information regarding this assumption and will revise this policy as necessary based on any additional information.

The division received 33 sample results for dissolved iron and 15 sample results for total iron via DMRs submitted in compliance with the general permit for Discharges Associated with Hydrostatic Testing of Pipelines, Tanks, and Similar Vessels, COG604000. Of the 33 reported results for dissolved iron, only four had concentrations above the 0.1 mg/l detection limit, and the maximum reported value was 0.370 mg/L. Of the 15 reported results for total recoverable iron, the maximum reported concentration was 34.0 mg/L and the average was 5.48 mg/L. The division has not required monitoring for zinc in permits issued for fire suppression systems.

The division is unaware of any investigations that identify the potential for substantive pollutant contributions associated with other pipe materials (e.g., copper and plastic). It is possible that elevated copper may occur associated with water in copper pipes in systems. However, copper piping in fire suppression systems would only be expected to occur in small systems, such as in single family homes that would only generate very small quantities of discharge. None of the copper data cited in Table 5 below were from samples taken from systems containing copper pipes.

5. **Contributions from Valves, Fittings, and Solder**
Components and fittings that are part of the fire suppression system may contain lead, brass, copper, or other materials. These materials may contribute additional metals to discharges. Specifically, lead has been identified in water contained in fire suppression systems, and is attributed to such fittings.

Information on elevated concentrations of lead in water-based fire suppression systems was published in reports by Duranceau et al. (1998) and Alleman et al. (1981). Total lead concentrations from main drain flushes that were identified in the Duranceau et al. (1998) report are identified in Table 4. The range of average values provided represent averages for different durations of the flushes provided in the report, the median value was consistent for all flush durations. It is of note that the maximum concentration identified was significantly higher than the second highest value of 0.44 mg/l and the third highest value of 0.15 mg/l. A total of 79 nationwide sites were included in the study and reported lead data for flushes.

| **Table 4: Summary of Lead Data** (Duranceau et al., 1998) | | | |
|---|---|---|---|
| | Maximum | Average | Median |
| Total Lead (mg/l) | 1.70 | 0.06 to 0.08 | 0.01 |

Information on elevated concentrations of copper in water-based fire suppression systems was published in reports by Duranceau et al. (1998) and Alleman et al. (1981). Total copper concentrations from main drain flushes that were identified in the Duranceau et al. (1998) report are identified in Table 5. The range of average values provided represent averages for different durations of the flushes provided in the report, the median value was consistent for all flush durations. It is of note that the maximum concentration identified was significantly higher than the second highest value of 0.23 mg/l. Only three sites had samples that exceeded 0.20 mg/l, and seven exceeded 0.10 mg/l. A total of 76 nationwide sites were included in the study and reported copper data for flushes.

| **Table 5: Summary of Copper Data** (Duranceau et al., 1998) | | | |
|---|---|---|---|
| | Maximum | Average | Median |
| Total Copper (mg/l) | 0.42 | 0.02 | Below Detection Limit |

The two studies reviewed by the division did not identify dissolved versus suspended form of the metals. The division does not have adequate information to make assumptions about the form the lead or copper is expected to be present in these types of discharges and therefore took into consideration potential impacts from both dissolved and total lead.

The identified source of lead within fire suppression systems is limited to valves, fixtures, and solder. Although copper may also be contributed by copper pipes, the division's evaluation focused on copper associated with fixtures because of the relative rarity of copper piped systems and the expectations that such systems would produce small volumes of discharge. Fixtures, valves, and exposed solder comprise only a small portion of the system, so would not be expected to significantly influence the bulk of the volume generated during discharges. For this reason, it is the division's current assumption that the median values identified in this report are the most representative of discharges and the best values to use when identifying potential impacts and the higher concentrations of lead identified would not be expected to occur throughout a discharge.

6. **Potential for Additional Pollutant Contributions**
   It is possible that the sources identified above, or other sources, could contribute additional pollutants that would have the potential to negatively impact water quality. As part of the ongoing review of this policy, the division will continue to seek additional information regarding such additional pollutants not currently identified in this policy.

**Potential Impacts on Water Quality and Beneficial Uses**

The data available to the division and discussed above demonstrate that there is a potential for pollutant contributions from sources associated with water-based fire suppressions systems within the scope of the policy to result in concentrations at the point of discharge exceeding the following water quality standards:

- Groundwater Standards
    - Dissolved Lead – Agriculture, Domestic Water Supply
    - Dissolved Copper – Agriculture

- Chronic Surface Water Standards
    - Total Recoverable Iron - Aquatic Life
    - Dissolved Lead – Aquatic Life
    - Total Recoverable Lead – Agriculture
    - Dissolved Copper – Aquatic Life
    - Total Recoverable Copper – Agriculture
    - Total Recoverable Zinc – Agriculture, Domestic Water Supply, Water + Fish, and Fish Ingestion

- Acute Surface Water Standards
    - Dissolved Lead – Aquatic Life, Domestic Water Supply
    - Dissolved Copper – Aquatic Life

In dense, downtown urban areas with frequent discharge-generating activities, the overall occurrence of discharges reaching surface waters and the cumulative discharge volume is not expected to be such that chronic surface water impacts would occur. Special consideration was given to the potential for chronic impacts resulting from particulate iron deposition which could occur in close proximity to a discharge point. Because the discharge is expected to occur at outfalls that also contain stormwater flows, the flushing affect of those flows is expected to minimize the potential for chronic impacts resulting from iron depositions in the receiving water at the outfall location. The division is not aware of any observations of increased iron sediment deposits in proximity to urban outfalls that could be contributed to fire suppression system discharges.

Because the zinc and iron contributions are expected to be in particulate form, the only potential groundwater pollutants of concern identified was dissolved lead and copper. Discharges covered by the scope of this policy directed to land with potential percolation to groundwater would be intermittent, limited to smaller volumes, and in disperse locations, as necessitated by the single point in time land application nature of the discharge. Therefore, in cases where lead or copper concentrations in the discharge did exceed groundwater standards, the division did not identify a potential threat of the discharge actually resulting in an appreciable increase in lead or copper concentrations in the groundwater table.

Based on the information evaluated by the division, the potential for pollutant concentration that could exceed acute surface water standards at the point of discharge were only identified for dissolved lead and copper. Because iron and zinc are expected to occur as a particulate in discharges, exceedance of acute standards for the dissolved form of these pollutants is not expected.

The median expected concentration of total lead based on the data from Duranceau et al. (1998) was 0.01mg/l, and was less than all of Colorado's chronic water quality standards. However, concentrations of lead were identified in grab samples from flushes that would exceed both the dissolved lead acute aquatic life and the total recoverable lead acute domestic water supply standards. The data are summarized above in the section on contributions from valves and fittings. In receiving waters with very low hardness, the aquatic life standard may be less than the drinking water standard of 0.05 mg/l. However, the lower aquatic life standard would only occur in waters with mean hardness below 100 mg/l which is a condition not expected to occur with any significant frequency in receiving waters for discharges within the scope of this policy.  Of the 79 nationwide sites with applicable lead data in the Duranceau et al. (1998) study, 20 sites had at least one exceedance of the acute drinking water standard in grab samples from flushes, however two of those systems also had lead concentrations approaching or exceeding the standard in water sampled from the potable water source system.

The median expected concentration of total copper based on the data from Duranceau et al. (1998) was below the detection limit. Although the detection limit used for each sample was not provided in the study, all detection limits were stated to be less than the most current EPA national primary and secondary drinking water standards. However, the drinking water standards for copper are higher than the Colorado acute aquatic life standards considered for copper. A review of the sample data from entities conducting analysis for the study show that most entities reported data down to 0.01 mg/l, which represented 53 of the 76 sites, and 29 of the 35 sites reporting below detection limits for all flush data. Although 0.01 mg/l remains higher than the Colorado acute aquatic life table value standard for hardness values below 75 mg/l, receiving waters with hardness in that range are not expected to be present with any significant frequency for discharges within the scope of this policy. Therefore, the division has determined that the data are appropriate for evaluating potential water quality impacts for the purpose of this policy.

Concentrations of copper were identified in grab samples from flushes that would exceed the dissolved copper acute aquatic life standards. The data are summarized above in the section on contributions from valves and fittings. Of the 76 nationwide sites with applicable copper data in the Duranceau et al. (1998) study, 41 sites had at least one exceedance in grab samples from flushes of the acute aquatic life standard for copper at 75 mg/l hardness, and 22 of the acute aquatic life standard for copper at 150 ug/l hardness.

**Determination to Not Seek Permit Coverage**

The regulation of discharges from water-based fire suppression systems through the current Colorado Discharge Permitting System presents a significant challenge. In reviewing approaches across the county, the division has identified that this source is generally not subject to permitting by other states or the EPA. Standard practice includes the discharge of untreated water directly to storm sewers, surface waters, and the ground (land application). Current practices in Colorado often rely on the direct discharge of untreated water directly to storm sewers, surface waters, and the ground. Although many facilities are being constructed or modified in Colorado to prevent this uncontrolled discharge, the practice remains common place. As a result, the discharges identified within the scope of this policy are already being regularly occurring to surface waters and the ground in Colorado without treatment and significant impacts have not been identified by the division. The division emphasizes that it is not allowing new or increased sources of pollutant to state waters under this policy, but instead is addressing sources that already exist. The division also continues to encourage the practice of reducing the occurrence of untreated discharges from fire suppression systems to waters of the state.

The practice of releasing water from fire suppression systems is essential for operation of the systems and required in Colorado by Department of Public Safety regulations. The division has thoroughly evaluated the ability to permit discharges from this source. Two significant barriers exist to issuance of permits for the source; the ability of operators to meet water quality based effluent limits at the point of discharge (i.e., without dilution) given the lack of treatment options identified at this time, and the feasibility of permitting discharges that occur for typically a few minutes at thousands of locations across the state. Issuance of permits for this source would also put Colorado in the position of non-alignment with typical practices in other parts of the country.

The division has identified that discharges covered under the scope of this policy have the potential to contain lead in concentrations that exceed acute drinking water standards, and both lead and copper in concentrations that exceed acute aquatic life water standards. For this reason, discharges addressed by this policy have not been included under Water Quality Control Division Low Risk Discharges Water Quality Policy 27. The division has not identified any additional potential exceedance of water quality standards that would be expected to occur as a result of discharges within the scope of this policy. Stream segments with an existing impairment for lead or copper have not been identified in areas with urban development for which any significant volumes of discharges covered by this policy would be expected, and for which those discharges that do occur would be extremely intermittent due to the low density of structures containing water based fire suppression systems in non-urban areas. Due to the nature of the aquatic life and domestic water supply uses potentially impacted, and the intermittent nature and typically low volume of discharges, it would also be expected that dilution would be available in most cases to reduce the potential of actual exceedances within the water body. The division is also not aware of any impacts to these uses occurring in receiving waters that could be associated with discharges from fire suppression systems.

The division's determination to proceed with issuance of this policy is based primarily on the fact that this category of discharge is already occurring and is an existing source of pollutants to waterways for which immediate solutions to terminate or treat discharges state-wide have not been identified. In many cases, practices may be currently possible, or existing facilities may be able to be retrofitted, to facilitate the disposal of waste water without a discharge to waters of the state. Although the division continues to encourage these practices, the solutions provided often take an extended period of time, and the practicability varies for different facilities statewide. Therefore, the division has determined that guidance, rather than permitting, is the most effective way to reduce the potential for increased impacts to waters of the state at this time. The division's decision to issue this policy is based on current conditions and determinations based on the practicability of other options. The division still intends to seek a long term solution that is protective of water quality standards under all potential conditions and that results in compliance with the permitting requirements of the Clean Water Act and Colorado Water Quality Control Act.

The division's approach to address the discharges within the scope of this policy is similar to the Maximum Extent Practicable approach statutorily required for discharges from Municipal Separate Storm Sewer Systems (MS4). Most discharges covered by this policy will occur through stormwater conveyance systems regulated for MS4 discharges. When establishing the requirement for discharge permits for MS4s, congress set a standard that pollutants should be reduced to the Maximum Extent Practicable, recognizing that the discharges were existing and that the application of numeric effluent limits may not be practicable in all cases. The division believes this condition is also true for the discharges from fire suppression systems within the scope of this policy. Because the Maximum Extent Practicable standard is only applicable to MS4 discharges, the application for fire suppression system is only intended to take a similar approach, but is outside of the regulatory permitting framework. In evaluating practicable control measures for fire suppression system discharges, the division restricted the systems covered within the scope of the policy, required practices to control chlorine and erosion, and placed limitations on operators. The division also identified that providing education on good practices and coordinating with operators and stakeholders to encourage use of appropriate control measures met the intent of the Maximum Extent Practicable standard for this source. This guidance will be provided through a separate document to be distributed by the division.

The Colorado regulatory framework may provide additional options for authorizing discharges through permits for this source. This may include standard changes or variances. These approaches would take additional time to evaluate and implement, and still present the division with the problem of issuing permits to operators. The division will continue to evaluate the options of such approaches and may revise or withdraw this policy in the future if such options are determined appropriate and available.

The division has identified that it is appropriate to re-evaluate this policy once every five years. The division will reevaluate all assumptions and determinations documented in the Background section based on the availability of new information of potential chronic impacts during future reviews of this policy. The division may also reopen this policy for considerations at any time prior to the five year reevaluation period based on new information.

**Operator Limitations**

One of the limitations included in the policy is the requirement that the operator of the discharge be certified by the Colorado Division of Fire Suppression and Control. The Division of Fire Suppression and Control requires operators to be certified prior to working on systems covered by this policy. The limitation therefore helps ensure that discharges are conducted in accordance with necessary operations of these systems.

## References:

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2. Colorado Discharge Permit System Regulations 5 CCR 1002-61 (Regulation 61)
3. Duranceau, Steven J., Jacquline V. Foster, and Jack Poole. *Impact of Wet-pipe Fire Sprinkler Systems on Drinking Water Quality*. Denver, CO: AWWA Research Foundation and American Water Works Association, 1998
4. Water Quality Control Division Low Risk Discharges Water Quality Policy 27
5. Water Quality Control Division Low Risk Discharge Guidance for Discharges of Potable Water