



February 2022

CHEMICAL ACCIDENT PREVENTION

EPA Should Ensure Regulated Facilities Consider Risks from Climate Change

Accessible Version

GAO Highlights

Highlights of [GAO-22-104494](#), a report to congressional requestors

Why GAO Did This Study

Over 11,000 RMP facilities across the nation have extremely hazardous chemicals in amounts that could harm people, property, or the environment if accidentally released. Risks to these facilities include those posed by natural hazards, which may damage the facilities and potentially release the chemicals into surrounding communities. Climate change may make some natural hazards more frequent or intense, according to the Fourth National Climate Assessment.

GAO was asked to review climate change risks at RMP facilities. This report examines, among other things, (1) what available federal data indicate about RMP facilities in areas with natural hazards that may be exacerbated by climate change; and (2) challenges RMP facilities face in managing risks from natural hazards and climate change, and opportunities for EPA to address these challenges. GAO analyzed federal data on RMP facilities and four natural hazards that may be exacerbated by climate change, reviewed agency documents, and interviewed agency officials and stakeholders, such as industry representatives.

What GAO Recommends

GAO is making six recommendations, including that EPA issue regulations, guidance, or both to clarify requirements and provide direction to facilities on incorporating natural hazards and climate change into risk management programs. EPA agreed with our recommendations.

View [GAO-22-104494](#). For more information, contact J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov.

February 2022

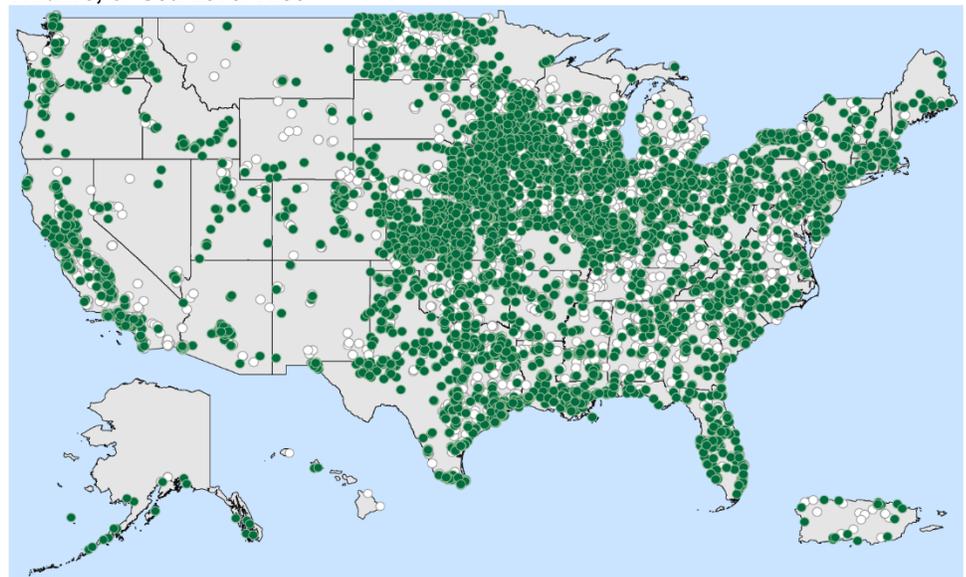
CHEMICAL ACCIDENT PREVENTION

EPA Should Ensure Regulated Facilities Consider Risks from Climate Change

What GAO Found

The Environmental Protection Agency's Risk Management Plan (RMP) Rule requires certain facilities that make, use, handle, or store hazardous substances (chemicals) to develop and implement a risk management program to detect and prevent or minimize the consequences of an accidental release. These facilities, known as RMP facilities, include chemical manufacturers and water treatment plants. Federal data on flooding, storm surge, wildfire, and sea level rise—natural hazards that may be exacerbated by climate change—indicate that over 3,200 of the 10,420 facilities we analyzed, or about 31 percent, are located in areas with these natural hazards (see figure). View the full results of GAO's analysis [here](#).

RMP Facilities Located in Areas That May Be Impacted by Flooding, Storm Surge, Wildfire, or Sea Level Rise



Risk Management Plan (RMP) facilities that GAO analyzed (10,420)

- Located in an area with one or more of these natural hazards (3,219)
- Located in an area without one or more of these natural hazards or where hazards are unknown (7,201)

Sources: GAO analysis of Environmental Protection Agency, Federal Emergency Management Agency, National Oceanic and Atmospheric Administration, and U.S. Forest Service data; U.S. Census Bureau (map). | [GAO-22-104494](#)

Notes: This map does not include one RMP facility in each of Guam and the U.S. Virgin Islands, Storm surge data are not available for the West Coast and Pacific islands other than Hawaii, and sea level rise data are not available for Alaska.

RMP facilities face several challenges, including insufficient information and direction, in managing risks from natural hazards and climate change, according to some EPA officials and stakeholders. By issuing regulations, guidance, or both to clarify requirements and provide direction on how to incorporate these risks into risk management programs, EPA can better ensure that facilities are managing risks from all relevant hazards. When developing any such regulation, EPA should, pursuant to relevant executive orders, conduct a cost-benefit analysis.

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Abbreviations

CalARP	California Accidental Release Prevention Program
Chemical Safety Board	U.S. Chemical Safety and Hazard Investigation Board
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
LEPC	Local Emergency Planning Committee
Natech	Natural Hazards Triggering Technological Accidents
NCA	Fourth National Climate Assessment
NOAA	National Oceanic and Atmospheric Administration
OECA	Office of Enforcement and Compliance
OECD	Organization for Economic Co-Operation and Development
OLEM	Office of Land and Emergency Management
OSHA	Occupational Safety and Health Administration
RAGAGEP	recognized and generally accepted good engineering practices
RMP	Risk Management Plan

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February 28, 2022

The Honorable Tom Carper
Chairman
Committee on Environment and Public Works
United States Senate

The Honorable Cory A. Booker
United States Senate

Over 11,000 facilities across the nation make, use, or store extremely hazardous chemicals in amounts that could harm people, the environment, or property if accidentally released. These facilities are in industry sectors such as chemical manufacturing, energy, and water and wastewater treatment. Accidental chemical releases at these facilities can result in fatalities and serious injuries, evacuations, and other harm to humans, according to the Environmental Protection Agency (EPA). Natural hazards such as flooding and hurricanes—which may become more frequent and intense due to climate change, according to the Fourth National Climate Assessment (NCA)¹—are among the hazards that may lead to such accidental releases, according to the U.S. Chemical Safety and Hazard Investigation Board (Chemical Safety Board) and the Center for Chemical Process Safety.² Socially vulnerable individuals, such as

¹U.S. Global Change Research Program, *Climate Science Special Report, Fourth National Climate Assessment*, vol. I (Washington, D.C.: 2017). The Global Change Research Act of 1990 requires the Committee on Earth and Environmental Sciences of the Federal Coordinating Council on Science, Engineering, and Technology to prepare and submit a scientific assessment at least every 4 years. Pub. L. No. 101-606, §106, 104 Stat. 3096, 3101 (*codified at* 15 U.S.C. § 2936). The U.S. Global Change Research Program—which coordinates and integrates the activities of 13 participating federal departments and agencies that carry out research and support the nation’s response to global change—conducts this national assessment, known as the National Climate Assessment.

²The Chemical Safety Board is an independent, non-regulatory federal agency responsible for investigating accidental release of regulated or extremely hazardous substances; recommending measures to reduce the likelihood or the consequences of accidental releases; and proposing corrective steps to make chemical production, processing, handling, and storage as safe and free from risk of injury as is possible. The Center for Chemical Process Safety is a not-for-profit, corporate membership organization within the American Institute of Chemical Engineers that works on issues of process safety for facilities handling, storing, using or processing, and transporting hazardous materials.

those living in poverty, are less able than others to adapt to or recover from natural disasters and climate change, according to the NCA. They are also more likely to live in proximity to these facilities, and are, therefore, also at greater risk from chemical releases than other populations, according to EPA.

Pursuant to the Clean Air Act, the Risk Management Plan (RMP) Rule seeks to prevent the accidental release of certain hazardous substances (chemicals) from certain facilities and to minimize the consequences of such releases.³ The RMP Rule applies to stationary sources (facilities) where certain hazardous chemicals above a threshold quantity are present in a process.⁴ We refer to facilities subject to the RMP Rule as RMP facilities. A process is defined by EPA regulations as being any activity, including manufacturing, use, storage, or handling, involving a

³In 1996, EPA issued a final rule for risk management programs under Clean Air Act section 112(r)(7). We refer to this rule as amended as the RMP Rule. The rule was amended several times, most recently in 2017 and 2019. In January 2017, EPA issued a final rule amending the RMP Rule (2017 Amendments Rule) that, according to EPA, made changes to the accident prevention program requirements, enhanced emergency response requirements, and improved public availability of chemical hazard information, among other things. 82 Fed. Reg. 4594 (Jan. 13, 2017). Before the 2017 Amendments Rule went into effect, EPA published a final rule delaying the effective date and subsequently published additional rules further delaying the effective date. 82 Fed. Reg. 8499, 8500 (Jan. 26, 2017); 82 Fed. Reg. 13968 (Mar. 16, 2017); 82 Fed. Reg. 16146 (Apr. 3, 2017); 82 Fed. Reg. 27133 (June 14, 2017). The 2017 Amendments Rule went into effect in September 2018 pursuant to a court order. *Air All. Houston v. Env't. Protect. Agency*, 906 F.3d 1049 (D.C. Cir. Aug. 17, 2018) (vacating the final rule promulgated on June 14, 2017 the delayed the effective date of the 2017 Amendments Rule). *Air All. Houston v. Env't. Protect. Agency*, No. 17-1155 (D.C. Cir. Sept. 21, 2018). In December 2019, EPA promulgated a new final RMP Rule (2019 Reconsideration Rule) that repealed several provisions of the 2017 Amendments Rule and retained other provisions with modifications. 84 Fed. Reg. 69834 (Dec. 19, 2019). Several environmental organizations filed a lawsuit in the Court of Appeals for the D.C. Circuit challenging the 2019 Reconsideration Rule. *Air All. Houston v. Env't. Protect. Agency*, No. 19-1260 (D.C. Cir. Dec. 19, 2019). The court has held the case in abeyance since May 2020.

⁴In addition to the RMP Rule, the General Duty Clause of the Clean Air Act (section 112(r)(1)) imposes on owners and operators of stationary sources producing, processing, handling, or storing substances regulated under section 112(r) or any other extremely hazardous substance a general duty to (1) identify hazards which may result from accidental release, (2) design and maintain a safe facility taking such steps as are necessary to prevent release, and (3) minimize the consequences of accidental releases. Although the General Duty Clause is not a regulation, EPA may conduct inspections of all stationary sources and assess penalties for non-compliance with this statutory requirement. This report focuses on facilities subject to the RMP Rule, not facilities that are subject only to the General Duty Clause.

hazardous chemical that EPA regulates under the Clean Air Act's prevention of accidental releases provision.⁵

The RMP Rule requires that each RMP facility develop and implement a risk management program to detect and prevent or minimize accidental releases. The facility must then submit an RMP describing its risk management program to EPA.⁶ According to EPA, the RMP Rule builds upon existing industry codes and standards. For example, the regulation requires RMP facilities to document that equipment complies with recognized and generally accepted good engineering practices (RAGAGEP).⁷ In addition, requirements for some RMP facilities are the requirements of the Occupational Safety and Health Administration (OSHA) Process Safety Management standard.⁸ The RMP Rule does not specify exactly what a facility must do to develop and implement a risk management program; instead, it provides the facility with flexibility to develop a facility-appropriate approach, according to EPA.

The RMP Rule divides covered processes into three program levels with different requirements that reflect the processes' relative potential for public impacts and the level of effort needed to prevent accidents,

⁵The Clean Air Act prevention of accidental release provision is section 112(r)(7) and the regulations implementing it, including the RMP Rule, are in 40 C.F.R. pt. 68. The substances regulated under section 112(r)(7) of the Clean Air Act include 77 toxic substances, such as anhydrous ammonia and chlorine, and 63 flammable substances, such as butane and propane. For the purposes of this report, we refer to all of these regulated substances as "hazardous chemicals." Facilities may have multiple processes involving hazardous chemicals but each process is evaluated and classified separately.

⁶A facility must revise and resubmit its RMP every 5 years or when certain events occur, such as when a new regulated chemical is first present in an already-covered process above a threshold quantity.

⁷According to EPA, RAGAGEP may include regulations, codes, standards, guidelines, engineering documents, and safety data sheets. According to OSHA, RAGAGEP may also include consensus standards that have been widely adopted by federal, state, or municipal jurisdictions. Examples include the *National Fire Protection Association 70 National Electric Code*; consensus documents developed by organizations based on certain standards, such as those set by the American Society of Mechanical Engineers in *Essential Requirements: Due Process Requirements for American National Standards*; certain non-consensus documents developed by industries, such as pamphlets on safety from the Chlorine Institute; manufacturers' recommendations; and some internal standards developed by facilities.

⁸OSHA's Process Safety Management of Highly Hazardous Chemicals (Process Safety Management) Standard (29 C.F.R. § 1910.119) contains requirements for the management of hazards associated with processes using highly hazardous chemicals that will protect worker health and safety.

according to EPA guidance. Facilities with Program 1 processes—those that would not affect the public in a worst-case release—have the fewest requirements under the RMP Rule. Facilities with Program 2 processes have more requirements, and facilities with Program 3 processes have the most requirements. A single facility may have multiple processes and, therefore, multiple program levels. As of December 2020, there were 11,444 current and active RMP facilities nationwide. Of these facilities, 648 facilities have only Program 1 processes. At 3,882 facilities, Program 2 processes are the highest level process at the facility, and at 6,914 facilities, Program 3 processes are the highest level process.⁹

EPA's Office of Emergency Management, within the agency's Office of Land and Emergency Management (OLEM), manages the implementation of the RMP Rule. The Office of Emergency Management and Office of Enforcement and Compliance Assurance (OECA) at both the headquarters and regional levels provide compliance assistance to RMP facilities, such as outreach and technical assistance. EPA also supports federal, state, and local government and non-governmental accident prevention and emergency planning, according to EPA. Credentialed inspectors based in EPA regional offices, along with inspectors in the nine states and four counties to which EPA has delegated authority to implement and enforce the RMP Rule, conduct facility inspections to determine facility compliance with the RMP Rule.¹⁰

Accidental releases of hazardous chemicals caused by natural hazards have been rare at RMP facilities, according to EPA and the Chemical Safety Board. However, recent natural disasters have demonstrated the potential for natural hazards to trigger fires, explosions, and releases of

⁹For the purposes of this report, "current and active facilities" are those facilities that submitted an RMP to EPA within 5 years of December 2020 and that have not been closed or deregistered through EPA's online database system.

¹⁰States may be delegated complete or partial authority to implement and enforce accidental release prevention programs (40 C.F.R. pt. 68), including the RMP Rule. As of November 2021, states with delegated authority are Delaware, Florida, Georgia, Mississippi, New Jersey, North Carolina, North Dakota, Ohio, and South Carolina. Additionally, states have further delegated authority to the following local jurisdictions: Jefferson County, Kentucky; and Forsyth, Buncombe, and Mecklenburg Counties, North Carolina. Florida has a partial delegation (everything but propane facilities), and North Dakota has a partial delegation (only agricultural ammonia facilities). For the purposes of this report, we focus on the activities of EPA RMP inspectors.

toxic chemicals at facilities.¹¹ In some parts of the U.S., climate change is increasing the severity and frequency of current natural hazards, such as flooding, hurricanes, and wildfires, as well as accelerating the impacts of sea level rise, according to the NCA. The Chemical Safety Board has reported that as the rate of such natural disasters increases, the frequency of accidents at chemical facilities affected by those natural hazards might also rise unless appropriate actions are taken to strengthen the resilience of the facilities.

You asked us to review climate change risks at RMP facilities. This report examines 1) what available federal data indicate about the number and types of RMP facilities that are located in areas with selected natural hazards that may be exacerbated by climate change; 2) challenges RMP facilities face in managing risks to human health and the environment from natural hazards and climate change, and opportunities for EPA to address these challenges; and 3) the extent to which EPA assesses how RMP facilities manage risks from natural hazards and climate change, and challenges EPA faces in doing so.

To determine what available federal data indicate about the number and type of RMP facilities that are located in areas with selected natural hazards that may be exacerbated by climate change, we reviewed the NCA, federal data on natural hazards, and our prior work on chemical facilities and climate change. We identified and obtained national-level federal data sets on four hazards that the NCA reported will be exacerbated by climate change in some areas of the country: flooding (Federal Emergency Management Agency (FEMA)), storm surge from hurricanes (National Oceanic and Atmospheric Administration (NOAA)), wildfires (U.S. Forest Service), and sea level rise (NOAA). These data are based on current and past conditions. We refer to these four hazards as selected natural hazards throughout this report. (See app. I for more detail on steps we took to assess the reliability of the data, and see app. II for more detail on the scope and types of natural hazard data used in this report.)

¹¹According to the Federal Emergency Management Agency (FEMA), natural hazards and natural disasters are related but are not the same. A natural hazard is the threat of an event that will likely have a negative impact. A natural disaster is the negative impact following an actual occurrence of natural hazard in the event that it significantly harms a community.

We obtained data from EPA's RMP database on the location and characteristics of RMP facilities identified in the database as current and active and as having Program 2 or 3 processes.¹² We analyzed these data using mapping software to identify RMP facilities located in areas that may be impacted by the selected natural hazards. To assess the reliability of the data used for our analysis, we, among other things, assessed the accuracy of the data and found the data to be sufficiently reliable for our analysis.¹³

To identify challenges that RMP facilities face in managing risks to human health and the environment from natural hazards and climate change and opportunities for EPA to address those challenges, we reviewed documents from EPA, OSHA, and the Chemical Safety Board. We also interviewed EPA, OSHA, and Chemical Safety Board officials as well as representatives of 11 selected stakeholder groups—such as industry associations and local emergency response organizations—to obtain their views. We also interviewed representatives of three RMP facilities to obtain illustrative examples of how RMP facilities manage risks from natural hazards and climate change and any challenges they face in doing so.

To determine the extent to which EPA assesses how RMP facilities manage these risks and challenges that EPA faces in doing so, we reviewed regulations; guidance, outreach, and training materials from EPA; *Federal Register* notices and EPA responses to public comments on proposed revisions to the RMP regulation; reports from the Chemical Safety Board; and documents from other organizations, such as the Center for Chemical Process Safety. We also interviewed EPA officials from headquarters and at all 10 regional offices, officials from OSHA and the Chemical Safety Board, and representatives of the stakeholder groups and three RMP facilities identified above. Appendix I describes our objectives, scope, and methodology in more detail.

We conducted this performance audit from August 2020 to February 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain

¹²We identified 11,444 current and active RMP facilities. We excluded RMP facilities with Program 1 processes from our analysis (648 facilities). We also excluded RMP facilities whose location information we assessed to be insufficiently reliable (376 facilities).

¹³Our analysis estimated the number of RMP facilities located in areas with selected natural hazards that may be exacerbated by climate change without site-specific information. Our analysis is not intended to provide estimates of actual risk.

Letter

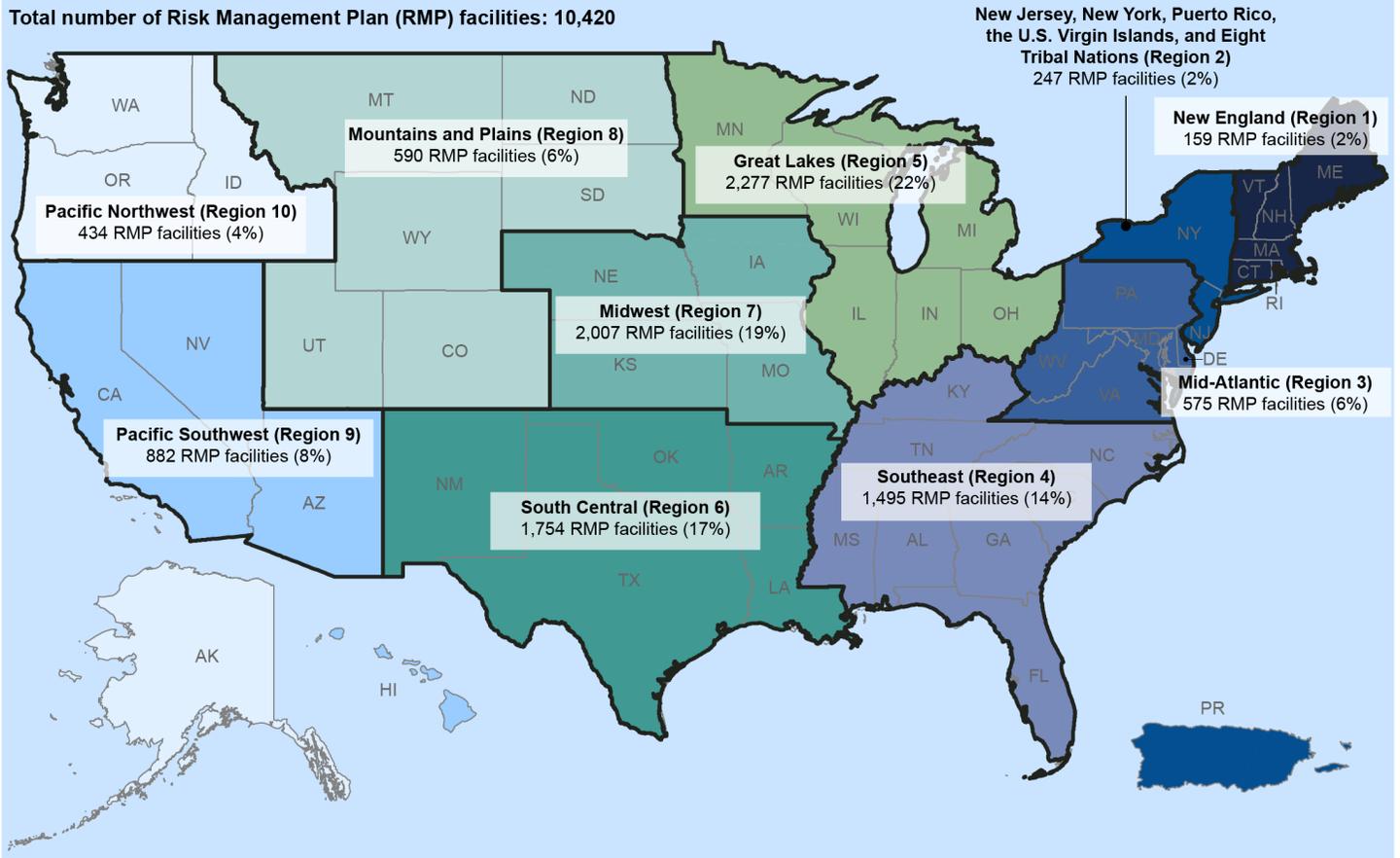
sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Number and Characteristics of RMP Facilities and Surrounding Communities

As of December 2020, there were over 11,000 current and active RMP facilities in EPA's RMP database. These facilities are located in communities across the country, with about 40 percent of the facilities with at least one Program 2 and 3 Process located in the Great Lakes and Midwest regions (see fig. 1).

Figure 1: Number and Percent of RMP Facilities with at least one Program 2 and 3 Process per Environmental Protection Agency Region (December 2020)



Sources: GAO analysis of Environmental Protection Agency (EPA) data and Map Resources. | GAO-21-104494

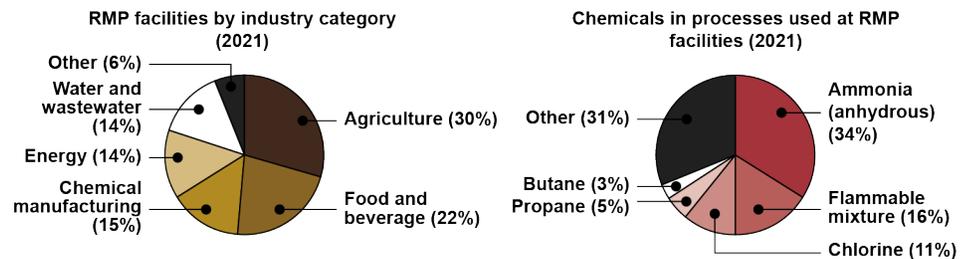
Accessible Information for Figure 1: Number and Percent of RMP Facilities with at least one Program 2 and 3 Process per Environmental Protection Agency Region (December 2020)

EPA Region Number	EPA Region Title	Number of RMP Facilities	Percent of RMP Facilities
1	New England (Region 1)	159	2%
2	New Jersey, New York, Puerto Rico, the U.S. Virgin Islands and Eight Tribal Nations (Region 2)	247	2%
3	Mid-Atlantic (Region 3)	575	6%
4	Southeast (Region 4)	1495	14%
5	Great Lakes (Region 5)	2277	22%
6	South Central (region 6)	1754	17%
7	Midwest (Region 7)	2007	19%
8	Mountains and Plains (Region 8)	590	6%
9	Pacific Southwest (Region 9)	882	8%
10	Pacific Northwest (Region 10)	434	4%

Note: This map includes current and active RMP facilities that have hazardous chemicals in processes on site that could potentially affect the public in the event of an accidental release (categorized by EPA as Program 2 and 3 processes). Current and active facilities are those facilities that submitted an RMP to EPA within 5 years of December 2020 and that have not been closed or deregistered through EPA's online database system. This map does not include one RMP facility in each of Guam and the U.S. Virgin Islands, although we include them in the counts above.

These facilities represent a range of industries and have covered processes that use a variety of toxic and flammable hazardous chemicals (see fig. 2). For example, more than a third of RMP facilities have covered processes involving anhydrous ammonia, which is used as a refrigerant and applied to land as a fertilizer. Anhydrous ammonia can irritate skin, eyes, throat, and lungs; exposure at very high concentrations can lead to lung damage and death. (See fig. 3 for an example of how an RMP facility that uses anhydrous ammonia is managing risks from natural hazards.)

Figure 2: Characteristics of Risk Management Plan (RMP) Facilities



Source: GAO analysis of Environmental Protection Agency data. | GAO-22-104494

Accessible Data for Figure 2: Characteristics of Risk Management Plan (RMP) Facilities

RMP Facilities by EPA Industry Category

Industry	Number of Facilities	Percent of Facilities
Agriculture	3544	30
Food and Beverage	2553	22
Chemical Manufacturing	1821	15
Energy	1645	14
Water and Wastewater	1645	14
Other	661	6

Chemical in Processes Used at RMP Facilities

Chemical	Number of Processes	Percent of Facilities
Ammonia (anhydrous)	7140	34%
Flammable Mixture	3239	16%
Chlorine	2355	11%
Propane	946	5%
Butane	609	3%
Other	6485	31%

Figure 3: Kettle Cuisine, a Risk Management Plan (RMP) Facility in Massachusetts

Overview

Kettle Cuisine produces soups at a facility in Lynn, Massachusetts, on the edge of Nahant Bay. Kettle Cuisine refrigerates and chills its soups using anhydrous ammonia. According to company representatives, the facility is surrounded by a mix of industrial and residential buildings, including a new 500-unit apartment building directly next door. Kettle Cuisine's facility is located in a census tract with relatively high social vulnerability, according to our analysis of the Federal Emergency Management Agency's National Risk Index.

Due to the amount of anhydrous ammonia on site, Kettle Cuisine is subject to the RMP Rule. An accidental release of anhydrous ammonia could pose risks to employees and the surrounding community. Inhaling the chemical can cause effects ranging from irritation, severe respiratory injuries, and death at high concentrations, according to the Environmental Protection Agency (EPA).

Preparing for Natural Hazards

According to representatives of Kettle Cuisine, some pipes and equipment containing anhydrous ammonia are located on the roof of the facility (see photo). Here, they are safe from flooding but may be vulnerable to high winds.



According to representatives, without appropriate safeguards, high winds could cause a pipe to rupture and release anhydrous ammonia. Kettle Cuisine complies with multiple industry standards and codes to safeguard equipment from accidents, including design and operations standards set by the International Institute of Ammonia Refrigeration, according to facility representatives. The exterior equipment at the facility is designed to withstand 128-mile-per-hour winds, in alignment with American Society of Mechanical Engineers standard, for instance. To further address risks from natural hazards, Kettle Cuisine had a local meteorologist conduct an analysis of the potential effects of climate change on the facility and had a structural engineer look at whether piping on the facility's roof could be vulnerable to hurricanes.

Working with Stakeholders

The company works closely with local stakeholders to manage risks from natural hazards. For example, Kettle Cuisine invited local emergency response officials, such as members of the fire department, and regional EPA officials to visit the facility to familiarize themselves with the layout and identify potential areas of risk. In addition, the company held a community tabletop exercise that modeled a natural disaster in the region. EPA officials, 45 officials from the local emergency response planning committee, and representatives of other local facilities participated in the exercise and identified response capabilities and deficiencies. According to a Kettle Cuisine representative, representatives of other local facilities have used this experience to improve their management of natural hazards and build relationships with local stakeholders.

Sources: GAO analysis of information from Kettle Cuisine; Kettle Cuisine (photo). | GAO-22-104494

Accessible Information for Figure 3: Kettle Cuisine, a Risk Management Plan (RMP) Facility in Massachusetts

Overview

Kettle Cuisine produces soups at a facility in Lynn, Massachusetts, on the edge of Nahant Bay. Kettle Cuisine refrigerates and chills its soups using anhydrous ammonia. According to company representatives, the facility is surrounded by a mix of industrial and residential buildings, including a new 500-unit apartment building directly next door. Kettle Cuisine's facility is located in a census tract with relatively high social vulnerability, according to our analysis of the Federal Emergency Management Agency's National Risk Index.

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Sources: GAO analysis of information from Kettle Cuisine; Kettle Cuisine (photo). | GAO-22-104494

Based on an analysis of RMP facility location data and other studies, EPA concluded in 2018 that risks from RMP facilities affect minority and low-income populations to a greater degree than these risks affect other populations. In its analysis, EPA found that communities living within a 1-mile radius of RMP facilities had 10 percent more low-income populations and 11 percent more minority populations compared to U.S. averages. Further, according to our own analysis of facility location data from EPA's RMP*Info database and FEMA's National Risk Index's Social Vulnerability Index, 16 percent of EPA's RMP facilities are located in census tracts with communities that have high or very high social vulnerability.¹⁴ FEMA broadly defines social vulnerability as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood.

Causes of Accidental Chemical Releases and Potential Risks from Climate Change

Accidental releases at RMP facilities can be caused by a variety of events, including equipment failure, such as a piece of equipment not functioning as designed; human error, such as a person performing an operation improperly; or a natural hazard, such as flooding. As of December 2021, RMP facilities had reported an average of approximately 190 accidental releases per year from 2010 through 2019 from all causes, according to data from EPA. The 5-year accident histories RMP facilities submit in their RMPs show a reduction on average in the frequency of accidents since the RMP Rule was finalized in 1996, according to EPA, but there continue to be serious chemical releases. For example, in 2014, a release of highly toxic methyl mercaptan occurred at an insecticide production unit at the DuPont chemical facility in La Porte, Texas, leading to the death of four workers. In 2016, incompatible chemicals were inadvertently mixed at the MGPI Processing Plant in Atchison, Kansas, resulting in a release of chlorine gas and other compounds that sent 140

¹⁴FEMA's National Risk Index includes a modified version of the University of South Carolina's Hazards and Vulnerability Research Institute Social Vulnerability Index that ranks communities based on 29 socioeconomic variables, such as percent of persons living in poverty, median age, and percent of the population who identify as Native American. According to FEMA, the index of social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards.

individuals to area hospitals and resulted in shelter-in-place and evacuation orders for thousands of residents.

Accidental Chemical Release

A plume of chlorine gas and other compounds was released from the MGPI Processing Plant in Atchison, Kansas in 2019 when two incompatible chemicals were accidentally combined.



Source: U.S. Chemical Safety and Hazard Investigation Board. | GAO-22-104494

Natural hazards, including those exacerbated by climate change, may lead to accidental releases in a variety of ways. For example, flooding may inundate tanks and pipelines, leading to corrosion, severance of pipe connections, and rupture, according to FEMA. Wildfires or the threat of wildfires may lead to power outages, which could affect the safe operations of RMP facilities, according to EPA officials from one region and a stakeholder group.

Facilities face a unique challenge in managing risks of an accidental release caused by a natural hazard because such a release may occur simultaneously with the damage and disruption caused by a natural disaster.¹⁵ Natural hazards can lead to disasters that cause multiple and simultaneous releases over extended areas, potentially overwhelming both on- and off-site response capabilities. For example, a facility needs to assume that emergency response resources, such as hazmat teams or firefighters, may be scarce during a natural disaster. In addition, a facility needs to take into account that blocked roads may limit access to the facility, which may also prevent community members from evacuating. Utilities may also be disrupted, leading to a loss of power needed for safeguards or safe shut-down procedures at facilities.

¹⁵Such events are sometimes called Natech events (Natural Hazards Triggering Technological Accidents); in this case, the technological accident is a chemical release.

According to EPA officials, few accidental releases from RMP facilities have been caused by natural hazards. The agency conducted an analysis of accidents reported by RMP facilities during Hurricanes Harvey, Katrina, and Rita; the agency found two examples of accidental releases from RMP facilities, neither of which led to significant impacts, according to EPA.¹⁶ EPA officials from eight regional offices could recall three accidental releases that involved natural hazards, one caused by lightning, one by extreme cold, and one by flooding.¹⁷ According to information on nearly 1,500 accidents reported by RMP facilities that submitted RMPs to EPA in the last 5 years, a natural hazard was the initiating event in 2 percent of reportable accidental chemical releases.¹⁸ In addition, facilities cited unusual weather conditions being present at the time of the accidental release in 3 percent of reported instances.

However, climate change is altering the characteristics of many extreme weather events, according to the NCA. Some of these events have already become more frequent, intense, widespread, or of longer duration; many are expected to continue to worsen, according to the NCA. In the U.S., high temperature extremes, heavy precipitation events, high-tide flooding events along the coastline, and forest fires in the western U.S. and Alaska have been and are all projected to continue increasing due to climate change, according to the NCA. According to NOAA, calendar year 2020 was the sixth consecutive year in which the U.S. experienced 10 or more weather and climate disaster events that each cost more than \$1 billion in overall damages.¹⁹ From 2016 to 2020, the cost of such disasters in the U.S. averaged \$128 billion each year.

¹⁶In order to be reported by a facility in its 5-year accident history, an accidental release from a covered process must result in either (1) on-site deaths, injuries, or significant property damage; or (2) known offsite deaths, injuries, property damage, environmental damage, evacuations, or sheltering in place. Based on its analysis, EPA reported that the Mississippi Phosphates plant in Pascagoula, Mississippi, experienced an ammonia release in 2005 during Hurricane Rita, but it reported no impacts from the accident. In addition, the Chevron Phillips plant in Sweeny, Texas, reported an accidental release in 2017 during Hurricane Harvey that resulted in onsite property damage.

¹⁷Officials from the other two regional offices did not provide us with this information.

¹⁸Facilities reported equipment failure as the initiating event in 57 percent of accidental chemical releases, human error in 37 percent of releases, and other factors in 4 percent of releases.

¹⁹National Oceanic and Atmospheric Administration, National Centers for Environmental Information, *U.S. Billion-Dollar Weather and Climate Disasters*, accessed Sept. 9, 2021, <https://www.ncdc.noaa.gov/billions/>.

(See fig. 4 for an example of how one RMP facility is working with local stakeholders to manage risks from natural disasters.)

Figure 4: Covestro, a Risk Management Plan (RMP) Facility in Texas

Overview

Covestro is a chemical manufacturing facility located outside Houston in Baytown, Texas (see photo). The facility produces polymers, such as polyurethane and polycarbonate, which are used in products such as adhesives, insulation, footwear, and mattresses. Over 1,000 employees work at the facility, which is surrounded by other chemical and industrial facilities.

According to the RMP Covestro submitted to EPA in 2019, the facility uses 11 chemicals regulated under the Clean Air Act’s prevention of accidental releases provision in quantities above the threshold amount. One of those chemicals is anhydrous hydrogen chloride (used to make hydrochloric acid). According to EPA, hydrochloric acid may cause eye, nose, and respiratory tract irritation and inflammation as well as pulmonary edema in humans.

Preparing for Natural Hazards

In recent years, Houston has experienced a number of destructive storms, including Tropical Storm Beta and Hurricane Laura in 2020 and Hurricane Harvey in 2017. Covestro representatives identified storm surge and winds from hurricanes as natural hazards that may impact the facility. According to our analysis of federal data, the Covestro facility is located in an area that currently may be impacted by storm surge from a Category 5 hurricane.

Prior to each hurricane season, Covestro creates detailed hurricane response plans for hurricanes which, for example, cover topics such as planning how the company will stage resources for emergency response and ensuring appropriately trained staff are available during and after a storm to safeguard against accidents. Covestro uses the

National Institute Management System emergency response training as well as fire response training from Texas A&M University.

Working with Stakeholders

According to Covestro representatives, the company works with other facilities to ensure all facilities in the region are prepared for natural hazards. For example, Covestro is a member of the East Harris County Manufacturers Association, an organization of more than 130 companies in the region. Members share best practices in areas such as crisis communication and safety processes, according to company representatives. Seventeen of the member companies, including Covestro, produced a hurricane preparedness guide that the association sends out to all member companies and plant managers in the region prior to hurricane season. In addition, the association operates an online resource that provides information to the community on incidents at chemical facilities and whether any action is required by local residents.

Covestro also works with the Greater Houston Local Emergency Planning Committee—an entity appointed by the state of Texas pursuant to the federal Emergency Planning and Community Right-to-Know Act that consists of government, business, and community members—to prepare for potential accidental releases. The committee provides information about chemicals to the community and, in the case of an accidental release, sends alerts and evacuation information to local residents. The committee also meets monthly with community and facility leaders to discuss potential concerns, including those regarding risks from extreme weather. In addition, the committee helps facilities develop emergency response plans, review these plans annually, and provide information about chemicals to the community.

Sources: GAO analysis of information from Covestro and the Greater Houston Local Emergency Planning Committee. | GAO-22-104494

Accessible Information for Figure 4: Covestro, a Risk Management Plan (RMP) Facility in Texas

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Sources: GAO analysis of information from Covestro and the Greater Houston Local Emergency Planning Committee. | GAO-22-104494

Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, states that it is the policy of the administration to deploy the full capacity of federal agencies to combat the climate crisis to implement a government-wide approach that increases resilience to the impacts of climate change, among other things.²⁰ The Executive Order also directed agencies to develop action plans with steps each agency can take to bolster adaptation and increase resilience to the impacts of climate change. In October 2021, EPA released its 2021 Climate Adaptation Action Plan.²¹ The plan states that EPA will ensure its programs, policies, rules, enforcement, and compliance assurance activities consider current and future impacts of climate change and how those impacts will disproportionately affect certain communities. In addition, EPA's draft Strategic Plan for fiscal years 2022 to 2026 includes an objective to accelerate resilience and adaptation to climate change impacts.²²

RMP Rule Requirements

Facilities subject to the RMP Rule must develop and implement a risk management program that includes, among other things, a prevention program and an emergency response program.²³ The requirements for prevention programs differ for each of the three program processes. Facilities with Program 1 processes must certify that no additional measures are necessary to prevent offsite impacts from accidental releases. For Program 2 processes, facilities must include a hazard review that identifies the hazards associated with the processes and regulated substances. It must also include the safeguards used or needed to control the hazards or prevent equipment malfunction or human error, among other things. According to a *Federal Register* notice, EPA expects that for many Program 2 processes, a facility can comply

²⁰86 Fed. Reg. 7619, 7622 (Feb. 1, 2021).

²¹Environmental Protection Agency, *Climate Adaptation Action Plan* (Washington, D.C.: Oct. 2021).

²²Environmental Protection Agency, *FY 2022-2026 EPA Strategic Plan Draft* (Washington, D.C.: Oct. 1, 2021).

²³OLEM officials conduct periodic reviews to identify facilities that have hazardous chemicals above the threshold quantity but that have failed to file an RMP with EPA, according to OLEM officials. OLEM officials compare facilities that have filed an RMP with other federal data on chemical facilities. In addition, officials may also identify such facilities through citizen complaints and tips or while conducting inspections for other EPA regulations.

with the prevention program requirements by complying with other federal regulations, state laws, industry standards, and good engineering practices. For Program 3 processes, facilities' prevention program must include, among other things, a process hazard analysis that identifies, evaluates, and controls the hazards involved in the process. According to EPA, the Program 3 prevention program requirements are the requirements of the OSHA Process Safety Management standard, so compliance with that standard will constitute compliance with the RMP Rule.

The requirements for emergency response program requirements differ for each of the three program processes.²⁴ For Program 1 processes, facilities must coordinate emergency responses with local responders. For Program 2 and 3 processes, facilities must coordinate response needs with local emergency planning and response organizations and exercises, and they must develop and implement an emergency response exercise program. According to EPA guidance, local emergency planning committees can be valuable resources in conducting this planning. (See app. III for examples of nonfederal entities acting to manage risks from natural hazards and climate change.)

A facility's risk management program must be described in an RMP submitted to EPA via the agency's RMP*Submit system or on paper, and the RMP must include all covered processes at the facility. A facility must revise and resubmit its RMP every 5 years or when certain events occur, such as when a new regulated chemical is first present in an already-covered process above a threshold quantity.

In May 2021, in response to President Biden's Executive Order 13990 *Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis*, EPA announced that it was developing a regulatory proposal to revise its RMP Rule. EPA said this effort would address administration priorities outlined in the executive order, including

²⁴Facilities with Program 2 and 3 processes whose employees will not respond to accidental releases do not need an emergency response program in certain circumstances, but these facilities must conduct emergency response coordination activities and exercises. 40 C.F.R. § 68.90(b).

bolstering resilience to the impacts of climate change and environmental justice. EPA plans to issue a new final rule by August 2023.²⁵

Incorporating Risks from Natural Hazards and Climate Change into Risk Management Programs

An RMP facility may incorporate risks from natural hazards, including natural hazards that may be exacerbated by climate change, throughout its risk management program, according to EPA and OSHA guidance.

According to EPA and OSHA, an RMP facility should consider external hazards, such as natural hazards, as part of the hazard review or process hazard analysis conducted for its prevention program. Specifically, EPA guidance for RMP facilities with Program 2 processes recommends facilities consider “reasonably anticipated external events” as part of their hazard reviews. For example, if the facility is in an area subject to hurricanes or flooding, EPA recommends that the facility examine whether its covered processes would survive these external events without releasing a hazardous chemical. OSHA guidance used by facilities with Program 3 processes for conducting a process hazard analysis recommends that facilities analyze “external factors” that might pose a risk to the covered processes. In addition, any changes in risks from natural hazards, including those due to climate change, should be taken into consideration when an RMP facility updates its hazard review or process hazard analysis at least once every 5 years, according to OECA officials. However, the RMP Rule does not explicitly require a facility to consider natural hazards or climate change as part of its risk management program.

Once an RMP facility has identified a natural hazard in its hazard review or process hazard analysis, it must identify actions to safeguard against risks from the hazard in order to prevent accidental releases. Safeguards may include aspects of equipment design, maintenance, operations, and training, according to EPA guidance. Facilities rely on federal, state, and local requirements and industry RAGAGEP to determine how to safeguard against hazards. For example, facilities may rely on the

²⁵EPA rulemaking is subject to Executive Order 12866, as supplemented by Executive Order 13563, which direct federal agencies to assess both the costs and the benefits of the intended regulation and propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Executive Order 12866, 58 Fed. Reg. 51735 (Sept. 30, 1993); Executive Order 13563, 76 Fed. Reg. 3821 (Jan. 18, 2011).

National Fire Protection Association Hazardous Materials Code 400, which contains safeguards for protecting hazardous materials containers and container foundations in areas subject to natural hazards such as flooding, wind, and fire, according to EPA.

Hazards identified by a facility during its hazard review or process hazard analysis, including natural hazards, should inform and focus the facility's emergency response planning, according to EPA guidance. EPA guidance states that facilities should consider all possible causes of emergencies—including those from the surrounding environment such as flooding, temperature extremes, hurricanes, and power failures—in developing emergency response plans.

EPA's Implementation of the RMP Rule

In implementing the RMP Rule, EPA provides compliance assistance to facilities, conducts inspections of facility risk management programs, and takes enforcement actions.

Compliance assistance. Compliance assistance for facilities may include guidance, webinars, tools, policy statements, manuals, and technical assistance. For example, EPA issued alerts for facilities highlighting the importance of taking certain safety measures and held training for agricultural ammonia facilities.

Inspections. EPA regional offices, as well as states and counties with delegated authority, evaluate compliance with the RMP Rule through facility inspections. In 2019, EPA employed 43 credentialed RMP inspectors, including both EPA employees and contractors, and it inspected approximately 2 percent (284) of RMP facilities.²⁶ EPA credentials these inspectors, offers on-going training, and provides guidance on conducting inspections.²⁷

²⁶While data are available for 2020, we did not include the data here due to the disruptions to standard inspection practices caused by Coronavirus Disease 2019 in 2020, including delaying inspections and conducting virtual inspections.

²⁷To be credentialed as an RMP inspector, individuals must, among other things, complete a 5-day training course and online training pertaining to applicable regulations, as well as on-the-job training such as on conducting inspections at petroleum refineries and reviewing process hazards analyses. Sector- and element-specific training are also available for inspectors. EPA has also developed general guidance for RMP inspectors on conducting inspections.

Inspections generally consist of both a site visit to inspect the facility and an offsite review of documents relevant to the risk management program and RMP. Among other actions, EPA instructs inspectors to determine if the facility has used an appropriate methodology to identify major hazards, if the facility emergency response plan includes specific actions to be taken in response to an accidental release, and if employees have been appropriately trained. According to OLEM, if a facility has identified a specific hazard, the inspector would look for physical evidence that the facility has appropriate safeguards in place, such as new equipment or documentation of updated emergency response plans. Inspectors determine compliance with the RMP Rule based in part on a facility's compliance with state and local codes and industry RAGAGEP, according to EPA officials. (See app. III for an example of how Florida, a state with delegated authority, implements its RMP Rule.)

Enforcement. Inspections may result in a variety of enforcement actions and penalties if violations are found, and EPA may require a facility to revise its RMP and correct deficiencies in its underlying risk management program. Once EPA finds that an RMP facility has violated the RMP Rule, the agency may take administrative action, such as issuing a compliance order, notice of noncompliance, or administrative penalty orders; it may also refer the matter to the Department of Justice for further action.²⁸

More than 3,200 RMP Facilities of Various Types Are Located in Areas with Selected Natural Hazards That May Be Exacerbated by Climate Change

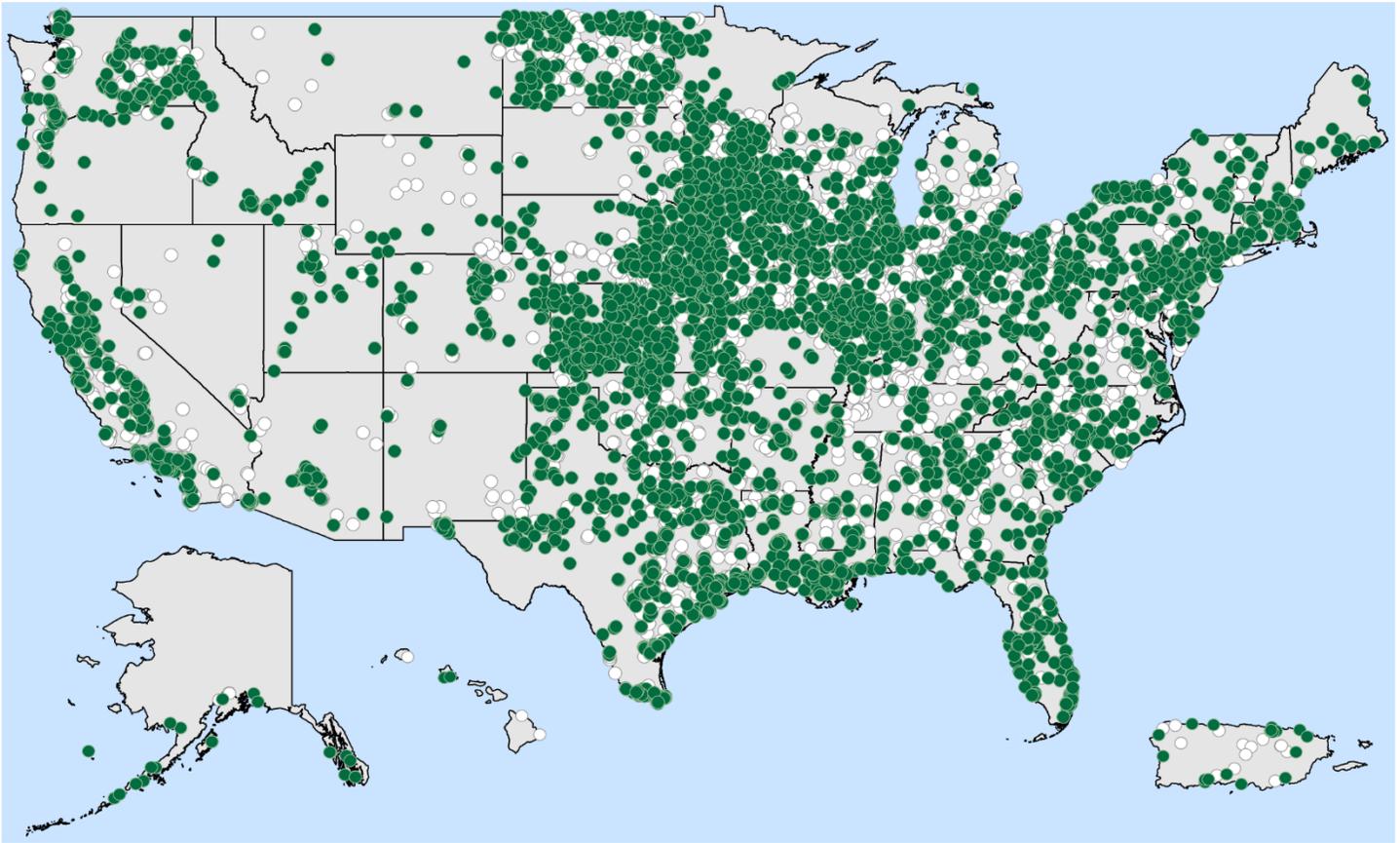
Available federal data suggest that 3,219 of 10,420 RMP facilities with at least one program 2 or 3 process, or about 31 percent, are located in areas with one or more selected natural hazards that may be exacerbated

²⁸For example, in November 2021, EPA announced it would collect a penalty from a fertilizer distributor in Postville, Iowa, to resolve alleged violations of the RMP Rule, such as failure to update its hazard review and maintain operating procedures. The company stores 457,000 pounds of anhydrous ammonia on site.

by climate change: flooding, storm surge, wildfire, and sea level rise.²⁹ The locations of these facilities are shown in figure 5; the full results of our analysis and additional information about these facilities are available in an interactive map and downloadable data file, which can be viewed at <https://www.gao.gov/products/gao-22-104494>.

²⁹When we refer to RMP facilities in this analysis, we are referring to current and active facilities with at least one Program 2 or 3 process whose location information we assessed to be sufficiently reliable. We excluded RMP facilities with only Program 1 processes (648 facilities) from our analysis because, by definition, a worst-case release of hazardous chemicals from these facilities would not affect the public. In addition, we excluded RMP facilities whose location information we assessed to be insufficiently reliable (376). The count includes facilities located in areas with at least one or more of the following natural hazards: 0.2 percent or higher annual chance of flooding or other flood hazards, storm surge from Category 4 or 5 hurricanes, high and very high wildfire hazard potential, and 3 feet sea level rise.

Figure 5: More than 3,200 RMP Facilities Are Located in Areas That May Be Impacted by Flooding, Storm Surge, Wildfire, or Sea Level Rise



Risk Management Plan (RMP) facilities that we analyzed (10,420)

- Located in an area with one or more of these natural hazards (3,219)
- Located in an area without one or more of these natural hazards or where hazards are unknown (7,201)

Sources: GAO analysis of Environmental Protection Agency (EPA), Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA), and U.S. Forest Service data; U.S. Census Bureau (map). | GAO-22-104494

Notes: We analyzed RMP facilities that EPA classified as current and active and that have at least one Program 2 or 3 process. These processes use hazardous chemicals that could potentially affect the public in the event of an accidental release. We excluded RMP facilities whose location information we assessed to be insufficiently reliable. We approximated the boundaries of RMP facilities with a 0.094-mile radius around the primary geographic coordinate of each facility. Depending on the actual facility boundaries, the results of our analysis may not accurately reflect the number of RMP facilities located in areas with these selected natural hazards. This map does not include one RMP facility in each of Guam and the U.S. Virgin Islands, although we include them in the counts above. The full results of our analysis, which include additional information about these RMP facilities, are available in an interactive map and downloadable data file, and can be viewed at <https://www.gao.gov/products/gao-22-104494>. This analysis is based on the most recently available data from EPA, FEMA, NOAA, and the U.S. Forest Service, as of December 2020.

These data, however, may not fully account for the number of RMP facilities that may be impacted by these hazards for several reasons. First, data are not available for some areas. For example, NOAA's storm surge data is unavailable for the West Coast and Pacific Islands other than Hawaii and sea level rise data are not available for Alaska. Second, some facilities may be indirectly impacted by natural hazards even if they are located outside areas with these hazards, according to interviews with EPA officials, state and local emergency management officials, and officials from an RMP facility. For example, a facility may be indirectly impacted by a wildfire due to loss of power even if the facility is located outside an area that U.S. Forest Service data indicate has high or very high wildfire hazard potential. Third, we approximated the boundaries of RMP facilities with a 0.094-mile radius around their primary geographic coordinates, which may not accurately reflect their area (i.e., they may be larger or smaller). Fourth, we did not analyze site-specific information for these RMP facilities that may mitigate risks from natural hazards, such as steps specific facilities have taken to manage potential risks from selected natural hazards.

Furthermore, while our analysis identifies facilities that are located in areas with natural hazards that may be exacerbated by climate change, our analysis does not reflect when, how, or at what rate conditions in these areas may change as the climate changes. The federal data sets we used in our analysis on flooding, storm surge, and wildfire are based on current or past conditions. Further, the NCA has reported that climate change may exacerbate flooding, storm surge, wildfire, and sea level rise differentially in certain regions of the U.S. Moreover, other climate change effects may also impact RMP facilities, such as potential increases in salt water intrusion (the movement of saline water into freshwater aquifers), drought, hurricane winds, and average and extreme temperatures, according to the NCA, EPA documents, and previous GAO reports. We did not analyze these other potential effects because we did not identify relevant national-level federal data sets for these effects that fit the criteria for our analysis, such as compatibility with our mapping software or being national or near national in scope. (For more information about available federal data on these selected natural hazards, see app. II.)

Approximately 2,900 RMP Facilities across the Country Are Located in Areas that May Be Impacted by Flooding

We identified 2,893 RMP facilities—approximately 28 percent of RMP facilities we analyzed—located in areas that FEMA identified as having at

least 0.2 percent annual chance of flooding, which FEMA considers moderate flood hazard, or other flood hazards, as of October 2020.³⁰ Of those, we identified 2,441 facilities—approximately 23 percent of RMP facilities we analyzed—located in areas that have 1 percent or higher annual chance of flooding, which FEMA considers high flood hazard. According to the NCA, heavy rainfall is increasing in intensity and frequency across the United States and is expected to continue to increase, which may lead to an increase in flooding in the future.

According to industry officials we interviewed, flooding can damage facilities—for example, rising water can dislodge tanks or lead to a loss of power—and potentially cause accidental releases of hazardous chemicals. The full results of our analysis—which include information on the RMP facilities in areas that have 1 percent or higher annual chance of flooding, 0.2 percent or higher annual chance of flooding or other flood hazards, unknown flood hazard or no data, and minimal flood hazard—are available in our interactive map, which can be viewed [here](#).

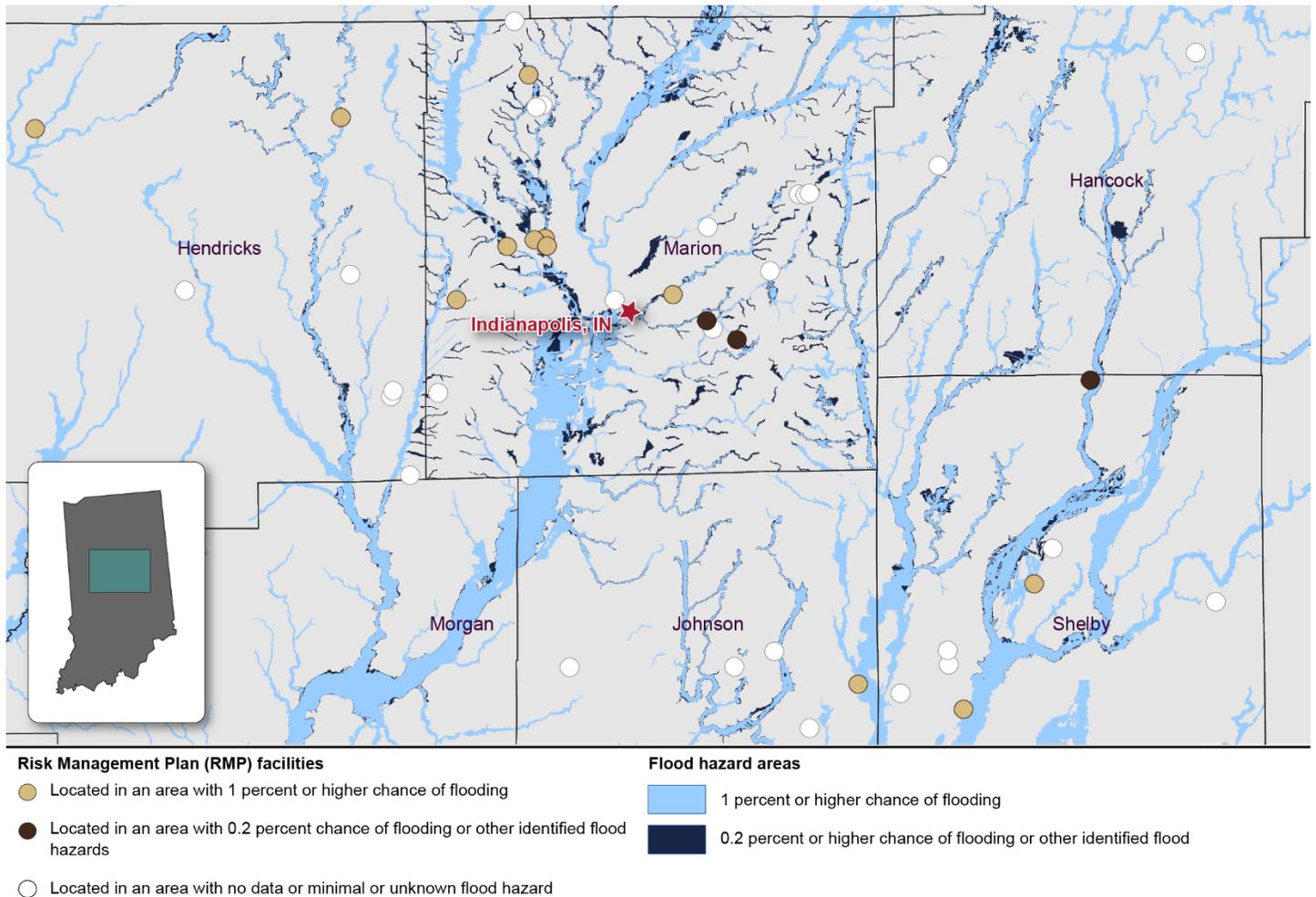
The facilities that we identified as having a 0.2 percent or higher annual chance of flooding or other flood hazards are located across the country, and they include facilities from a range of industries. In Florida, 132 of 237 RMP facilities—approximately 56 percent—are located in areas with moderate or high flood hazard, whereas in Indiana, 91 of 394 RMP facilities—approximately 23 percent—are located in such areas. We found that nearly half of facilities with the North American Industry Classification System code for “Water, Sewage, and Other Systems” are located in areas that may be impacted by moderate or high flood hazard. These types of facilities commonly use chlorine—which can cause headaches and inflame the lungs and could be deadly at higher doses if inhaled—to treat water.

Historic flooding in the U.S. Midwest in March 2019 impacted numerous cities and towns, becoming one of the costliest U.S. inland flooding events on record, with damages estimated at over \$11 billion, according

³⁰Areas having other flood hazards include areas with reduced risk because of levees as well as areas with flood hazard based on future conditions, such as the future implementation of land-use plans. FEMA considers areas with at least 0.2 percent annual chance of flooding as having moderate flood hazard and those with 1 percent or higher annual chance of flooding to be Special Flood Hazard Areas (i.e., those with the highest chance of flooding).

to NOAA. RMP facilities located in areas that may be impacted by flooding in central Indiana can be seen in figure 6.

Figure 6: Risk Management Plan (RMP) Facilities Located in Areas that May Be Impacted by Flooding in Central Indiana



Sources: GAO analysis of Environmental Protection Agency (EPA), Federal Emergency Management Agency (FEMA) data; U.S. Census Bureau (map). | GAO-22-104494

Notes: We analyzed chemical facilities subject to EPA's RMP Rule that EPA classified as current and active and that have at least one Program 2 or 3 process whose location information were assessed to be sufficiently reliable. These processes use hazardous chemicals that could potentially affect the public in the event of an accidental release. We approximated the boundaries of these RMP facilities with a 0.094-mile radius around the primary geographic coordinate of each RMP facility. Depending on the actual facility boundaries, the results of our analysis may not accurately reflect the number of RMP facilities located in these areas. This analysis is based on EPA and FEMA data as of December 2020 and October 2020, respectively.

Nationwide, there may be additional RMP facilities located in areas that may be impacted by flooding. This is because nearly 1,900 RMP facilities

are located in areas that FEMA has not assessed for flood hazards or that we did not analyze because the data were not available in a form we could use with our mapping software.³¹

Approximately 750 RMP Facilities, Mostly in Gulf Coast States, Are Located in Areas that May Be Inundated by Storm Surge

We identified 746 RMP facilities—7 percent of RMP facilities we analyzed—in areas that may be inundated by storm surge corresponding to Category 4 or 5 hurricanes, the highest categories, based on NOAA’s storm surge model that uses data as of March 2020.³² Of these RMP facilities, 264 are located in areas that may be inundated by a storm surge corresponding to Category 1 hurricanes. We analyzed areas that may be inundated by storm surge corresponding to the highest possible category because, according to the NCA, a projected increase in the intensity of hurricanes in the North Atlantic could increase the probability of inundation by storm surge along most of the Atlantic and Gulf Coast states, beyond what would be projected based solely on relative sea level rise.³³ The full results of our analysis, which include information on the number of RMP facilities in areas that may be inundated by storm surge from Category 1 and from Category 4 or 5 hurricanes, are available in our interactive map, which can be viewed [here](#). (For an example of a facility that may be impacted by storm surge, see fig. 7 below.)

³¹The distribution of RMP facilities located in areas that have not been assessed for flood hazards—or that we did not analyze because the data were not available in a form we could use with our mapping software—is not uniform across the U.S. For example, 303 of the 1,099 RMP facilities located in Texas—nearly 28 percent—are located in areas that FEMA has designated as unmapped or not updated, or they were not available in a form we could use with our mapping software. Eight of the 737 RMP facilities located in California—about 1 percent—are located in such areas. See app. I for additional information.

³²According to a NOAA website, the model does not account for future conditions, such as erosion, subsidence (i.e., the sinking of an area of land), construction, or sea level rise.

³³The NCA also stated that there is uncertainty in the projected increase in frequency or intensity of Atlantic hurricanes, and other factors may affect the potential for flooding from storm surge, such as changes in overall storm frequency or tracks.

Figure 7: South Cross Bayou Advanced Water Reclamation Facility, a Risk Management Plan (RMP) Facility in Florida

Overview

The South Cross Bayou Advanced Water Reclamation Facility is the largest wastewater treatment facility in Pinellas County, near Tampa Bay, Florida (see photo). The facility treats an average of 23 million gallons of wastewater a day and serves over 220,000 residential and commercial customers. The community surrounding the facility is residential and located in a census tract with relatively high social vulnerability, according to our analysis of data from the Federal Emergency Management Agency's National Risk Index.



The facility uses chlorine and sulfur dioxide, in quantities above the threshold amount listed in the RMP Rule, to treat wastewater. The chemicals are stored in large cylinders on site. According to Environmental Protection Agency (EPA), the effects of exposure to chlorine gas can include bronchitis, asthma, swelling of the lungs, headaches, heart disease, and meningitis. Acute exposure can cause death. Also according to EPA, short-term exposure to sulfur dioxide can harm the respiratory system and make breathing difficult.

EPA has delegated implementation and enforcement of the RMP Rule to the state of Florida, with the Florida Division of Emergency Management overseeing the implementation.

Preparing for Natural Hazards

Representatives from the South Cross Bayou facility told us that several natural hazards may impact their facility, including high winds and storm

surge from hurricanes. According to our analysis of federal data, the South Cross Bayou facility is located in an area that currently may be impacted by storm surge from a Category 1 to 5 hurricane and sea level rise of 0, 1, or 3 feet.

Chemical storage areas at the facility are surrounded by a reinforced concrete structure capable of withstanding hurricane force winds, according to facility representatives. With enough warning, the facility can prepare the chemical storage cylinders, so even structural damage would not cause a significant release.

Working with Stakeholders

The South Cross Bayou facility uses training, data analysis, and coordination with local emergency management to manage risks from natural hazards, among other activities. For example, the facility relies on emergency response plans developed by the County Emergency Response Coordinator that include training for responding to potential hurricane scenarios. The facility works with state and local entities that use data from National Oceanic and Atmospheric Administration and the National Hurricane Center to model storm surge risks and reevaluates flooding data every five years.

The facility also coordinates with the Tampa Bay Local Emergency Planning Committee (LEPC). The LEPC created a disaster planning guide for facilities that provides guidance on preparing for hazards, including hurricanes and floods. The LEPC also conducts worst-case scenario planning with facilities to prepare for accidental releases. In addition, LEPC is organizing a resiliency planning program to identify and manage risks related to sea level rise and climate change.

According to officials, Pinellas County is beginning to identify changes in floodplains in the region with the goal of providing information to facilities, so they can manage risks.

Sources: GAO analysis of information from the South Cross Bayou Advanced Water Reclamation Facility and the Tampa Bay Local Emergency Planning Committee; Pinellas County Government (photo). | GAO-22-104494

Accessible Information for Figure 7: South Cross Bayou Advanced Water Reclamation Facility, a Risk Management Plan (RMP) Facility in Florida

Overview

The South Cross Bayou Advanced Water Reclamation Facility is the largest wastewater treatment facility in Pinellas County, near Tampa Bay, Florida (see photo). The facility treats an average of 23 million gallons of wastewater a day and serves over 220,000 residential and commercial customers. The community surrounding the facility is residential and located in a census tract with relatively high social vulnerability, according to our analysis of data from the Federal Emergency Management Agency's National Risk Index.

The facility uses chlorine and sulfur dioxide, in quantities above the threshold amount listed in the RMP Rule, to treat wastewater. The chemicals are stored in large cylinders on site. According to Environmental Protection Agency (EPA), the effects of exposure to chlorine gas can include bronchitis, asthma, swelling of the lungs, headaches, heart disease, and meningitis. Acute exposure can cause death. Also according to EPA, short-term exposure to sulfur dioxide can harm the respiratory system and make breathing difficult.

EPA has delegated implementation and enforcement of the RMP Rule to the state of Florida, with the Florida Division of Emergency Management overseeing the implementation.

Preparing for Natural Hazards

Representatives from the South Cross Bayou facility told us that several natural hazards may impact their facility, including high winds and storm surge from hurricanes. According to our analysis of federal data, the South Cross Bayou facility is located in an area that currently may be impacted by storm surge from a Category 1 to 5 hurricane and sea level rise of 0, 1, or 3 feet.

Chemical storage areas at the facility are surrounded by a reinforced concrete structure capable of withstanding hurricane force winds, according to facility representatives. With enough warning, the facility can prepare the chemical storage cylinders, so even structural damage would not cause a significant release.

Working with Stakeholders

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natural hazards, among other activities. For example, the facility relies on emergency response plans developed by the County Emergency Response Coordinator that include training for responding to potential hurricane scenarios. The facility works with state and local entities that use data from National Oceanic and Atmospheric Administration and the National Hurricane Center to model storm surge risks and reevaluates flooding data every five years.

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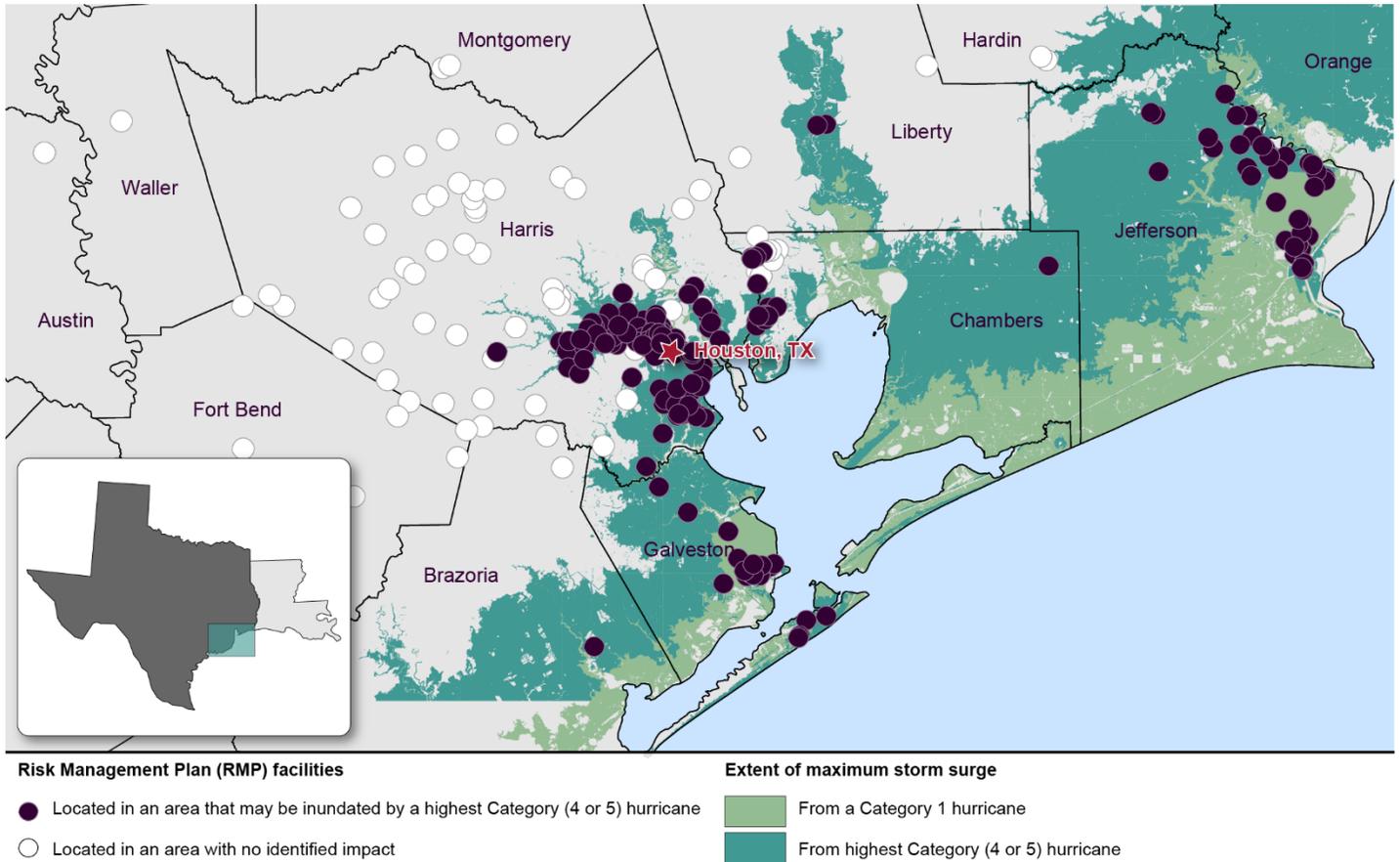
According to officials, Pinellas County is beginning to identify changes in floodplains in the region with the goal of providing information to facilities, so they can manage risks.

Sources: GAO analysis of information from the South Cross Bayou Advanced Water Reclamation Facility and the Tampa Bay Local Emergency Planning Committee; Pinellas County Government (photo). | GAO-22-104494

The facilities that we identified in areas that may be inundated by storm surge corresponding to Category 4 or 5 hurricanes are concentrated along the Gulf Coast, and they include facilities from a range of industries. Over 70 percent of RMP facilities that are located in areas that may be inundated by storm surge corresponding to Category 4 or 5 hurricanes—555 of 746—are located in Texas, Louisiana, Florida, and Mississippi, with the majority located in Texas. Nearly 25 percent of RMP facilities with North American Industry Classification System code designations for “Petroleum and Coal Products Manufacturing” or “Basic Chemical Manufacturing” are located in areas that may be inundated by storm surge corresponding to Category 4 or 5 hurricanes. Of the 213 facilities with these two North American Industry Classification System code designations located in areas that may be inundated by storm surge corresponding to Category 4 or 5 hurricanes, approximately 55 percent (118) are located in Texas.

Several recent hurricanes have impacted states along the Gulf Coast. For example, in 2020, Hurricane Laura made landfall in Louisiana, costing an estimated \$19 billion, according to NOAA. In 2017, Hurricane Harvey produced approximately 19 trillion gallons of rain over Texas, according to EPA, resulting in damage to several drinking water and wastewater facilities. Figure 8 shows RMP facilities near Houston, Texas, that are located in areas that may be inundated by storm surge.

Figure 8: RMP Facilities Located in Areas That May Be Inundated by Storm Surge near Houston, Texas



Sources: GAO analysis of Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), and U.S. Forest Service data; U.S. Census Bureau (map). | GAO-22-104494

Note: We analyzed chemical facilities subject to EPA's RMP Rule that EPA classified as current and active and that have at least one Program 2 or 3 process whose location information we assessed to be sufficiently reliable. These processes use hazardous chemicals that could potentially affect the public in the event of an accidental release. We approximated the boundaries of these RMP facilities with a 0.094-mile radius around the primary geographic coordinate of each RMP facility. Depending on the actual facility boundaries, the results of our analysis may not accurately reflect the number of RMP facilities located in these areas. This analysis is based on EPA and NOAA data as of December 2020.

Nationwide, the number of RMP facilities in areas that may be impacted by storm surge may be higher because, as of December 2020, NOAA has not modeled areas along the West Coast or Pacific islands other than

Hawaii.³⁴ Further, our analysis did not include other potential impacts from hurricanes, such as rainfall.

Approximately 350 RMP Facilities Are Located in Areas That May Be Impacted by Wildfire

We identified 357 RMP facilities— approximately 3 percent of RMP facilities we analyzed—located in areas with high or very high wildfire hazard potential, based on a U.S. Forest Service model as of December 2020.³⁵ Areas with higher wildfire hazard potential are more likely to burn with a higher intensity, according to the U.S. Forest Service. The full results of our analysis on the number of RMP facilities in areas with high or very high wildfire hazard potential are available in our interactive map, which can be viewed [here](#).

While approximately 30 percent of facilities located in areas with high or very high wildfire hazard potential are located in Florida, Georgia, and South Carolina, approximately 17 percent of facilities in these areas are located in the western U.S., where the NCA anticipates increased frequency and intensity of wildfire. According to the NCA, the incidence of large forest fires in the western U.S. and Alaska has increased since the early 1980s and is projected to further increase in these regions as the climate changes. In addition, according to the NCA, modeling studies suggest that the southeastern U.S. will experience increased fire risk and a longer fire season. Although projections vary by state and region, on average, the annual area burned by lightning-ignited wildfire is expected to increase by at least 30 percent by 2060. However, the NCA noted that analyses regarding the effect of climate change on the incidence of wildfire in other parts of the U.S. are not readily available, so it is

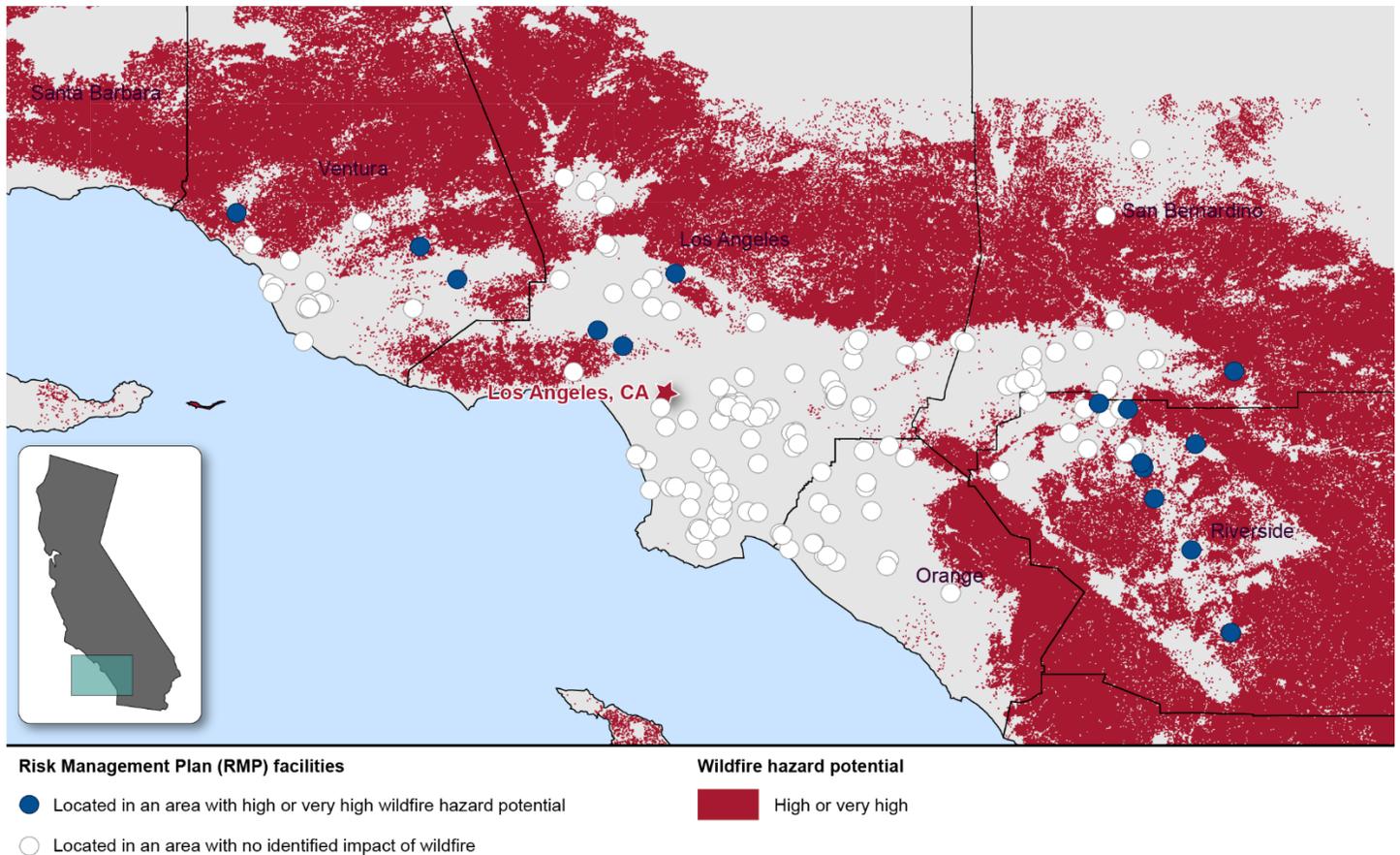
³⁴Our analysis may not accurately account for storm surge hazards in areas that are protected by levees. NOAA officials told us that storm surge in these areas is difficult to model.

³⁵For this analysis, we combined the high and very high wildfire hazard potential categories; we did not identify the number of facilities in each of these categories separately. We did not analyze areas that have moderate or lower wildfire hazard potential. Those with moderate or lower wildfire hazard potential are less likely to experience high-intensity wildfire, and the extent to which wildfire hazard potential may change in the future is unknown. However, U.S. Forest Service officials stated that areas of moderate or lower wildfire hazard potential can experience impacts from wildfire under certain conditions.

unknown how climate change will affect the number of RMP facilities in areas with high or very high wildfire hazard potential nationwide.

In 2018, the California Camp Fire, which at that time was the most destructive and deadly wildfire on record in California, burned approximately 153,000 acres, caused 85 fatalities, and destroyed approximately 18,800 structures in northern California, according to the U.S. Forest Service. We identified 61 RMP facilities in California located in areas with high or very high wildfire hazard potential. Figure 9 shows such facilities in the Los Angeles area.

Figure 9: RMP Facilities Located in Areas That May Be Impacted by Wildfire near Los Angeles, California



Source: GAO analysis of Environmental Protection Agency (EPA) and U.S. Forest Service data; U.S. Census Bureau (map). | GAO-22-104494

Notes: We analyzed chemical facilities subject to EPA’s RMP Rule that EPA classified as current and active and that have at least one Program 2 or 3 process whose location information were assessed to be sufficiently reliable. These processes use hazardous chemicals that could potentially affect the public in the event of an accidental release. We approximated the boundaries of these RMP facilities

with a 0.094-mile radius around the primary geographic coordinate of each RMP facility. Depending on the actual facility boundaries, the results of our analysis may not accurately reflect the number of RMP facilities located in these areas. This analysis is based on EPA and U.S. Forest Service data as of December 2020.

Nationwide, the number of RMP facilities in areas that have high or very high wildfire hazard potential may be higher than 357 because wildfire hazard data are not available in some areas of the U.S. (i.e., there are no data for Pacific islands other than Hawaii, Puerto Rico, or the U.S. Virgin Islands). In addition, according to EPA Region 9 officials and state and county officials in California, facilities not directly impacted by wildfire can be indirectly impacted by smoke and loss of power from nearby wildfire. For example, state and county officials in California said that facilities in California can lose power due to destruction of infrastructure from a nearby wildfire or because power is purposefully shut down in the area to slow the spread of a wildfire. (See app. III for information about the California Accident Release Prevention Program, a state-level program required by state law that inspects and provides compliance assistance to facilities in the state of California.)

More than 150 RMP Facilities, Mostly in Gulf Coast States, Are Located in Areas that May Be Inundated By 1 Foot of Sea Level Rise

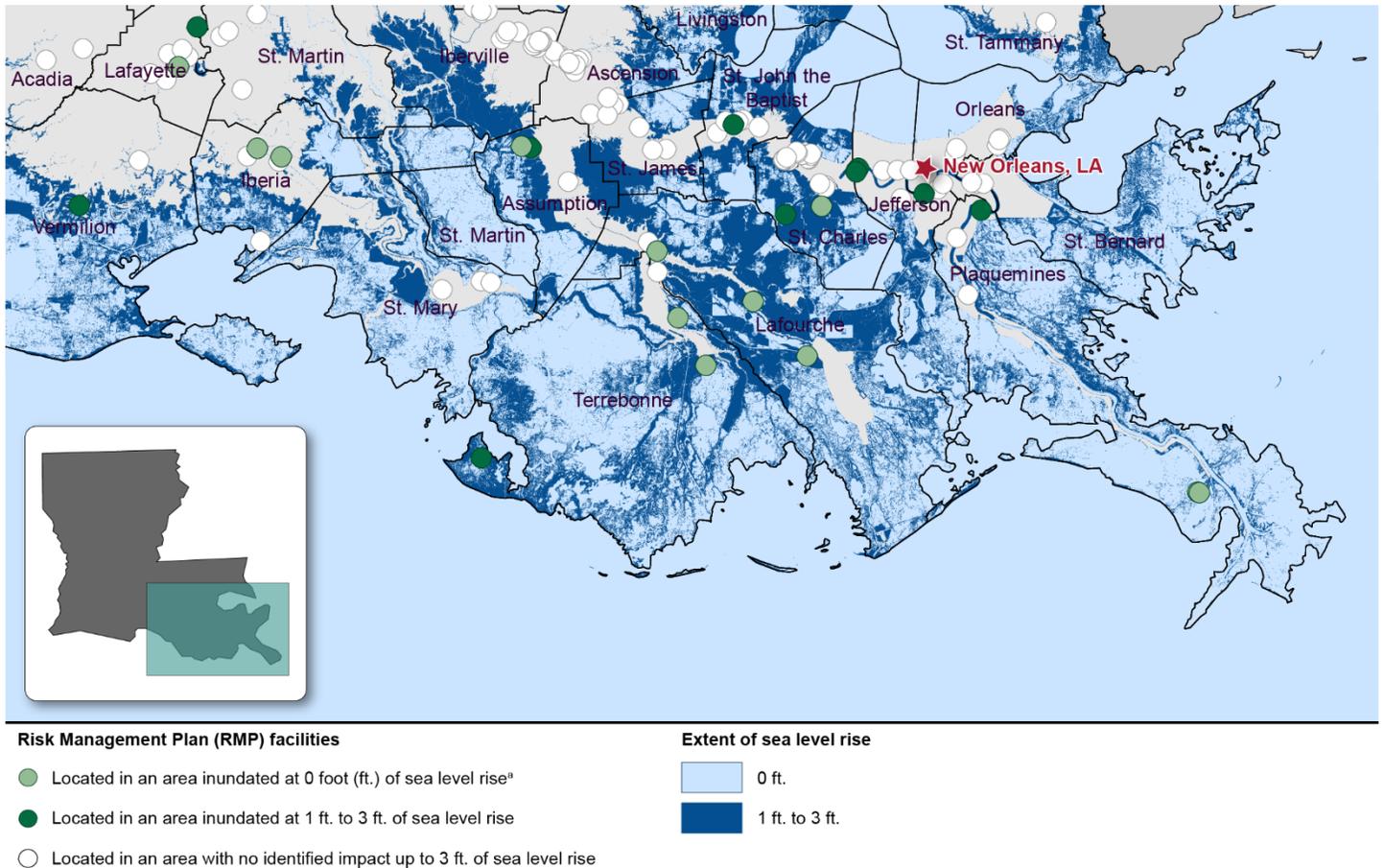
We identified 155 RMP facilities—less than 2 percent of RMP facilities we analyzed—located in areas that may be inundated if sea levels rose by 1 foot, based on our analysis of NOAA sea level rise data from July 2020. Of those facilities, 133 are located in areas that may currently be inundated at a typical high tide.³⁶ Our analysis shows that if sea levels rose by a total of 3 feet, 208 RMP facilities may be inundated, which includes the 155 RMP facilities located in areas that may be inundated if sea levels rose by 1 foot. According to the NCA, global average sea levels are very likely to continue to rise by at least several inches in the next 13 years and by 1.0 to 4.3 feet by 2100. In addition, over the next two to three decades, storm surges and high tides could combine with sea level rise and land subsidence to further increase inundation, according to the NCA. The full results of our analysis, which include information on the number of RMP facilities in areas that may already be inundated at high tide and that would be inundated if sea levels rise by 1

³⁶These RMP facilities are located in areas at 0-foot sea level rise, which is equivalent to the water level at the average of the highest of the two daily tides from 1983 to 2001, according to NOAA.

foot and 3 feet, are available in our interactive map, which can be viewed at [here](#).

Approximately 41 percent of RMP facilities that would be inundated by a sea level rise of 1 foot are located in Texas, Louisiana, Florida, and Mississippi. Parts of this region have already experienced land loss because of sea level rise and coastal flooding, according to the NCA. The locations of facilities near New Orleans, Louisiana, a region that is experiencing sea level rise, are shown in figure 10.

Figure 10: RMP Facilities Located in Areas That May Be Inundated by Sea Level Rise near New Orleans, Louisiana



Sources: GAO analysis of Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA) data; U.S. Census Bureau (map). | GAO-22-104494

Notes: We analyzed chemical facilities subject to EPA’s RMP Rule that EPA classified as current and active and that have at least one Program 2 or 3 process whose location information were assessed to be sufficiently reliable. These processes use hazardous chemicals that could potentially affect the public in the event of an accidental release. We approximated the boundaries of these RMP facilities

with a 0.094-mile radius around the primary geographic coordinate of each RMP facility. Depending on the actual facility boundaries, the results of our analysis may not accurately reflect the number of RMP facilities located in these areas. This analysis is based on EPA and NOAA data as of December 2020 and July 2020, respectively.

^aA 0 ft. sea level rise means an area may already be inundated at high tide.

Nationally, the number of RMP facilities that may be inundated by various heights of sea level rise may vary from the results of our analysis because different parts of the U.S. may experience higher or lower sea level rise than the global average. For example, the NCA states that sea level rise will be higher than the global average on the East and Gulf Coasts of the U.S. and lower than the global average in most of the Pacific Northwest and in Alaska.

RMP Facilities Face Various Challenges in Managing Risks from Natural Hazards and Climate Change, and EPA Has Opportunities to Address These Challenges

RMP Facilities Face Challenges Such as Insufficient Information and Direction Regarding Risks

EPA, OSHA, and Chemical Safety Board officials and representatives of stakeholder groups we interviewed identified a variety of challenges that RMP facilities face in managing risks from natural hazards and climate change through their risk management programs. These challenges include insufficient information about risks from natural hazards and climate change, insufficient direction on how to incorporate risks from natural hazards and climate change into risk management programs, and the cost of managing these risks. These challenges are particularly difficult for smaller facilities.

Insufficient information about risks. One challenge RMP facilities face in managing risks from natural hazards and climate change is that they may not have sufficient information about the risks they face, according to some officials and stakeholder groups. There are a variety of reasons why RMP facilities may not have sufficient information. For example, according to officials and stakeholder groups with whom we spoke, the information may not exist or be out of date, facilities may be unaware the

information exists, or facilities may be unable to understand the information. Relevant models may not exist on how risks from natural hazards may be increasing due to climate change, for instance, according to a stakeholder group. A facility may be unaware of FEMA's flood maps, according to EPA officials in one region. Because climate change is increasing the frequency and severity of extreme precipitation events in some parts of the country, FEMA's 100- and 500-year flood zone maps may not represent current and future flood hazards, presenting a challenge to facilities in managing these risks, according to OSHA officials, EPA officials from one region, and a stakeholder group.

We reported on similar challenges with climate information in prior work. In November 2015, we reported that decision makers may be unaware that climate information exists or be unable to use what is available. Most decision makers need a basic set of information to understand and make choices about how to adapt to climate change, according to a 2010 National Research Council report on making informed decisions about climate change and our October 2009 report on climate adaptation.³⁷ This includes information about observed climate conditions, impacts, and vulnerabilities; and projections of what climate change may mean for local areas. We found that existing federal efforts do not fully meet the climate information needs of federal, state, local, and private decision makers.³⁸

³⁷National Research Council, *America's Climate Choices: Panel on Informing Effective Decisions and Actions Related to Climate Change, Informing an Effective Response to Climate Change* (Washington, D.C.: 2010); and GAO, *Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions*, [GAO-10-113](#) (Washington, D.C.: Oct. 7, 2009).

³⁸In November 2015, we recommended that the Executive Office of the President designate a federal entity to develop a set of authoritative climate change projections and observations and create a national climate information system with defined roles for federal and nonfederal entities. As of December 2020, the Executive Office of the President had not taken action in response to this recommendation. GAO, *Climate Information: A National System Could Help Federal, State, Local, and Private Sector Decision Makers Use Climate Information*, [GAO-16-37](#) (Washington, D.C.: Nov. 23, 2015).

Managing Flood Risks: The Chemical Safety Board Report on the 2017 Arkema Fire

In May 2018, the Chemical Safety Board reported on its investigation of a fire at the Arkema plant in Crosby, Texas. In 2017, flooding from Hurricane Harvey caused the plant to lose power, backup power, and critical organic peroxide refrigeration systems, leading the organic peroxide to decompose and burn. Officials established a 1.5-mile evacuation zone around the facility. Although there were two chemicals regulated under the Clean Air Act's prevention of accidental releases provision on site, these chemicals were not released in the incident, according to the Board and Arkema representatives.

During its investigation, the Board found that there is a lack of robust flood risk guidance available to help prepare facilities for extreme weather events. Federal safety regulations also lack specific requirements or detailed guidance on how facilities should evaluate and address such events.

In response to a recommendation from the Chemical Safety Board, in 2019, the Center for Chemical Process Safety released guidance, titled *Assessment and Planning for Natural Disasters*, to help facilities assess risks from potential extreme weather events. The guidance does not mention climate change.

Sources: Chemical Safety Board, *Organic Peroxide Decomposition, Release, and Fire at Arkema Crosby Following Hurricane Harvey Flooding 2017-01-I-TX*, (Washington, D.C.: May 2018); Center for Chemical Process Safety, *CCPS Monograph: Assessment of and Planning for Natural Hazards* (2019). | GAO-22-104494

Insufficient direction on incorporating risks. Another challenge facilities face is insufficient direction on how to incorporate increasing risks from natural hazards and climate change into their risk management programs, according to EPA officials from four regions, Chemical Safety Board, and four stakeholder groups. For example, according to one stakeholder group, there is no information for facilities on how to prepare for events that have never been experienced before, such as those caused by climate change. In 2018, the Chemical Safety Board found that chemical facilities lacked sufficient industry guidance to effectively prepare for natural hazards such as flooding. Based on our review of EPA documents, we found no evidence that EPA has developed direction for RMP facilities on incorporating risks from climate change into facility risk management programs. Moreover, we found no EPA guidance materials for regulated facilities that mentioned climate change.

The RMP Rule does not explicitly require a facility to consider natural hazards or climate change as part of its risk management program. However, EPA guidance says that an RMP facility should consider external hazards, such as natural hazards, as part of the hazards review or process hazard analysis conducted for its prevention program. In addition, according to EPA officials, risks from climate change are implicitly included in RAGAGEP among external risks that may impact facilities, even if climate change is not mentioned explicitly. Some industry association technical committees that develop and update RAGAGEP are currently strengthening relevant areas of codes that deal with natural hazards, for example, even if they do not mention climate change, according to these officials. When there is new information on risks from natural hazards, such as if flood risks have already increased due to climate change, industry associations will update the RAGAGEP, EPA officials told us. EPA officials from some regional offices told us that RAGAGEP include information on managing risks from extreme weather, but EPA officials from seven regional offices told us that they were unaware of any industry RAGAGEP that discuss climate change.³⁹ Officials from one region told us that industry associations are slow to change standards and codes and often only update them following events such as floods and fires. Without industry standards on these increasing risks, even if a facility is aware of the risks, the facility may not take steps to prepare for them, officials from one region told us.

Cost of managing risks. Another challenge for facilities in managing risks from natural hazards and climate change is the cost of managing these risks, according to some EPA officials and stakeholder groups. EPA officials from two regions and two stakeholder groups told us that assessing risks from natural hazards and climate change can be costly. Officials from one EPA region said that obtaining the information needed to better assess the risks requires money and resources. Addressing the risks may also be expensive, according to EPA officials from headquarters and a regional office and four stakeholder groups. Retrofitting or changing facility operations to safeguard against increasing risks from natural hazards can require significant funding, according to EPA officials from one region. The extent to which a facility addresses risks may come down to the resources the facility has on hand, according

³⁹Three EPA regional offices did not respond to our question about whether RAGAGEP include information on risks from climate change.

to EPA officials from one region, and facilities may lack the resources they need to address the hazards they identify in their hazard review.

Challenges facing smaller facilities. The challenges described above are particularly difficult for smaller facilities, according to officials from OSHA and seven EPA regions and three stakeholder groups. According to EPA officials from one region, smaller facilities may not have the resources required to join industry groups, which can provide information on risks to their members, or hire a third party to conduct a process hazard analysis, according to a stakeholder group. According to officials from another EPA region, smaller facilities also tend not to be aware of information resources the EPA regional office provides to facilities.

EPA Has Opportunities to Address Challenges Faced by RMP Facilities, Such as Providing Additional Compliance Assistance and Clarifying Requirements

We identified a number of opportunities for EPA to help address the challenges facilities face in managing risks from natural hazards and climate change through a review of documents and interviews with EPA, OSHA, and Chemical Safety Board officials; representatives of stakeholder groups; and our own analysis. These opportunities include providing additional compliance assistance to facilities and clarifying requirements, including providing direction to RMP facilities, on how to incorporate risks from natural hazards and climate change into risk management programs.

Additional compliance assistance. One opportunity for EPA to support RMP facilities in managing risks from natural hazards and climate change would be to provide facilities with additional compliance assistance related to risks from natural hazards and climate change, according to officials from OSHA and four EPA regions and five stakeholder groups.

EPA has provided some compliance assistance to facilities that highlights risks from natural hazards and available information on incorporating natural hazards into risk management programs. For example, in 2018, EPA Region 2 gave a presentation to facilities on preparing for and responding to natural disasters, and in 2020, the region shared a safety alert and related video on preparing for extreme weather events that was

developed by the Chemical Safety Board.⁴⁰ However, we found that EPA compliance assistance to RMP facilities generally did not include information related to risks from natural hazards, and none included information on climate change.

Some officials and stakeholder groups identified opportunities for EPA to provide additional compliance assistance to facilities. A stakeholder group suggested that EPA regional offices provide facilities with mapping data on natural hazards. Officials from an EPA region suggested that EPA officials in the region provide facilities with information about risks from climate change through presentations or pamphlets. Officials from three EPA regions and one stakeholder group said that EPA could provide additional training for facilities, including on how to assess and react to these risks. (See app. IV for examples of how some nonfederal entities are providing compliance assistance to RMP facilities.)

Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, states that it is the policy of the administration to deploy the full capacity of federal agencies to combat the climate crisis to implement a government-wide approach that increases resilience to the impacts of climate change, among other things. According to GAO's Disaster Resilience Framework, one way federal entities can facilitate and promote resilience to natural disasters is by sharing information with decision makers to help them manage risks from natural hazards and climate change.⁴¹ Relevant information regarding natural hazards and climate change may be available from a variety of sources, including federal

⁴⁰U.S. Chemical Safety and Hazard Investigation Board, *Extreme Weather Safety Message* (June 23, 2020); and *2020 Hurricane Season: Guidance for Chemical Plants During Extreme Weather Events* (Washington, D.C.: June 23, 2020).

⁴¹In October 2019, we issued a Disaster Resilience Framework to serve as a guide for analysis of federal action to facilitate and promote resilience to natural disasters. The principles in this framework can help identify opportunities to enhance such federal efforts. GAO, *Disaster Resilience Framework: Principles for Analyzing Federal Efforts to Facilitate and Promote Resilience to Natural Disasters*, [GAO-20-100SP](#) (Washington, D.C.: Oct. 2019).

agencies, industry associations, local governments, and academic institutions.⁴²

EPA's 2021 Climate Adaptation Action Plan states that the agency will support businesses, as well as other entities, by producing and delivering the training, tools, technical support, data, and information they need to adapt and increase resilience to climate change. The Office of Policy and EPA's Senior Climate Change Adaptation Official is responsible for the execution of this Plan. The Office of Research and Development is the agency lead in identifying and addressing the science needs of program and regional offices, including information on climate change risks, vulnerabilities, and the latest data, models, and tools. By providing compliance assistance related to risks from natural hazards and climate change to RMP facilities, EPA could be better assured that facilities have the information they need to appropriately manage these risks. Such assistance may be particularly useful to smaller RMP facilities that may not have the resources needed to identify and access this information on their own.

Based on our analysis, we found that EPA has an opportunity to tailor its compliance assistance for RMP facilities to ensure that facilities have the specific information they need. We found that EPA headquarters does not have information on common deficiencies found by RMP inspectors during inspections of RMP facilities. According to EPA officials, EPA's enforcement and compliance database includes information on facilities' violations and enforcement actions, but it does not capture details on specific deficiencies, such as whether a facility did not consider risks from natural hazards in its process hazard analysis. However, two regions

⁴²Potential relevant sources of information on natural hazards may include NOAA's Hurricane Center and sea level rise data, FEMA flood maps, American Society for Civil Engineers wind prediction maps, consultants, and insurance companies, according to the Center for Chemical Process Safety. NOAA's Heat Stress Index and the U.S. Geological Survey's National Water Information System are other potential federal sources of information, for example. Officials from Region 9 told us that facilities may also use county or city flood maps or guidance to identify hazards. EPA guidance documents also point to education institutions as a source of information. For example, the University of Washington Climate Impacts Group and Department of Atmospheric Sciences developed a regional climate model to project future flooding in King County rivers with funding from King County Flood Control District and the Department of Homeland Security, among others. Texas A&M University is in the process of modeling and analyzing the vulnerability of petrochemical facilities along Galveston Bay to flood-induced chemical spills and releases, with funding from the National Academy of Sciences, Engineering, and Medicine.

informally identified common deficiencies and found that some facilities were not appropriately identifying natural hazards. One region then highlighted this fact in a webinar for facilities.

According to GAO internal controls, management should design an information system to meet information requirements and respond to the entity's objectives and risks. The objective of the RMP Rule is to prevent or minimize the consequences of accidental releases of hazardous chemicals. By designing an information system to track common deficiencies found during inspections, including any related to natural hazards and climate change, EPA could more effectively target compliance assistance to ensure that facilities have the information they need to meet the RMP Rule's objective.⁴³

Direction on incorporating risks from natural hazards and climate change. EPA officials from OECA and four regional offices, OSHA officials, and seven stakeholder groups suggested that EPA could provide direction to facilities on how to incorporate natural hazards and climate change into risk management programs. For example, one official said that EPA could develop new guidance to describe how to include climate change in hazard reviews and process hazard analysis. EPA officials from another region suggested that EPA create guidance on developing appropriate emergency response plans. A stakeholder group said that EPA could clarify how preparing for climate change fits in the current regulation. Representatives of the Center for Chemical Process Safety suggested that EPA could build on the Center's guidance with additional practical guidance and training for facilities. In addition, OSHA officials suggested that relevant case studies on natural hazards and climate change would be beneficial to facilities in risk management planning.

Some stakeholder groups have suggested that EPA should explicitly require facilities to incorporate natural hazards and climate change into their risk management programs. For example, one stakeholder group recommended that the RMP Rule require facilities to assess their risks of an accidental release caused by a natural hazard, including the vulnerability of emergency response resources to these events. Another

⁴³According to EPA's draft strategic plan for fiscal years 2022 to 2026, effective compliance monitoring and enforcement increasingly depends on effective use of data management and data science capabilities. The draft plan states that the agency will improve its collection and management of compliance monitoring information through modernization of existing data systems and creation of new tools to streamline the compliance monitoring process.

stakeholder group stated that the RMP Rule should require facilities to consider climate change when developing process hazard analyses, RMPs, and natural disaster preparedness protocols.

According to the Chemical Safety Board, rigorous advance planning for extreme weather is critical for facilities to react successfully to emergencies. This requires equipment and process design as well as training and routine practice. The European Commission Joint Research Centre reports that companies fare better during extreme weather events if they have implemented risk reduction measures and if they design specifically for extreme weather.

EPA's 2021 Climate Adaptation Action Plan states that EPA will ensure its programs, policies, rules, enforcement and compliance assurance activities, and operations consider current and future impacts of climate change. To build resilience to natural disasters, GAO's Disaster Resilience Framework recommends that the federal government assist decision makers by sharing information that would help them understand their disaster risk and by conducting analysis and planning to help them take resilience actions.⁴⁴ The framework also recommends coordinating across government programs and leveraging the expertise of nonfederal partners to make consistent policies and procedures. By issuing regulations, guidance, or both, as appropriate, to clarify requirements and provide RMP facilities with direction on how to incorporate these risks into their risk management programs, EPA could better ensure that RMP facilities are managing risks from all relevant hazards, including natural hazards and climate change. When developing any such regulation, EPA should, pursuant to relevant executive orders, conduct a cost-benefit analysis. When developing such direction, EPA would benefit from leveraging the expertise of stakeholders, including OSHA, industry officials, and state and local emergency response organizations, as appropriate.

EPA Does Not Consistently Assess Management of Risks from Natural Hazards

⁴⁴[GAO-20-100SP](#).

and Climate Change, and Faces Challenges Such as Insufficient Guidance

EPA's RMP inspectors vary in the extent to which they assess how facilities manage risks from natural hazards and climate change in their risk management programs. Inspectors face several challenges, including insufficient guidance, which make it difficult to consistently assess how facilities are managing these risks. Officials and stakeholders have identified opportunities to address some of these challenges. EPA can only assess how facilities are managing risks at the facilities that it inspects; however, we found that EPA does not consider natural hazards or climate change, or the relative social vulnerability of surrounding communities, when it selects facilities for inspection.

RMP Inspectors Vary in the Extent to Which They Assess How Facilities Manage Risks from Natural Hazards and Climate Change

RMP inspectors in EPA regional offices vary in the extent to which they assess whether facilities have identified natural hazards. EPA officials from headquarters and four regions told us that generally, the onus is on a facility to identify natural hazards in the facility's location. For example, EPA officials from one region said that inspectors determine whether a facility has identified any hazards and then whether it has safeguarded against those hazards; however, they do not verify that the facility has identified all hazards.

Inspectors in some EPA regions take a more active role in determining what natural hazards a facility may be facing. For example, EPA officials in one region told us that prior to an inspection, inspectors determine whether a facility is located in a FEMA flood hazard area. If so, the inspectors assess whether the facility has appropriately identified and addressed this hazard based on RAGAGEP. Inspectors will cite a facility if the facility fails to identify a relevant hazard to a covered process, according to EPA officials from one region.

Inspectors rely on their own experience and knowledge of the local area to identify which natural hazards a facility should include in its risk management program, according to EPA officials from headquarters and three regional offices. For example, after Hurricane Sandy, inspectors in Region 2 began routinely asking whether facilities were preparing for

extreme weather. According to EPA officials from another region, they would discuss with a facility whether it was addressing a particular hazard only if a facility experienced an accident caused by that hazard or inspectors were made aware of the hazard by local emergency response officials after an incident.

Regarding increasing risks from climate change, EPA officials from OECA and five regional offices told us that inspectors do not assess whether facilities incorporate these risks in their risk management programs. EPA officials in one region said that it would be difficult for an inspector to call out a missing hazard in a process hazard analysis if the hazard is outside the norm of current hazards or past incidents. This would also be the case with natural hazards that may be exacerbated by climate change in the future. However, EPA officials from another region told us that inspectors would assess how a facility incorporates climate change risk into its risk management program if the facility itself identified increasing risks from climate change as a hazard. Officials from one region told us that inspectors discuss with facilities the fact that events that previously might occur once in a lifetime may now be occurring more frequently.

RMP Inspectors Face Challenges, Including a Lack of Guidance, in Assessing How Facilities Manage Risks from Natural Hazards and Climate Change

EPA and OSHA officials and stakeholder groups identified several challenges that RMP inspectors face in assessing how RMP facilities manage risks from natural hazards and climate change, including insufficient guidance and training for inspectors on how to do so. Two of the challenges that facilities face—insufficient information on natural hazards and climate change and insufficient direction on how to incorporate these risks into risk management programs—also present challenges for inspectors. Some EPA officials told us that EPA does not have sufficient credentialed inspectors available to conduct inspections. Officials and stakeholders identified opportunities for EPA to address some of these challenges.

Insufficient guidance and training for RMP inspectors. RMP inspectors have insufficient guidance and training on how to assess whether facilities are managing risks from natural hazards and climate change, according to EPA officials from three regions and representatives of two stakeholder groups. Some EPA officials and stakeholders we interviewed said that one opportunity to address this challenge would be

for EPA to issue guidance for inspectors on how to assess the extent to which RMP facilities are managing these risks and to develop related training. In its 2021 Climate Adaptation Action Plan, EPA states that it will develop, update, and expand existing climate adaptation training modules for its staff to, in part, (1) encourage all EPA staff to consider the changing climate in the normal course of business, and (2) introduce its staff to specific methods and tools for integrating climate adaptation into decision making processes.

However, EPA cannot develop such guidance and training for inspectors until it develops a method for inspectors to use in assessing how facilities manage risks from natural hazards and climate change. According to OLEM officials, EPA has not developed a method for inspectors to use to validate that risk management programs comprehensively address these risks. OECA officials suggested that EPA could work with industry associations to develop such a method. By (1) developing a method for inspectors to assess the sufficiency of RMP facilities' incorporation of risks from natural hazards and climate change into risk management programs and (2) providing related guidance and training to RMP inspectors, EPA could ensure that inspectors consistently assess how facilities manage these risks.

Insufficient information and direction for facilities. Two of the challenges facing facilities—insufficient information on natural hazards and climate change and insufficient direction on how to incorporate these risks into risk management programs—also pose challenges for RMP inspectors. For example, inspectors need information on risks from natural hazards and climate change, such as maps, to assess whether facilities are correctly identifying these risks, according to EPA officials from one region.⁴⁵ Officials from another region told us that inspectors need such information to justify why a facility should consider risks from climate change.

According to officials from OSHA and three EPA regional offices and a stakeholder group, inspectors may also find it challenging to assess how facilities are managing risks from natural hazards and climate change

⁴⁵Insufficient information may be problematic if inspectors are relying on their own experience to determine whether a facility has identified relevant natural hazards. For example, the Chemical Safety Board reported that relying on the experience of individuals is insufficient to determine the risk of flooding. This may be particularly true when floods from extreme rainfall events have increased and are projected to continue to increase in many parts of the U.S., according to the NCA.

because there is insufficient direction for facilities against which inspectors can assess a facility's risk management program. For example, EPA officials from one region told us that it is difficult to make the case that a facility is not appropriately managing these risks when facilities do not have sufficient guidance on how to do so. We discussed opportunities for EPA to address these challenges in the prior section.

Insufficient number of credentialed RMP inspectors. Another challenge EPA faces in assessing how facilities manage risks is a shortage of credentialed RMP inspectors, according to EPA officials at headquarters and some regional offices and two stakeholder groups. In 2020, the number of credentialed inspectors, including contractors, reached its lowest level (35 inspectors) in a decade, according to data from EPA regional offices. Officials from two regions told us that they had lost experienced inspectors, and they have found it challenging to recruit new inspectors to fill vacancies. The number of RMP facilities that EPA inspects each year has declined since 2012, from 625 per year (5 percent of facilities) in 2012 to 284 per year (2 percent of facilities) in 2019, according to EPA.

Officials in one region told us that a number of factors contributed to the decrease in the number of inspections, including constraints on resources, shifting priorities, and a reduction in the number of contracted employees, which included inspectors. Regional officials told us that they are in the process of credentialing or hiring an additional 15 inspectors across multiple regions. However, according to a stakeholder group, new inspectors may not have the experience necessary to conduct effective inspections. According to EPA officials in one region, by providing additional compliance assistance to facilities as discussed above, EPA could help ensure facilities are managing risks while facing the inspector shortage.

EPA Does Not Consider Natural Hazards or Climate Change, or the Relative Social Vulnerability of Surrounding Communities, When Selecting Facilities for Inspection

EPA can only assess how RMP facilities are managing risks at the facilities that it inspects. However, based on our interviews with EPA headquarters officials and regional officials, we found that EPA does not consider natural hazards or climate change, or the relative social vulnerability of surrounding communities to these hazards, when selecting

facilities for inspection. EPA has focused on a variety of other risk-based criteria in selecting facilities to inspect. EPA policy requires regional offices to prioritize inspections at “high-risk” facilities: facilities with a large residential population within the facility’s worst-case scenario vulnerable zone, facilities with a history of significant accidental releases, and facilities with very large quantities of hazardous chemicals held on site (or with multiple hazardous chemicals held above a threshold quantity). According to EPA headquarters officials, there are currently approximately 1,800 high-risk facilities. EPA officials at regional offices also consider other factors in selecting facilities for inspection, including length of time since the last inspection and referrals from other agencies such as OSHA.

According to the Center for Chemical Process Safety, natural disasters such as Hurricanes Katrina and Harvey, Superstorm Sandy, and various river flooding events have made it clear to the refining and chemical industries that planning for such natural hazards is very important. According to the NCA, more frequent and intense extreme weather and climate-related events are expected to continue to damage infrastructure. EPA’s climate action plan states that the agency will ensure its enforcement and compliance assurance activities consider current and future impacts of climate change. According to EPA guidance, inspectors may select facilities for inspection based on factors such as geographic location and specific facility hazards. By including vulnerability to natural hazards and climate change as criteria in selecting facilities for inspection, EPA could better ensure that such facilities are appropriately managing these risks to prevent and minimize the consequences of an accidental release.

Many RMP facilities are located in socially vulnerable communities, according to EPA. Individuals in these communities face disproportionately high impacts from accidental releases caused by natural hazards. These same communities may also be less able to prepare for, respond to, and recover from a natural disaster, according to the NCA.

In its Environmental Justice 2020 Action Agenda, EPA set a goal to deepen environmental justice practice within EPA programs to improve the health and environment of overburdened communities, such as by ensuring environmental justice is appropriately analyzed, considered, and addressed in EPA rules with potential environmental justice concerns. EPA’s 2022-2026 draft strategic plan states that EPA will increase inspections at facilities where an accident would potentially affect

communities with environmental justice concerns. According to EPA guidance for inspectors, inspectors may consider proximity to minority or low-income residential areas as a factor in selecting facilities for inspection, although we did not identify any regions that currently do so. Executive Order 14008, issued in January 2021, directs the Administrator of EPA to strengthen enforcement of environmental violations with disproportionate impact on underserved communities. By incorporating the relative social vulnerability of surrounding communities as criteria when selecting facilities for inspection, EPA could better ensure that such facilities are appropriately managing risks to prevent and minimize the consequences of an accidental release on these communities.

Conclusions

Climate change may exacerbate natural hazards, such as flooding, storm surge, and wildfires, which could potentially lead to accidental releases of hazardous chemicals at RMP facilities. EPA has the opportunity to reduce the risk of accidental releases and minimize the consequences of such releases by ensuring that RMP facilities are managing risks from natural hazards and climate change.

However, facilities and EPA face several challenges in doing so. For example, RMP facilities do not always have sufficient information on risks from natural hazards and climate change. EPA could be better assured that facilities have the information they need to manage these risks by providing facilities with additional compliance assistance—such as data, tools, and technical support—related to these risks. Such compliance assistance would be especially useful for smaller facilities with limited resources. Moreover, by designing an information system to track common deficiencies found during inspections, including any related to natural hazards and climate change, EPA could more effectively target compliance assistance.

In addition, RMP facilities have insufficient direction on incorporating natural hazards and climate change into risk management programs. By issuing regulations, guidance, or both, as appropriate, to clarify requirements and provide RMP facilities with direction on how to incorporate these risks into their risk management programs, EPA could better ensure that RMP facilities are managing risks from all relevant hazards, including natural hazards and climate change. When developing any such regulation, EPA should, pursuant to relevant executive orders, conduct a cost-benefit analysis. When developing such direction, EPA

would benefit from leveraging the expertise of stakeholders, including OSHA, state and local emergency response committees, and industry officials, as appropriate.

One challenge RMP inspectors face in assessing how facilities manage risks from natural hazards and climate change is insufficient guidance on how to do so. EPA has an opportunity to address this challenge by providing guidance and related training for inspectors. However, EPA must first develop a method for inspectors to use in assessing how facilities manage these risks. By developing a method for inspectors to assess the sufficiency of RMP facilities' incorporation of risks from natural hazards and climate change into risk management programs and then providing related guidance and training to RMP inspectors, EPA could ensure that inspectors consistently assess how facilities manage these risks.

EPA can only assess how RMP facilities are managing risks at the facilities it inspects. Currently, however, when selecting facilities for inspection, the agency does not consider facilities' vulnerability to natural hazards and climate change or the relative social vulnerability of surrounding communities. By broadening the criteria it uses to select facilities for inspection to include these potential vulnerabilities, EPA can ensure that vulnerable facilities are appropriately managing risks and positioned to prevent and minimize the consequences of accidental chemical releases in socially vulnerable communities.

Recommendations for Executive Action

We are making the following six recommendations to EPA:

The Assistant Administrator of the Office of Enforcement and Compliance Assurance and Director of the Office of Emergency Management, together with EPA officials at regional offices, should provide additional compliance assistance to RMP facilities related to risks from natural hazards and climate change. (Recommendation 1)

The Assistant Administrator of the Office of Enforcement and Compliance Assurance should design an information system to track common deficiencies found during inspections, including any related to natural hazards and climate change, and use this information to target compliance assistance. (Recommendation 2)

The Director of the Office of Emergency Management should issue regulations, guidance, or both, as appropriate, to clarify requirements and provide direction for RMP facilities on how to incorporate risks from natural hazards and climate change into their risk management programs. (Recommendation 3)

The Assistant Administrator of the Office of Enforcement and Compliance Assurance and Director of the Office of Emergency Management should develop a method for inspectors to assess the sufficiency of RMP facilities' incorporation of risks from natural hazards and climate change into risk management programs and provide related guidance and training to inspectors. (Recommendation 4)

The Assistant Administrator of the Office of Enforcement and Compliance Assurance, working with officials at regional offices, should incorporate vulnerability of RMP facilities to natural hazards and climate change as criteria when selecting facilities for inspection. (Recommendation 5)

The Assistant Administrator of the Office of Enforcement and Compliance Assurance, working with EPA officials at regional offices, should incorporate the relative social vulnerability of communities that could be impacted by an accidental release when selecting RMP facilities for inspection. (Recommendation 6)

Agency Comments

We provided a draft of this report to EPA for review and comments. In its comments, reproduced in appendix IV, EPA agreed with our assessment that many facilities regulated under the RMP Rule are located in areas that are susceptible to natural hazards from climate change. EPA also agreed with our recommendations and described steps it plans to take to implement them.

EPA noted that it had two significant comments. First, EPA said that the ongoing RMP rulemaking process will affect its timeline for implementing our recommendations. EPA stated that the agency plans to develop materials and products on risks from natural hazards and climate change, such as compliance assistance and guidance, as appropriate, based on the provisions in the final rule, which is scheduled to be published in 2023. We recognize that the rulemaking may affect the timing and approach for implementing some of our recommendations. However, we do believe that it is important for EPA to implement these

recommendations and that EPA can begin implementing those unaffected by the current rulemaking.

Second, in response to our recommendation regarding the design of an information system to track common deficiencies found during inspections and the use of this information to target compliance assistance, EPA stated that it does not view the development of a “sophisticated electronic database” as necessary to achieve the intent of this recommendation. EPA said that it plans to develop a written business process to periodically collate and review inspection findings and to use this process to target compliance assistance efforts. Any process that consistently and effectively tracks common deficiencies and leads to the agency targeting compliance assistance could meet the intent of this recommendation.

EPA also provided technical comments that we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Administrator of the Environmental Protection Agency, and other interested parties. In addition, the report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or gomezj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix V.

A handwritten signature in black ink that reads "Alfredo Gómez". The signature is written in a cursive style with a large, stylized 'G'.

J. Alfredo Gómez
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

This report examines (1) what available federal data indicate about the number and types of RMP facilities that are located in areas with selected natural hazards that may be exacerbated by climate change; (2) challenges RMP facilities face in managing risks to human health and the environment from natural hazards and climate change, and opportunities for EPA to address these challenges; and (3) the extent to which EPA assesses how RMP facilities manage risks from natural hazards and climate change, and challenges EPA faces in doing so.

To determine what available federal data indicate about the number and type of Risk Management Plan (RMP) facilities that are located in areas with selected natural hazards that may be exacerbated by climate change, we reviewed the Fourth National Climate Assessment (NCA), Environmental Protection Agency (EPA) documents (such as EPA's climate change adaptation implementation plan), other relevant documents (such as European Union reports), our prior work on climate change, and federal data on these selected natural hazards.¹

Based on our review, we identified the following natural hazards that may be exacerbated due to climate change: sea level rise, which may lead to increased frequency and extent of extreme flooding from coastal storms; greater frequency and magnitude of drought; increased intensity and frequency of heavy precipitation events, which may lead to increased local flooding; salt water intrusion; increased incidence of large wildfires; increased frequency and intensity of extreme high temperatures and sustained increases in average temperatures; decreased permafrost; and

¹U.S. Global Change Research Program, *Climate Science Special Report; and Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. II (Washington, D.C.: 2018). For prior GAO reports, see, for example, GAO, *Chemical Security: DHS Could Use Available Data to Better Plan Outreach to Facilities Excluded from Anti-Terrorism Standards*, [GAO-20-722](#) (Washington, D.C.: Sept. 29, 2020); *Superfund and Climate Change: EPA Should Take Additional Actions to Manage Risks from Climate Change*, [GAO-20-73](#) (Washington, D.C.: Oct. 18, 2018); *Climate Change: Better Management of Exposure to Potential Future Losses Is Needed for Federal Flood and Crop Insurance*, [GAO-15-28](#) (Washington, D.C.: Oct. 29, 2014); and *FEMA Flood Maps: Some Standards and Processes in Place to Promote Map Accuracy and Outreach, but Opportunities Exist to Address Implementation Challenges*, [GAO-11-17](#) (Washington, D.C.: Dec. 2, 2010).

increased intensity—including higher wind speeds and precipitation rates—and frequency of very intense hurricanes and typhoons. We reviewed the NCA, prior GAO reports, EPA documents (such as EPA’s climate change adaptation implementation plan) and other relevant documents (such as European Union reports) to identify potential natural hazards that may RMP facilities.

In addition, we interviewed officials from EPA headquarters, all 10 EPA regional offices, the Occupational Safety and Health Administration (OSHA), and the U.S. Chemical Safety and Hazard Investigation Board (Chemical Safety Board). We also interviewed selected stakeholders to obtain their perspective on potential risks from natural hazards, including representatives of a labor union, representatives from three industry associations, officials of two local emergency planning committees, an official from an association of state, tribal, and local emergency response commission and committee officials, representatives from a non-governmental standard-setting organization, officials at a state division of emergency management with delegated authority to implement the RMP Rule, and county officials implementing California’s accidental release prevention program. We identified these stakeholders through recommendations from federal officials; available relevant documents, such as public comments on the RMP Rule; and recommendations from other interviewees.

Through a review of federal agencies’ documents and databases and our previous work, we identified available national federal data sets on four natural hazards: flooding, storm surge, wildfires, and sea level rise from the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Forest Service. In this report, we refer to these four hazards as selected natural hazards that may be exacerbated by climate change. (See app. II for further discussion of these data sources.) We used the most recently available data for each of these natural hazards. To the extent that data were available, we analyzed a range of these potential natural hazards, reflecting different levels of intensity. For example, we used the maximum extent of storm surge from Category 1 hurricanes as well as from Category 4 or 5 hurricanes, the highest possible categories, as modeled by NOAA.

The range of the potential effects of selected natural hazards we provide in our report is as follows:

- For flooding, we used data from FEMA’s National Flood Hazard Layer as of October 2020.² FEMA identifies a variety of flood hazards, and for reporting purposes, we grouped flood hazards into four categories: (1) 1 percent or higher annual chance of flooding,³ (2) 0.2 percent or higher annual chance of flooding or other flood hazards,⁴ (3) unknown flood hazards,⁵ and (4) minimal flood hazard.
- For storm surge, we used data from NOAA’s model on Sea, Lake, and Overland Surges from Hurricanes as of December 2020 for Category 1 and Category 4 or 5 hurricanes.
- For wildfire, we used data from the U.S. Forest Service’s 2020 wildfire hazard potential map, which the U.S. Forest Service released in December 2020. We included areas with high or very high wildfire hazard potential in our analysis. The U.S. Forest Service based the 2020 map on wildfire likelihood and intensity data from 2020, spatial fuels and vegetation data from 2014, and point locations of past fire occurrence from 1992 to 2015.
- For sea level rise, we used NOAA data, last updated in July 2020. We used inundation data on 0, 1, and 3 feet of sea level rise and “not mapped” areas. Zero feet of sea level rise means that the area may already be inundated during a typical high tide, according to NOAA officials.

We obtained data from EPA’s database containing information on the location and other characteristics of current and active RMP facilities as of December 2020. The descriptive data in EPA’s RMP database, such as location, types of chemicals onsite, and accident history, is self-reported by the RMP facilities as part of their RMP submission. We excluded RMP facilities with Program 1 processes (648 facilities) from our analysis because a worst-case release of chemicals from these facilities would not affect the public. We also excluded 376 RMP facilities whose

²FEMA updates the mapping data every 2 weeks, at minimum, according to FEMA officials.

³This category includes zones A, A99, AE, AH, AO, V, VE, and Open Water.

⁴This category includes hazards FEMA categorizes in zone X (excluding minimal flood hazard).

⁵This category includes zones D, NP, missing values, area not included, and no data. In addition, we included data that we could not analyze using our mapping software, such as those available in paper-based maps, as being part of this category.

location information we assessed to be insufficiently reliable.⁶ In addition, we downloaded data on the relative social vulnerability of people living in the census tracts from FEMA's National Risk Index. The National Risk Index's Social Vulnerability Index uses 29 socioeconomic variables, such as percent of persons living in poverty, median age, and percent of the population who identify as Native American, to classify areas as high, relatively high, moderate, relatively low, or low social vulnerability.

In our analysis, we used an approximate 500-foot radius, or 0.094 mile, around the primary geographic coordinate point of each RMP facility to estimate the size of each facility, which may not accurately represent their actual areas because the facilities vary in size and shape. To analyze whether RMP facilities are located in areas that may be impacted by flooding, we used ArcGIS mapping software to overlap the area of a 0.094 mile radius around the primary coordinate of each facility with the categories we defined from the National Flood Hazard Layer. To analyze whether RMP facilities are located in areas that may be impacted by storm surge, wildfires, and sea level rise, we used MapInfo mapping software to overlap the area of a 0.094-mile radius around the primary coordinates of facilities with each of these layers. Overlap indicates that a facility is located in an area that may be impacted. We consulted with EPA when developing this approach.

To assess the reliability of FEMA's National Flood Hazard Layer, NOAA's data on Sea, Lake, and Overland Surges from Hurricanes, U.S. Forest Service's wildfire hazard potential data, and NOAA's data on sea level rise, we reviewed our prior report that used the data for similar purposes, such as mapping and overlapping locations of sites with selected natural hazards.⁷ In addition, we interviewed agency officials regarding the appropriateness of using these data for the purposes of this report. To further assess the reliability of FEMA's National Flood Hazard Layer, we reviewed FEMA's methodology for the data. We also interviewed FEMA

⁶To assess the reliability of RMP location data, we mapped the data using address and XY coordinates provided by each facility. We randomly selected a sample of facilities to review using satellite imagery. We determined that the street address location was generally closer to the selected facility locations in satellite imagery than were XY coordinates. About 79 percent of facilities could be located using address data. For the remaining facilities, we used XY coordinate data to locate facilities unless the XY coordinate was in a different zip code than the address provided by the facility. We excluded facilities whose XY coordinates are in a different zip code than the zip code contained in the address provided by the facility.

⁷GAO, Superfund: EPA Should Take Additional Actions to Manage Risks from Climate Change, [GAO-20-73](#) (Washington, D.C.: Oct 2019).

officials to assess the accuracy of the data. To further assess the reliability of NOAA's data on Sea, Lake, and Overland Surges from Hurricanes, we reviewed NOAA's methodology for developing the model; interviewed NOAA officials to assess the accuracy of the data; and reviewed internal controls. To further assess the reliability of the U.S. Forest Service's wildfire hazard potential data, we reviewed the agency's documentation of the methodology used to develop the data. We also interviewed U.S. Forest Service officials to assess the accuracy of the data. To further assess the reliability of NOAA's data on sea level rise, we reviewed the methodology NOAA used for developing the model, and we interviewed NOAA officials to assess the accuracy of the data. In addition, to assess the reliability of FEMA's National Risk Index, we reviewed the methodology used to develop the model and agency documentation on how to use the model. In addition, we reviewed our prior report that used the data for similar purposes.⁸

To assess the reliability of EPA's data on RMP facilities, we reviewed agency manuals to understand data elements, interviewed EPA officials to assess the timeliness and accuracy of the data, and conducted data testing.⁹ In addition, we reviewed our prior report that used the data for similar purposes.¹⁰ As a result of the steps described above, we found the data from EPA, FEMA, NOAA, and the U.S. Forest Service to be sufficiently reliable for our purposes.

To identify challenges that RMP facilities face in managing risks from natural hazards and climate change and opportunities for EPA to address those challenges, we interviewed EPA officials at headquarters and all 10 regional offices and officials from OSHA and the Chemical Safety Board. We also interviewed selected stakeholders as described above. Two analysts reviewed records of interviews to record the challenges that officials and stakeholders identified. We then categorized the challenges for reporting purposes. The views of stakeholders we interviewed are illustrative and not generalizable to all stakeholders.

⁸GAO, *FEMA Flood Maps: Better Planning and Analysis Needed to Address Current and Future Flood Hazards*, [GAO-22-104079](#) (Washington, D.C.: Oct. 25, 2021).

⁹Agency manuals and websites included those related to EPA's Central Database Exchange and information on RMP's data quality, including the RMP Download Dataset User Guide and the RMP*Info Data Quality Information webpage.

¹⁰[GAO-20-722](#).

We selected three RMP facilities as illustrative examples of how RMP facilities manage risks from natural hazards and climate change and any challenges they face in doing so. The three facilities we selected are (1) Kettle Cuisine in Lynn, Massachusetts; (2) South Cross Bayou Water Reclamation Facility in St. Petersburg, Florida; and (3) Covestro in Baytown, Texas. To select these facilities, we asked for recommendations from EPA officials and stakeholders we interviewed. We selected facilities in three different EPA regions and in a variety of industries. To gather information about these facilities, we reviewed the most recent RMPs they submitted to EPA and interviewed representatives of the facilities. We also interviewed representatives of local stakeholder groups as relevant, including state officials and representatives of local emergency planning committees. The results from these illustrative examples are not generalizable to RMP facilities that we did not select.

To determine the extent to which EPA assesses how RMP facilities manage risks from natural hazards and climate change, challenges it faces in doing so, and opportunities to address these challenges, we reviewed the RMP Rule; guidance, outreach, and training materials from EPA; *Federal Register* notices and EPA responses to public comments on proposed revisions to the RMP Rule; reports from the Chemical Safety Board; and documents from other organizations, such as the Center for Chemical Process Safety. We identified these documents by (1) conducting a search of websites of relevant agencies, including EPA, OSHA, and the Chemical Safety Board; and (2) requesting documents from EPA officials. We also interviewed EPA officials from OLEM and OECA and at all 10 regional, officials from OSHA and the Chemical Safety Board, and representatives of the stakeholder groups and three facilities identified above. Two analysts reviewed the challenges that we identified in these interviews and reached consensus on categorizing the challenges for reporting purposes.

We conducted this performance audit from August 2020 to February 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Available Federal Data on Flooding, Storm Surge, Wildfire, Sea Level Rise, and Social Vulnerability

Various federal agencies provide data on flooding, storm surge from hurricanes, wildfires, sea level rise, and social vulnerability. Specifically, the Federal Emergency Management Agency (FEMA) provides data on flood hazard and risk, the National Oceanic and Atmospheric Administration (NOAA) provides data on hurricane storm surge, and the U.S. Forest Service provides data on wildfire hazard potential. Data on flooding, storm surge, and wildfires are generally based on current or past conditions. NOAA also models the extent of inundation for various heights of sea level rise compared to the most recently available data on average high tide. In addition, FEMA's National Risk Index—which includes Social Vulnerability scores based on the Social Vulnerability Index developed by University of South Carolina's Hazards and Vulnerability Research Institute—provides information on the relative social vulnerability of communities by census tract.

FEMA Flood Hazard Data

FEMA provides flood hazard and risk information to communities nationwide. Among other information, FEMA provides data on coastal and riverine flooding in the National Flood Hazard Layer,¹ a database that contains the most current flood hazard data.² Federal law requires FEMA to assess the need to revise and update the nation's flood maps once every 5 years or more often as the FEMA Administrator determines

¹Riverine flooding is flooding related to or caused by a river, stream, or tributary overflowing its banks because of excessive rainfall, snowmelt, or ice.

²FEMA provides a tool for viewing, downloading, and printing flood maps for specific locations. FEMA's flood hazard maps are available at <https://www.fema.gov/flood-maps/national-flood-hazard-layer>.

necessary.³ Among other uses, the flood hazard data are used for flood insurance ratings and floodplain management.

The National Flood Hazard Layer identifies areas at the highest risk of flooding, which are those that have a 1 percent or higher annual chance of flooding.⁴ In some locations, the National Flood Hazard Layer also identifies areas with 0.2 percent or higher annual chance of flooding, which FEMA considers to be a moderate flood hazard,⁵ as well as other flood hazards.⁶ The National Flood Hazard Layer also identifies areas with minimal flood hazard, including those with less than 0.2 percent annual chance of flooding, and unknown flood hazard, including areas FEMA has not assessed for flood hazards.⁷

In 2018, the Technical Mapping Advisory Council noted that FEMA has produced modernized data (i.e., digital maps) for areas of the U.S. where 98 percent of the population resides, but has not determined the flood hazard for 40 percent of streams.⁸ In general, flood hazards are based on existing conditions in the watershed and floodplains. However, in certain cases, FEMA may include flood hazard information that is based on

³42 U.S.C. § 4101(e).

⁴These areas are known as Special Flood Hazard Areas. Under federal law, in communities that participate in the National Flood Insurance Program, homeowners are required to purchase flood insurance for properties located in Special Flood Hazard Areas that are secured by mortgages from federally regulated lenders. 42 U.S.C. § 4012a(b)(1).

⁵According to the Fourth National Climate Assessment, the magnitude and intensity of riverine flooding is projected to increase in the future, so areas with moderate flood hazard may have increased flood hazard in the future.

⁶Other flood hazards include areas with reduced risk because of levees as well as areas with flood hazard based on future conditions, for example, if land use plans were implemented. FEMA considers areas with at least 0.2 percent annual chance of flooding as having moderate flood hazard and those with 1 percent or higher annual chance of flooding to be Special Flood Hazard Areas (i.e., those with the highest chance of flooding).

⁷We also considered areas where flood data are not available in a form compatible with our mapping software, such as those only available in paper maps, as unknown flood hazard.

⁸The Technical Mapping Advisory Council is a federal advisory committee established to review and make recommendations to FEMA on matters related to the national flood mapping program.

future conditions, such as changes in zoning laws, according to FEMA regulations.⁹

NOAA Storm Surge Hazard Data

NOAA provides estimates of hurricane storm surge using a model called Sea, Lake, and Overland Surges from Hurricanes.¹⁰ Estimates are available for eastern U.S. coastal areas from Texas through Maine and other areas affected by storm surge, including Hawaii, Puerto Rico, and the U.S. Virgin Islands. As of January 2022, NOAA had not modeled storm surge for the West Coast of the U.S. or for Pacific islands other than Hawaii. The model takes into account a specific location's shoreline, incorporating bay and river configurations, water depths, bridges, roads, levees, and other physical features. It estimates the maximum extent of storm surge at high tide by modeling hypothetical hurricanes under different storm conditions, such as landfall location, storm trajectory, and forward speed.

NOAA models storm surge from Category 1 through Category 5 hurricanes for the Atlantic coast south of the North Carolina–Virginia border, the Gulf of Mexico, Puerto Rico, and the U.S. Virgin Islands; and Category 1 through Category 4 hurricanes for the Atlantic coast north of the North Carolina–Virginia border and Hawaii.¹¹ As we previously reported, the model is to be used for educational purposes and for awareness of the storm surge hazard at a city or community level. According to NOAA's website, the agency updates the model for portions of the shoreline each year to account for, among other changes, new data and the addition of flood protection devices, such as levees. The model

⁹Future conditions refer to the flood discharges associated with projected land-use conditions based on zoning and/or comprehensive land use plans. See 44 C.F.R. § 59.1. For example, as planned buildings and parking lots are constructed, the amount of impervious land within the watershed increases, which can increase the amount of direct runoff. In our analysis, we categorized these areas as other flood hazards.

¹⁰According to a NOAA document, storm surge is an abnormal rise of water generated by a storm, over and above the predicted tides. Storm surge is produced by water being pushed toward the shore by the force of the storm's winds. NOAA's storm surge hazard maps are available at <https://www.nhc.noaa.gov/nationalsurge/>.

¹¹We previously reported that NOAA does not estimate storm surge for Category 5 hurricanes in areas where such hurricanes have not historically made landfall, such as areas north of the North Carolina–Virginia border.

does not account for future conditions such as erosion, subsidence (i.e., the sinking of an area of land), construction, or sea level rise.

U.S. Forest Service Wildfire Hazard Potential Data

The U.S. Forest Service maps wildfire hazard potential based on landscape conditions and other observations.¹² We previously reported that the primary intended use of the wildfire hazard potential map is to identify priority areas for hazardous fuels treatments from a broad, national- to regional-scale perspective.

The U.S. Forest Service maps an index of wildfire hazard potential for the contiguous U.S., based on, among other factors, annual burn probabilities and potential intensity of large fires. The U.S. Forest Service categorizes the wildfire hazard potential index into five classes: very low, low, moderate, high, and very high. The U.S. Forest Service designates as “high” those areas with wildfire hazard potential index from the 85th to the 95th percentile, and as “very high” those areas above the 95th percentile. The U.S. Forest Service also categorizes areas as nonburnable (including agricultural and developed lands) and water.

According to the U.S. Forest Service, areas with higher levels of wildfire hazard potential have fuels that are more likely to burn with high intensity under certain weather conditions. However, areas with moderate, low, and very low wildfire hazard potential may still experience wildfire, particularly if they are near areas that have higher wildfire hazard potential. Wildfire hazard potential is not a forecast or wildfire outlook for

¹²According to the U.S. Forest Service, the objective of the wildfire hazard potential map is to depict the relative potential for wildfire that would be difficult for suppression resources to contain. For the 2020 map, the U.S. Forest Service used spatial data sets of wildfire likelihood and intensity from 2020, spatial fuels and vegetation data from 2013 and 2014, and point locations of past fire occurrence from 1992 through 2015. The U.S. Forest Service’s wildfire hazard potential map is available at <https://www.firelab.org/project/wildfire-hazard-potential>.

any particular season, as it does not include any information on current or forecasted weather or fuel moisture conditions.¹³

NOAA Sea Level Rise Viewer Data

NOAA models the extent of inundations from various heights of sea level rise (up to 10 feet above average high tides) for the contiguous U.S., Hawaii, other Pacific islands, Puerto Rico, and the U.S. Virgin Islands. It provides the results in a web mapping tool called the Sea Level Rise Viewer.¹⁴ According to NOAA, the sea level rise data can be used for planning and education, but it cannot be used for site-specific analysis.

NOAA's guidance on the Sea Level Rise Viewer states that data are not available for Alaska. In addition, NOAA labels areas as not mapped if elevation data of sufficient quality for the areas are not available. NOAA does not model natural processes, such as erosion, subsidence, or future construction. It also does not forecast how much sea level is likely to rise in a given area. Rather, for various heights of local sea level rise, NOAA determines extent of inundation based on the elevation of an area and the potential for water to flow between areas.

FEMA National Risk Index

FEMA provides social vulnerability data by census tract for the U.S. as part of its National Risk Index. FEMA defines social vulnerability as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards. According to FEMA, the National Risk Index can be used to support prioritizing resilience efforts, such as updating emergency

¹³According to a U.S. Forest Service official, the wildfire hazard potential data are not meant to substitute for local data, which may more accurately capture the potential for wildfire in particular areas.

¹⁴NOAA's Sea Level Rise Viewer is available at <https://coast.noaa.gov/digitalcoast/tools/slr.html>.

**Appendix II: Available Federal Data on
Flooding, Storm Surge, Wildfire, Sea Level
Rise, and Social Vulnerability**

operations plans and enhancing hazard mitigation plans, by providing an at-a-glance overview of multiple risk factors, such as social vulnerability.

The Social Vulnerability Index that FEMA uses was originally developed by the University of South Carolina's Hazards and Vulnerability Research Institute and uses 29 socioeconomic variables, such as percentage of persons living in poverty and median age. FEMA transformed this data into a 0.01-100 scale for census tracts.¹⁵ FEMA then separated the data into categories of social vulnerability: very high, relatively high, relatively moderate, relatively low, and very low.

¹⁵According to FEMA, 292 census tracts that have no population do not have social vulnerability scores.

Appendix III: Examples of Nonfederal Approaches to Managing Risks from Natural Hazards and Climate Change

The following entities take a variety of roles and approaches to ensure facilities with hazardous chemicals manage risks from natural hazards and climate change, including by providing compliance assistance and direction to facilities.

Florida's Division of Emergency Management Implements and Enforces the Risk Management Plan (RMP) Rule in the State

EPA has delegated the authority to implement and enforce the RMP Rule except at propane facilities to the state of Florida since 1999, according to EPA. The delegated RMP program is housed within the Florida Division of Emergency Management. Florida RMP officials inspect RMP facilities and provide compliance assistance to chemical facilities. Florida's four credentialed inspectors conduct an average of 33 inspections per year, out of a total of 267 RMP facilities in the state, according to Florida Division of Emergency Management. The State Emergency Response Committee selects facilities for inspection using criteria such as the number of accidents at the facility, the date the facility was last inspected, whether the facility is on the federal list of high-risk facilities or a similar state list, and whether a facility needs additional compliance assistance.

According to Florida Division of Emergency Management officials, they provide compliance assistance related to risks from natural hazards to RMP facilities in a variety of ways. Florida Division of Emergency Management works with facilities and local emergency planning committees to develop facility hazardous materials response plans. Florida RMP inspectors then use these plans, in addition to mapping tools and National Hurricane Center modeling tools, to assist facilities with managing risks from natural hazards. Florida RMP inspectors also offer information to facilities on best practices in areas related to emergency

preparedness and risk management. For example, according to Florida Division of Emergency Management officials, if inspectors see a particularly effective approach to mitigation at a facility, they share those approaches with other Florida RMP facilities.

The California Accidental Release Prevention Program (CalARP) Places Additional Requirements on RMP Facilities in California

CalARP includes the federal chemical accident prevention regulations with certain additions to implement state law. For example, according to officials from the state of California, the CalARP program regulates substances that are not regulated under the Clean Air Act's prevention of accidental release provision and has lower threshold quantities for some chemicals subject to regulation under the Clean Air Act's prevention of accidental release provision. According to the California Department of Toxic Substances Control, the purpose of the CalARP program is to prevent accidental releases of regulated substances (chemicals) that can cause serious harm to the public and the environment, to minimize the damage if releases do occur, and to satisfy community right-to-know laws. According to state officials we interviewed, the county governments in California administer the majority of the program. This includes determining whether a facility must submit an RMP in certain circumstances, reviewing the RMPs, conducting facility inspections, and providing public access to information about regulated facilities. The state government provides guidance and training for county officials.

Contra Costa county, one of the counties that implements the CalARP program, has 42 facilities subject to the program, according to officials of Contra Coasta county. The county has seven inspectors and aims to inspect all facilities every 2 years. It may take 4 or 5 weeks to inspect the most complex chemical facilities in Contra Costa county, while it may take only 1 to 2 days to complete a more basic inspection. Contra Costa county officials identified several natural hazards that may impact the regulated facilities in the county, including sea level rise and wildfires. In addition, these officials noted that even if wildfires are not burning in the county itself, the fires could impact chemical facilities through increased air pollution or loss of power. In addition, Contra Costa county developed a checklist for regulated facilities to help them identify, assess, and prepare for external events, including extreme weather.

Governments and International Bodies Have Developed International Regulations, Guidance, and Compliance Assistance

Globally, international bodies and governments have undertaken initiatives to regulate, research, and develop guidance on the management of risks from natural hazards at chemical facilities.

For example, the European Union's Seveso III Directive explicitly requires that certain establishments in member states where dangerous substances are present in significant quantities identify and analyze the risk of a possible scenario of a major accident from natural hazards, such as floods. At the country level, Germany has issued a Technical Rule for Installation Safety, which requires certain procedures to protect facilities against accidents due to flood and heavy rainfall, according to the Organization for Economic Co-Operation and Development (OECD). The rule also requires that facilities apply a climate-adaptation factor to intensities of flood and precipitation events in their risk assessments to take into account the expected effects of climate change up to 2050, according to OECD.

For example, since 2008, a joint effort of the OECD, United Nations, and European Union groups and offices has researched and reported on prevention, preparedness, and response to Natural Hazards Triggering Technological Accidents (Natech) events. The group issued a record of good practices and examples of Natech risk management across countries and stakeholders, and it plans to release guidance on Natech risk management in 2024. Moreover, as a result of this joint effort, the OECD added a Natech Addendum to its Guiding Principles for Chemical Accident Prevention, Preparedness, and Response. The Addendum provides specific recommendations for government and industry on drafting regulations, rules and standards, their enforcement and implementation, and other activities in support of effective Natech risk management. U.S. officials participated in both drafting and reviewing the principles.

Appendix IV: Comments from the U.S Environmental Protection Agency

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Environmental Protection Agency**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Mr. Alfredo Gomez
Director
Natural Resources and Environment
U.S. Government Accountability Office
Washington, D.C. 20548

Dear Mr. Gomez:

Thank you for the opportunity to review and comment on the GAO's draft report, *Chemical Accident Prevention – EPA Should Ensure Regulated Facilities Consider Risks from Climate Change* (GAO-22-104494). This letter provides the U.S. Environmental Protection Agency's response to the draft report's findings, conclusions, and recommendation(s).

The Agency agrees with the GAO's assessment that many facilities regulated under the Clean Air Act (CAA) section 112(r)(7) (i.e., the Risk Management Program) are located in areas that are susceptible to natural hazards from climate change. The GAO's report includes several recommendations on how EPA can better ensure that such facilities are managing risks from natural hazards and climate change. However, EPA has two significant comments.

First, while EPA generally agrees with the recommendations, the timing to implement the recommendations will depend on the Agency's ongoing Risk Management Plan (RMP) rulemaking. EPA's Office of Emergency Management is actively working on a proposal to revise the RMP regulations. The proposal will consider how to address the Administration's priorities, including bolstering resilience to the impacts of climate change and prioritizing environmental justice. The proposed rule is scheduled for publication in the Federal Register in September 2022 and the final rule in August 2023 (see the Fall 2021 Regulatory Agenda; [RIN 2050-AH22](#)). EPA expects to develop materials and products on risks from natural hazards and climate change, such as compliance assistance, guidance, training, inspection methods, targeting metrics, and an information system, as appropriate, based on the provisions in the final rule. Given the current rulemaking, implementing the recommendations will take multiple years. The Agency will provide additional information and/or a timeline following the GAO final report. Second, the Agency has some concerns about the development and implementation of an information system to track common deficiencies found during inspections. These concerns are discussed in more detail below in EPA's response to Recommendation 2.

Enclosed with this letter is a list of recommended, minor corrections to the report. EPA's responses to specific recommendations are captured below.

GAO Recommendation 1:

The Assistant Administrator of the Office of Enforcement and Compliance Assurance and Director of the Office of Emergency Management, together with EPA officials at regional offices, should provide

**Appendix IV: Comments from the U.S
Environmental Protection Agency**

additional compliance assistance to RMP facilities related to risks from natural hazards and climate change.

EPA Response:

The Agency agrees with the recommendation to develop compliance assistance materials related to risks from natural hazards and climate change. EPA will develop materials, such as a fact sheet, which will compile resources on climate change-related impacts to RMP facilities. As noted above, the Agency is currently revising the RMP regulations using the notice-and-comment rulemaking process and expects to complete these revisions by August 2023. In addition, after publishing the final rule, EPA will develop additional materials to assist regulated entities in complying with the updated RMP regulations, as appropriate, if any new requirements relating to addressing risks from natural hazards and climate change are finalized.

GAO Recommendation 2:

The Assistant Administrator of the Office of Enforcement and Compliance Assurance should design an information system to track common deficiencies found during inspections, including any related to natural hazards and climate change, and use this information to target compliance assistance.

EPA Response:

The Agency agrees with the goal of this recommendation to use inspection data to target compliance assistance efforts. However, EPA does not view development of a sophisticated electronic database as necessary to achieve this goal. EPA believes that it can use other methods to target compliance assistance, such as periodic consultation with Regional inspectors on a sector-specific basis to share information and findings. EPA has already identified priority sectors for increased focus as part of the current Chemical Accident Risk Reduction National Compliance Initiative, such as ammonia refrigeration, fertilizer distribution, and gas processing. Regular consultation with inspectors would allow EPA to identify common problems and develop targeted compliance assistance. EPA can also leverage information that the Agency already collects in EPA's ICIS and ECHO databases. With this in mind, EPA concurs with the intent of this recommendation and intends on developing a written business process to periodically collate and review inspection findings to identify common deficiencies and to use this process to target compliance assistance efforts.

GAO Recommendation 3:

The Director of the Office of Emergency Management should issue regulations, guidance, or both, as appropriate, to clarify requirements and provide direction for RMP facilities on how to incorporate risks from natural hazards and climate change into their risk management programs.

EPA Response:

The Agency agrees with this recommendation. As indicated above, EPA's Office of Emergency Management is actively working on a proposal to revise the RMP regulations. EPA is reviewing the RMP rule in accordance with Executive Order 13990: Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis, which directs federal agencies to review existing regulations and take action to address the Administration's priorities, including bolstering resilience to the impacts of climate change and prioritizing environmental justice. The proposed rule is scheduled for publication in the Federal Register in September 2022 and the final rule in August 2023 (see the Fall 2021 Regulatory Agenda; [RIN 2050-AH22](#)). If needed, the Office of Emergency Management will develop compliance guidance or update existing guidance for regulated facilities after the final rulemaking is completed.

**Appendix IV: Comments from the U.S
Environmental Protection Agency**

GAO Recommendation 4:

The Assistant Administrator of the Office of Enforcement and Compliance Assurance and Director of the Office of Emergency Management should develop a method for inspectors to assess the sufficiency of RMP facilities' incorporation of risks from natural hazards and climate change into risk management programs and provide related guidance and training to inspectors.

EPA Response:

EPA agrees with this recommendation and intends to incorporate methods and/or materials into the Agency's RMP inspector training course. EPA Order 3500.1, which specifies training requirements for EPA inspectors and investigators, requires RMP inspectors to, among other things, complete the 40-hour Risk Management Program Inspector Training course to be a credentialed inspector. To meet the goal of Recommendation 4, the Agency will incorporate new methods and/or materials into that training course after the final rule is published.

GAO Recommendation 5:

The Assistant Administrator of the Office of Enforcement and Compliance Assurance, working with officials at regional offices, should incorporate vulnerability of RMP facilities to natural hazards and climate change as criteria when selecting facilities for inspection.

EPA Response:

The Agency agrees with this recommendation. The Office of Enforcement and Compliance Assurance established the Chemical Accident Risk Reduction National Compliance Initiative, which includes enforcement and compliance goals for chemical accident risk reduction. The Agency set a target of inspecting three percent of RMP facilities annually in FY 2023-2024, where at least 36% of inspections are at "high-risk" facilities. The Agency will incorporate risks from climate change into the NCI goals and inspection selection criteria.

GAO Recommendation 6:

The Assistant Administrator of the Office of Enforcement and Compliance Assurance, working with EPA officials at regional offices, should incorporate the relative social vulnerability of communities that would be impacted by an accidental release when selecting RMP facilities for inspection.

EPA Response:

EPA agrees with this recommendation. Under the Office of Enforcement and Compliance Assurance's National Program Guidance for the CAA 112(r) Chemical Accident Prevention Program, the Agency will "work collectively to address serious situations of non-compliance, with a focus on protecting vulnerable populations, many of which are in low income or minority communities, from the risks posed by those facilities." EPA has already begun incorporating environmental justice indicators into inspection targeting and will further refine this process in future years. The current list of high-risk facilities subject to RMP requirements already incorporates information concerning environmental justice indicators, and EPA is currently increasing its work to protect vulnerable populations Agency-wide. In a memo issued on April 30, 2021, the Agency committed to increase the number of facility inspections in overburdened communities. [*Strengthening Enforcement in Communities with Environmental Justice Concerns*](#) (Starfield, 2021). As this effort moves forward, the Agency will incorporate any new guidance and directives into our 112(r) work. Additionally, the Agency intends to update the NCI with new inspection targeting goals involving RMP facilities located in communities with environmental justice concerns.

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Environmental Protection Agency**

EPA appreciates the work done by the GAO on the report, *Chemical Accident Prevention – EPA Should Ensure Regulated Facilities Consider Risks from Climate Change*, and generally agrees with the recommendations. If the GAO has questions on EPA’s response or needs further information, please contact Loan Nguyen at nguyen.loan@epa.gov or Kecia Thornton at thornton.kecia@epa.gov from EPA’s Office of Enforcement and Compliance Assurance and Office of Land and Emergency Management, respectively.

Sincerely,

**LAWRENCE
STARFIELD** Digitally signed by
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Lawrence E. Starfield
Acting Assistant Administrator
Office of Enforcement and Compliance Assurance

**BARRY
BREEN** Digitally signed by
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Date: 2022.02.02
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Barry N. Breen
Acting Assistant Administrator
Office of Land and Emergency Management

Enclosure

cc: Carlton Waterhouse, EPA OLEM
Rosemarie Kelley, EPA OECA
Kathleen Salyer, EPA OLEM
EPA GAO Liaison Team

Accessible Text for Appendix IV: Comments from the U.S Environmental Protection Agency

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Natural Resources and Environment
U.S. Government Accountability Office
Washington, D.C. 20548

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Office of Enforcement and Compliance Assurance and Office of Land and
Emergency Management, respectively.

Sincerely,

Lawrence E. Starfield
Acting Assistant Administrator
Office of Enforcement and Compliance Assurance

Barry N. Breen
Acting Assistant Administrator
Office of Land and Emergency Management

Enclosure

cc: Carlton Waterhouse, EPA OLEM
Rosemarie Kelley, EPA OECA
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Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov

Staff Acknowledgments

In addition to the contact named above, Barbara Patterson (Assistant Director), Krista Mantsch (Analyst-in-Charge), Breanne Cave, Ellen Fried, Skip McClinton, John Mingus, Gabriel Nelson, Jeanette Soares, and Sara Sullivan made key contributions to this report.

Related GAO Products

FEMA Flood Maps: Better Planning and Analysis Needed to Address Current and Future Flood Hazards. [GAO-22-104079](#). (Washington, D.C.: Oct. 25, 2021).

Climate Resilience: Options to Enhance the Resilience of Federally Funded Roads and Reduce Fiscal Exposure. [GAO-21-436](#). (Washington, D.C.: Sept. 22, 2021).

Electricity Grid Resilience: Climate Change Is Expected to Have Far-reaching Effects and DOE and FERC Should Take Actions. [GAO-21-346](#). (Washington, D.C.: Mar. 5, 2021).

Chemical Security: Overlapping Programs Could Better Collaborate to Share Information and Identify Potential Security Gaps. [GAO-21-12](#). (Washington, D.C.: Jan. 21, 2021).

Water Infrastructure: Technical Assistance and Climate Resilience Planning Could Help Utilities Prepare for Potential Climate Change Impacts. [GAO-20-24](#). (Washington, D.C.: Jan. 16, 2020).

Disaster Resilience Framework: Principles for Analyzing Federal Efforts to Facilitate and Promote Resilience to Natural Disasters. [GAO-20-100SP](#). (Washington, D.C.: Oct. 23, 2019).

Superfund: EPA Should Take Additional Actions to Manage Risks from Climate Change. [GAO-20-73](#). (Washington, D.C.: Oct. 18, 2019).

Chemical Innovation: Technologies to Make Processes and Products More Sustainable. [GAO-18-307](#). (Washington, D.C.: Feb. 8, 2018).

Climate Change: Improved Federal Coordination Could Facilitate Use of Forward-Looking Climate Information in Design Standards, Building Codes, and Certifications. [GAO-17-3](#). (Washington, D.C.: Nov. 30, 2016).

Climate Information: A National System Could Help Federal, State, Local, and Private Sector Decision Makers Use Climate Information. [GAO-16-37](#). (Washington, D.C.: Nov. 23, 2015).

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