



May 2023

# EMERGENCY ALERTS

## NOAA Should Take Additional Actions to Help Ensure Tsunami Alerts Reach Those at Risk

Accessible Version

# GAO Highlights

Highlights of [GAO-23-105961](#), a report to congressional requesters

## Why GAO Did This Study

Tsunamis are powerful, destructive, and capable of striking any U.S. coast, making it critical that the public is alerted to tsunami hazards. NOAA has primary responsibility for sending tsunami alerts to the public.

GAO was asked to review NOAA's tsunami alerting system. This report examines (1) NOAA's primary methods for sending tsunami alerts to the public, and (2) the extent to which NOAA has addressed related challenges and opportunities for improvement.

GAO reviewed NOAA and other federal documentation and interviewed NOAA, FCC, and FEMA officials. GAO identified challenges NOAA faces and opportunities for improvement by reviewing advisory reports and interviewing a non-generalizable selection of stakeholders including tribal representatives, state and local emergency managers, industry associations, and a consumer group. GAO compared NOAA's efforts to selected key collaboration practices and federal internal control standards.

## What GAO Recommends

GAO is recommending that NOAA (1) assess NOAA Weather Radio's coverage of populated areas at risk of tsunamis and (2) collaborate with FCC and FEMA to determine how to use IPAWS to deliver tsunami alerts to the Emergency Alert System. NOAA concurred with GAO's recommendations.

View [GAO-23-105961](#). For more information, contact Andrew Von Ah at (202) 512-2834 or [vonaha@gao.gov](mailto:vonaha@gao.gov).

May 2023

# EMERGENCY ALERTS

## NOAA Should Take Additional Actions to Help Ensure Tsunami Alerts Reach Those at Risk

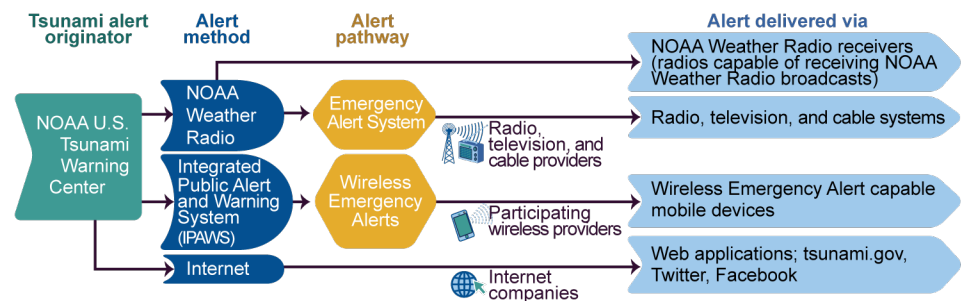
### What GAO Found

The National Oceanic and Atmospheric Administration (NOAA) primarily uses three methods to send tsunami alerts to the public (see figure):

- **NOAA Weather Radio** delivers alerts to listeners and to the Emergency Alert System, the nationwide system for broadcasting emergency messages over television, radio, and cable systems;
- **the Integrated Public Alert and Warning System (IPAWS)** delivers alerts through various pathways, including via Wireless Emergency Alerts—text-like messages on people's mobile devices; and
- **the internet** contains alerts on NOAA's website and social media posts.

The Federal Emergency Management Agency (FEMA) operates IPAWS and the Federal Communications Commission (FCC) sets rules and standards for wireless providers and broadcasters that participate in emergency alerting.

### National Oceanic and Atmospheric Administration's (NOAA) Primary Methods for Disseminating Tsunami Alerts to the Public



Source: GAO analysis of National Oceanic and Atmospheric Administration, Federal Communications Commission, and Federal Emergency Management Agency information. | GAO-23-105961

### Text for National Oceanic and Atmospheric Administration's (NOAA) Primary Methods for Disseminating Tsunami Alerts to the Public

Tsunami alert originator	Alert method	Alert pathway	Alert delivered via
NOAA U.S. Tsunami Warning Center	NOAA Weather Radio	-	NOAA Weather Radio receivers (radios capable of receiving NOAA Weather Radio broadcasts)
	NOAA Weather Radio	Emergency Alert System (Radio, television, and cable providers)	Radio, television, and cable systems

Tsunami alert originator	Alert method	Alert pathway	Alert delivered via
	Integrated Public Alert and Warning System (IPAWS)	Wireless Emergency Alerts (Participating wireless providers)	Wireless Emergency Alert capable mobile devices
	Internet	Internet companies	Web applications; tsunami.gov, Twitter, Facebook

Source: GAO analysis of National Oceanic and Atmospheric Administration, Federal Communications Commission, and Federal Emergency Management Agency information. | GAO-23-105961

NOAA has taken steps to address some tsunami alerting challenges, but GAO found opportunities for improvement. For example, NOAA has efforts underway to improve its website to allow users to more easily access critical information during tsunamis and to better target tsunami alerts to at-risk populations. GAO found that NOAA could improve its tsunami alerting by taking the following actions:

- *Assessing the extent of NOAA Weather Radio’s coverage of populated areas at risk of tsunamis.* NOAA Weather Radio is a critical tool to broadcast tsunami alerts, especially in tribal, remote, and rural areas, yet NOAA lacks assurance that tsunami alerts are reaching these areas. Assessing the extent of NOAA Weather Radio coverage would help NOAA and others understand whether at-risk communities have access to a key alerting method.
- *Enhancing collaborative efforts with FCC and FEMA to determine how to use IPAWS to deliver tsunami alerts to the Emergency Alert System.* Using IPAWS in this way would have many benefits, such as allowing tsunami alerts to be sent in multiple languages and to include additional information such as maps and video.

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### Abbreviations

EAS	Emergency Alert System
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
IPAWS	Integrated Public Alert and Warning System

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NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
WEA	Wireless Emergency Alert



May 16, 2023

The Honorable Lisa Murkowski  
United States Senate

The Honorable Dan Sullivan  
United States Senate

Tsunami waves are powerful, destructive, and capable of striking any U.S. coast, making it critical that the public is alerted to tsunami hazards. The National Oceanic and Atmospheric Administration (NOAA), through its National Weather Service, is the lead agency in the U.S. Tsunami Warning System and is responsible for identifying potential tsunami hazards and sending alerts to the public.<sup>1</sup> Other federal agencies, including the Federal Communications Commission (FCC) and the Federal Emergency Management Agency (FEMA), have key roles in the U.S. Tsunami Warning System by facilitating NOAA's ability to send tsunami alerts through national alert systems.

Congress has identified the importance of having an effective tsunami warning system. The Tsunami Warning, Education, and Research Act of 2017 required, among other things, that NOAA convene a board that is to report at least once every 4 years on NOAA's and other federal agencies' activities related to tsunamis including detection, alerting, and preparation.<sup>2</sup> In 2021, this board reported on challenges that NOAA faces in alerting the public of tsunami hazards.<sup>3</sup> The Tsunami Warning and Education Act requires that NOAA provide a capability for the dissemination of rapid and reliable alerts to the communities at risk of tsunamis.<sup>4</sup>

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<sup>1</sup>The U.S. Tsunami Warning System is a system led by NOAA that operates in collaboration with other federal, state, territory, international, and local organizations, as well as private industry.

<sup>2</sup>The Tsunami Warning, Education, and Research Act of 2017 was enacted as title V of the Weather Research and Forecasting Innovation Act of 2017, Pub. L. No. 115-25, 131 Stat. 91, 115-28.

<sup>3</sup>NOAA Science Advisory Board, *Report and Recommendations Concerning Tsunami Science and Technology Issues for the United States* (Dec. 8, 2021).

<sup>4</sup>Pub. L. No. 109-479, § 804(b)(7), 120 Stat. 3575, 3654 (2007) (codified as amended at 33 U.S.C. § 3203(b)(8)).

You asked us to review issues related to NOAA's dissemination of tsunami alerts. We focused our review on tsunami alerting for the public and not on the procedures used to detect or prepare for tsunami hazards. Specifically, this report (1) describes the primary methods that NOAA uses to send tsunami alerts to the public and (2) examines the extent to which NOAA has addressed related challenges and opportunities for improvement.

To identify the methods that NOAA uses to send tsunami alerts to the public, we reviewed NOAA and other federal documents that identify and describe NOAA's methods. In particular, we reviewed the National Tsunami Hazard Mitigation Program Guide, National Weather Service instruction manuals for tsunami alert dissemination and tsunami warning center operations, NOAA documentation on NOAA Weather Radio All Hazards (NOAA Weather Radio), and FCC and FEMA documentation on alert systems used by NOAA to broadcast tsunami alerts. We interviewed officials from NOAA, including from the agency's National Tsunami Warning Center, as well as from FCC and FEMA to further identify and understand the methods that NOAA uses to disseminate its tsunami alerts. We also reviewed our related reports on emergency alerting and tsunami planning.<sup>5</sup>

To determine the extent that NOAA has addressed tsunami-alerting challenges and opportunities for improvement, we first reviewed challenges identified in recent government advisory reports on systems and processes NOAA uses to send tsunami alerts.<sup>6</sup> We also interviewed a selection of 15 stakeholders to obtain a range of non-generalizable views on these challenges and opportunities for NOAA to improve its systems and processes for sending tsunami alerts. These stakeholders included representatives from nine state, local, and territory emergency management agencies; CTIA (an association representing wireless providers); the National Association of Broadcasters; Public Knowledge (a consumer advocacy association); and three State Emergency

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<sup>5</sup>GAO, *Emergency Alerting: Agencies Need to Address Pending Applications and Monitor Industry Progress on System Improvements*, [GAO-20-294](#) (Washington, D.C.: Feb. 6, 2020) and GAO, *Coast Guard: Additional Actions Needed to Improve Tsunami Emergency Planning in the Pacific Northwest*, [GAO-22-105220](#) (Washington, D.C.: Sept. 7, 2022).

<sup>6</sup>Communications Security, Reliability, and Interoperability Council III Working Group IX, *Final Report* (March 2013); Communications Security, Reliability, and Interoperability Council VII, Working Group I, *Report on Recommendations to Resolve Duplicate National Weather Service Alerts* (March 2021); and NOAA Science Advisory Board, *Report and Recommendations Concerning Tsunami Science and Technology Issues for the United States* (December 2021).



Communications Committees.<sup>7</sup> We selected emergency managers to interview from states and a U.S. territory that, according to NOAA and the U.S. Geological Survey, are at the highest risk of tsunamis: Alaska, California, Hawaii, Oregon, Washington, and American Samoa. We also interviewed two tribal organizations located in areas at risk of tsunamis. The views obtained from our stakeholder interviews are non-generalizable.

We assessed NOAA's efforts to determine whether one of its primary alerting methods is reaching areas at risk of tsunamis by interviewing NOAA officials and evaluating these efforts against *Standards for Internal Control in the Federal Government*.<sup>8</sup> Specifically, we assessed NOAA's efforts against the principles that management should use quality information to make informed decisions and externally communicate this information to achieve its objectives.

We also interviewed NOAA, FCC, and FEMA officials to determine the extent to which NOAA collaborates with these agencies on the use of a federal internet-based system to disseminate tsunami alerts. We compared NOAA's efforts to collaborate with these agencies to two of seven key practices for collaboration given the relevance of these practices to NOAA, FCC, and FEMA's efforts to determine how to use this system to send alerts.<sup>9</sup> Specifically, we selected one key practice related to clarifying agency responsibilities, including whether agencies have articulated and agreed to a process for making and enforcing decisions. We selected a second key practice related to documenting agreements on agency collaboration.

We conducted this performance audit from March 2022 to May 2023 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain

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<sup>7</sup>We selected the three associations based on our prior related emergency communications work. State Emergency Communications Committees are volunteer non-governmental organizations that develop plans for administering the Emergency Alert System in each state. (The Emergency Alert System is a nationwide alert system for delivering emergency messages over television, radio, and cable systems. This system is discussed in greater detail later in this report.)

<sup>8</sup>GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

<sup>9</sup>GAO, *Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms*, [GAO-12-1022](#) (Washington, D.C.: Sep. 27, 2012). The remaining five practices identified in [GAO-12-1022](#) were excluded because we determined they were not relevant for the purposes of our review.

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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.

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## Background

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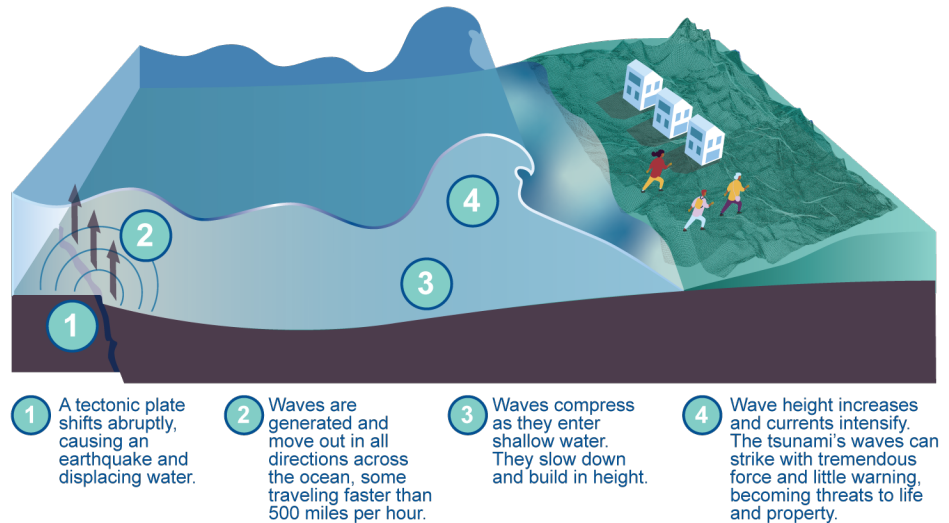
### Tsunami Formation

A tsunami is a series of long waves caused by a large and sudden displacement of the ocean. Most tsunamis are caused by undersea earthquakes on converging tectonic plate boundaries (see fig. 1).<sup>10</sup> Tsunamis radiate outward in all directions from the point of origin and can move across entire ocean basins at high rates of speed. When they reach the coast, they can cause dangerous coastal flooding and powerful currents that can last for several hours or days.

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<sup>10</sup>Earth's surface is made up of tectonic plates, which are large slabs of solid rock that fit together like puzzle pieces. These plates meet at plate boundaries and are in constant motion. Where the surfaces of these plates catch and lock along their boundary, stress builds up as the rest of the plates continue to move. When the stress becomes too great, the plates suddenly slip past one another, releasing tremendous amounts of energy, which causes the earth to shake and crack. These cracks are called faults. Most earthquakes occur on these faults, and tsunamis can be generated by earthquakes on any of these faults. A tsunami can also be generated by a landslide, volcanic activity, a near earth object (e.g., an asteroid or comet), and extreme air pressure disturbance.

**Figure 1: Formation of a Tsunami Caused by a Large Undersea Earthquake**



Source: GAO analysis of National Oceanic and Atmospheric Administration information. Topographic image, Kavik/stock.adobe.com. | GAO-23-105961

**Text for Figure 1: Formation of a Tsunami Caused by a Large Undersea Earthquake**

1. A tectonic plate shifts abruptly, causing an earthquake and displacing water.
2. Waves are generated and move out in all directions across the ocean, some traveling faster than 500 miles per hour.
3. Waves compress as they enter shallow water. They slow down and build in height.
4. Wave height increases and currents intensify. The tsunami's waves can strike with tremendous force and little warning, becoming threats to life and property.

Source: GAO analysis of National Oceanic and Atmospheric Administration information. Topographic image, Kavik/stock.adobe.com. | GAO-23-105961

Tsunamis can originate in any large body of water, but most often originate in the Pacific Ocean. According to NOAA and the U.S. Geological Survey, the states at highest risk of a tsunami are Alaska, California, Hawaii, Oregon, and Washington, followed by U.S. territories in the Pacific, such as American Samoa, and in the Caribbean, such as Puerto Rico.<sup>11</sup>

<sup>11</sup>National Tsunami Hazard Mitigation Program 2019 Tsunami Information Guide (Washington, D.C.: 2019).

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## The U.S. Tsunami Warning System

### Tsunami Observation Networks



NOAA uses observational networks to detect tsunamis and earthquakes capable of generating tsunamis. According to NOAA officials, the greatest density of these networks is in and around the Pacific Ocean. These networks include:

- seismic networks that provide information about an earthquake's location, depth, and magnitude;
- Deep-ocean Assessment and Reporting of Tsunami (DART) buoys and related systems that monitor water level changes; and
- coastal water level stations that collect information about ocean height at specific coastal locations.

Source: NOAA. | GAO-23-105961

The U.S. Tsunami Warning System is a system led by NOAA that operates in collaboration with other federal, state, territory, international, and local organizations, as well as private industry. Federal responsibilities in this system are distributed among the following agencies:<sup>12</sup>

- NOAA, which analyzes potential tsunami hazards and sends tsunami alerts;
- FCC, which sets rules and standards for wireless providers and broadcasters that participate in emergency alerting; and
- FEMA, which maintains and operates certain emergency alert systems that NOAA uses.

Major components of the U.S. Tsunami Warning System include: (1) observational networks to detect and analyze both tsunamis and earthquakes capable of generating tsunamis; (2) models to forecast potential tsunami effects; (3) methods to send tsunami alerts; and (4) preparedness and mitigation activities to improve tsunami response and reduce or eliminate effects.

NOAA analyzes potential tsunami hazards and sends tsunami alerts from two U.S. tsunami warning centers, which are operated by NOAA's National Weather Service. The National Tsunami Warning Center in Palmer, Alaska, has responsibility for analyzing tsunami hazards and sending alerts covering the continental U.S. and Alaska. The Pacific Tsunami Warning Center in Honolulu, Hawaii has this responsibility for Hawaii and U.S. territories in the Pacific and Caribbean. The time it takes a warning center to make a decision on whether to create and send a tsunami alert depends on the density of observational networks capable of detecting seismic activity in an area. For example, according to NOAA, in areas with a high density of observational networks, NOAA can issue a tsunami alert within 5 minutes of an earthquake or other seismic event, whereas in areas with a lower density of these networks, the time increases to up to 15 minutes.

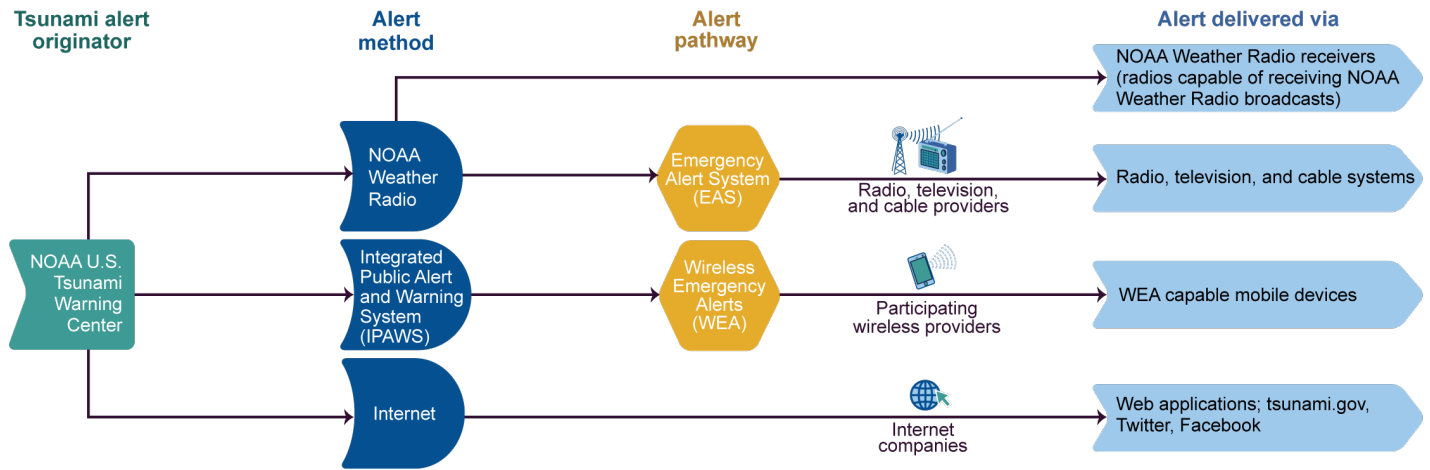
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<sup>12</sup>The U.S. Geological Survey supports NOAA's ability to analyze tsunami hazards by detecting and providing NOAA with information on earthquakes, which, as previously discussed, are the leading cause of tsunamis.

## NOAA Primarily Uses Three Methods to Send Tsunami Alerts to the Public

NOAA sends its tsunami alerts to the public primarily via: (1) NOAA Weather Radio, (2) the Integrated Public Alert and Warning System (IPAWS), and (3) the internet.<sup>13</sup> These methods are shown in figure 2 and described further below. NOAA officials told us that using multiple methods to disseminate tsunami alerts helps to ensure that tsunami and other alerts reach the affected public. Tsunami alerts and other hazard information are sent via one-way broadcasts. As such, data do not exist to show whether a person received the alert or paid attention to it.<sup>14</sup>

**Figure 2: The National Oceanic and Atmospheric Administration’s (NOAA) Primary Methods for Broadcasting Tsunami Alerts to the Public**



Source: GAO analysis of NOAA, Federal Communications Commission, and Federal Emergency Management Agency information. | GAO-23-105961

<sup>13</sup>In addition to the primary methods described in this report, NOAA uses several other systems—such as the National Warning System, the Emergency Managers Weather Information Network, and the NOAA Weather Wire Service—to help deliver its alerts to other alert providers, including emergency managers and the media.

<sup>14</sup>For example, according to representatives of a wireless industry association, wireless providers do not collect data on whether people have configured their mobile devices to receive emergency alerts or, if a device is configured to receive these alerts, whether the device actually received the alert or the person viewed the alert.

**Text for Figure 2: The National Oceanic and Atmospheric Administration’s (NOAA) Primary Methods for Broadcasting Tsunami Alerts to the Public**

Tsunami alert originator	Alert method	Alert pathway	Alert delivered via
NOAA U.S. Tsunami Warning Center	NOAA Weather Radio	-	NOAA Weather Radio receivers (radios capable of receiving NOAA Weather Radio broadcasts)
	NOAA Weather Radio	Emergency Alert System (Radio, television, and cable providers)	Radio, television, and cable systems
	Integrated Public Alert and Warning System (IPAWS)	Wireless Emergency Alerts (WEA) (Participating wireless providers)	Wireless Emergency Alert (WEA) capable mobile devices
	Internet	Internet companies	Web applications; tsunami.gov, Twitter, Facebook

Source: GAO analysis of National Oceanic and Atmospheric Administration, Federal Communications Commission, and Federal Emergency Management Agency information. | GAO-23-105961

## NOAA Weather Radio

NOAA Weather Radio is a radio system—provided to the public by NOAA—that continuously broadcasts weather and hazard information, including tsunami alerts, via a nationwide network of over 1,000 radio transmitters.<sup>15</sup> NOAA broadcasts tsunami alerts to NOAA Weather Radio via Weather Forecast Offices covering the affected tsunami hazard area.<sup>16</sup> Specifically, NOAA officials in Weather Forecast Offices receive the alert from one of NOAA’s tsunami warning centers and then

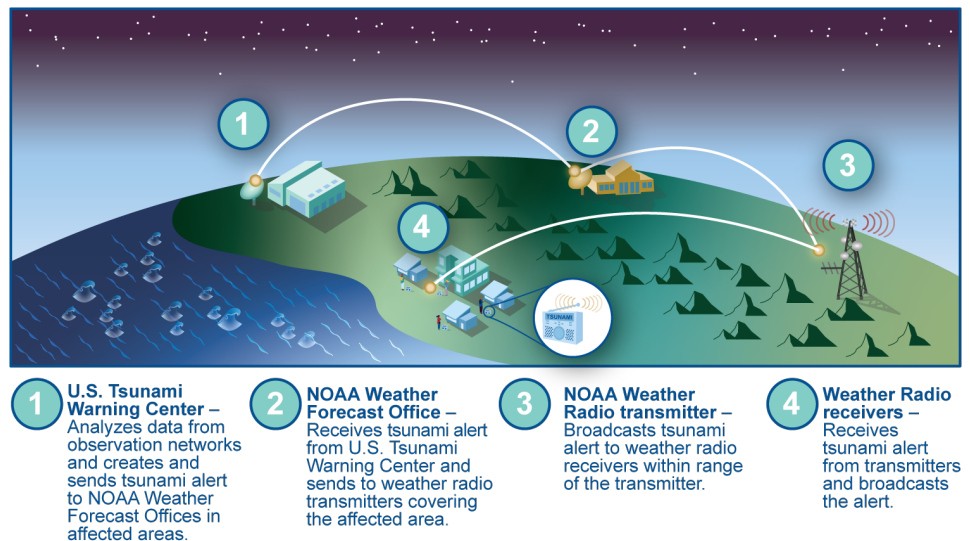
<sup>15</sup>NOAA Weather Radio is the only federal government-operated radio system providing direct weather and hazard information to the public. NOAA Weather Radio provides coverage in all 50 states, U.S. territories, and adjacent coastal waters. U.S. territories covered by NOAA Weather Radio include Puerto Rico, the U.S. Virgin Islands, American Samoa, Guam, and the Northern Mariana Islands. The NOAA Weather Radio stations broadcast directly from radio transmitters and associated antennas—that is, the broadcasts are automatically sent via a text-to-speech system to NOAA Weather Radio receivers. For a list of NOAA Weather Radio stations see [https://www.weather.gov/nwr/station\\_listing](https://www.weather.gov/nwr/station_listing).

<sup>16</sup>NOAA has 122 Weather Forecast Offices across the United States, Puerto Rico, and Guam, and one Weather Service Office in American Samoa, which, according to NOAA officials, performs the same functions as the Weather Forecast Offices with regard to tsunami alerting. According to NOAA officials, these offices are staffed with meteorologists and other NOAA personnel with local and regional expertise.

broadcast the alert to NOAA Weather Radio via radio transmitters. The alert information is targeted at a countywide level.<sup>17</sup>

To receive NOAA Weather Radio broadcasts, such as tsunami alerts, a person must: (1) have a radio receiver capable of picking up the broadcast; (2) have the receiver powered on or in standby mode; (3) have the receiver configured to receive weather and other hazard information; and (4) be in an area that has NOAA Weather Radio coverage. Figure 3 illustrates how a person would receive a tsunami alert on a NOAA Weather Radio receiver.

**Figure 3: How the National Oceanic and Atmospheric Administration (NOAA) Broadcasts Tsunamis Alerts to NOAA Weather Radio Receivers**



Source: GAO analysis of NOAA information. | GAO-23-105961

**Text for Figure 3: How the National Oceanic and Atmospheric Administration (NOAA) Broadcasts Tsunamis Alerts to NOAA Weather Radio Receivers**

- 1. U.S. Tsunami Warning Center** – Analyzes data from observation networks and creates and sends tsunami alert to NOAA Weather Forecast Offices in affected areas.
- 2. NOAA Weather Forecast Office** – Receives tsunami alert from U.S. Tsunami Warning Center and sends to weather radio transmitters covering the affected area.

<sup>17</sup>According to NOAA officials, “countywide or county-level” also includes county-level equivalents, such as municipal areas.

3. **NOAA Weather Radio transmitter** – Broadcasts tsunami alert to weather radio receivers within range of the transmitter.
4. **Weather Radio receivers** – Receives tsunami alert from transmitters and broadcasts the alert.

Source: GAO analysis of NOAA information. | GAO-23-105961

According to NOAA, NOAA Weather Radio receivers can typically receive a reliable signal up to 40 miles from a transmitter, but a variety of factors can weaken reception, such as mountains. NOAA Weather Radio reception is also dependent on the operational status of transmitters. For example, NOAA officials told us that some transmitters, particularly in Alaska, are located in remote areas subject to harsh weather conditions. As such, it can be challenging to quickly repair these transmitters, or the communications links between Weather Forecast Offices and transmitters, when they are damaged.<sup>18</sup>

NOAA Weather Radio is also a key method for activating the Emergency Alert System (EAS)—the nationwide alert system for delivering emergency messages to television, radio, and cable audiences.<sup>19</sup> NOAA Weather Radio is monitored by many broadcasters for their activation of

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<sup>18</sup>NOAA Weather Radio transmitters are owned by either the federal government or by nonfederal entities. NOAA personnel or contractors are responsible for maintenance of government-owned transmitters, whereas transmitter maintenance responsibilities vary at nonfederal transmitter sites. According to NOAA, maintenance of nonfederal sites belong to the site owner or, under certain situations, NOAA personnel. NOAA policy requires that NOAA personnel ensure proper system maintenance is performed at nonfederal transmitter sites.

<sup>19</sup>EAS also allows other authorized tribal, federal, state, territorial, and local government agencies to use EAS media platforms—including radio and television—to send alerts.



**Other Federal and Nonfederal Entities That Disseminate NOAA's Tsunami Alerts**

Other federal and nonfederal entities help NOAA alert the public to tsunami hazards. For example:

- FEMA offers a free mobile device application that people can download to receive notifications with NOAA's alerts on mobile phones and other devices.
- The U.S. Coast Guard broadcasts NOAA's alerts to the public in Alaska via U.S. Coast Guard radio transmitters.
- Some state and local authorities use methods such as text message and warning sirens to ensure that alerts reach communities at risk.
- Some broadcasters disseminate NOAA's alerts via methods such as television, radio, and the internet, including internet-based "smart speakers."

Source: GAO interviews and document review. | GAO-23-105961

EAS. EAS alerts can interrupt television and radio programs to broadcast alert information. Like tsunami alerts broadcast via NOAA Weather Radio, alerts broadcast via EAS generally cover an entire county or wider area.<sup>20</sup>

NOAA officials told us that when the agency wants to use EAS to deliver tsunami and other alerts to the public, the agency must send the alerts to television broadcasters and other EAS participants as requests, with the words "EAS Activation Requested."<sup>21</sup> The process NOAA uses to request EAS activation is similar to the process NOAA uses to broadcast alerts to NOAA Weather Radio receivers. The first step is for one of the tsunami warning centers to notify NOAA officials in affected Weather Forecast Offices of the tsunami alert. These officials then send the alert through radio transmitters to NOAA Weather Radio receivers. According to NOAA officials, EAS participants can monitor NOAA Weather Radio receivers for NOAA's alerts and then broadcast the alert in accordance with their respective state's EAS plan.<sup>22</sup> According to FEMA officials, unlike NOAA, most other alert originators—such as state and local emergency management agencies—use IPAWS, a network of systems discussed below, to request EAS activation.<sup>23</sup>

**IPAWS**

IPAWS is a FEMA-maintained and operated network of systems that allows tribal, federal, state, and local alert originators to send emergency messages to the public via various alert pathways, including EAS and Wireless Emergency Alerts (WEA). WEAs are text-like messages sent via

<sup>20</sup>Specifically, radio and television broadcasters and other EAS participants broadcast these alerts to the public in the entire coverage areas where the broadcasters' signals can be received. As such, the coverage area can encompass more than a single county; but the alert messages specify the county or counties (or other geographic areas) to which the alert applies.

<sup>21</sup>EAS participants include television and radio broadcasters, cable operators, satellite and television providers, and wireline video systems. See 47 C.F.R. § 11.11(a).

<sup>22</sup>EAS participants, through their State Emergency Communications Committee, may maintain state EAS plans that contain procedures for the distribution of national-level alerts as well as other voluntary alerts generated by state and local alerting authorities and NOAA. State EAS plans describe the EAS relay network of each state, including the monitoring assignments of EAS participants for all national-level and other alerts. All EAS participants are required to broadcast Presidential alerts, which enable the President to address the public during a national emergency.

<sup>23</sup>Further, FCC requires EAS participants to monitor IPAWS for alerts. See 47 C.F.R. § 11.52(d)(2).

one-way transmission to mobile devices, such as cell phones and smart watches. There is no charge associated with receiving a WEA. WEAs include a special tone and vibration, both repeated twice.

IPAWS is the only method available for sending WEAs and, like other alert originators, NOAA uses IPAWS to do so. NOAA sends tsunami alerts directly to IPAWS. Then, an automated IPAWS process authenticates the alert and transmits it to participating wireless providers.<sup>24</sup> Using information associated with the alert, an automated process at participating wireless providers transmits the alert to cell towers in the alert area, and these towers transmit the alert. NOAA can use WEAs to send tsunami alerts at a county level, but as discussed later in this report, the agency is developing a capability to send these alerts via WEAs to more specific geographic areas, known as “polygons.”<sup>25</sup>

To receive WEAs, a person must: (1) have a compatible mobile device; (2) have a service plan with a wireless provider that participates in WEA; (3) have their device turned on; (4) have notifications enabled; and (5) be within range of a cell tower in the area associated with the alert. The WEA message that a person will receive varies depending on the version of WEA supported by the person’s mobile device.<sup>26</sup> Specifically, WEA 1.0 allows for a 90-character, English-language text only message; WEA 2.0 allows for a 360-character message and Spanish-language alerts; and WEA 3.0 offers the capabilities of WEA 2.0 and allows for enhanced geographic targeting of alerts (we discuss enhanced geographic targeting later this report). Figure 4 shows how a WEA for a tsunami alert may appear on a person’s mobile device, depending on the version of WEA supported by the person’s mobile device.

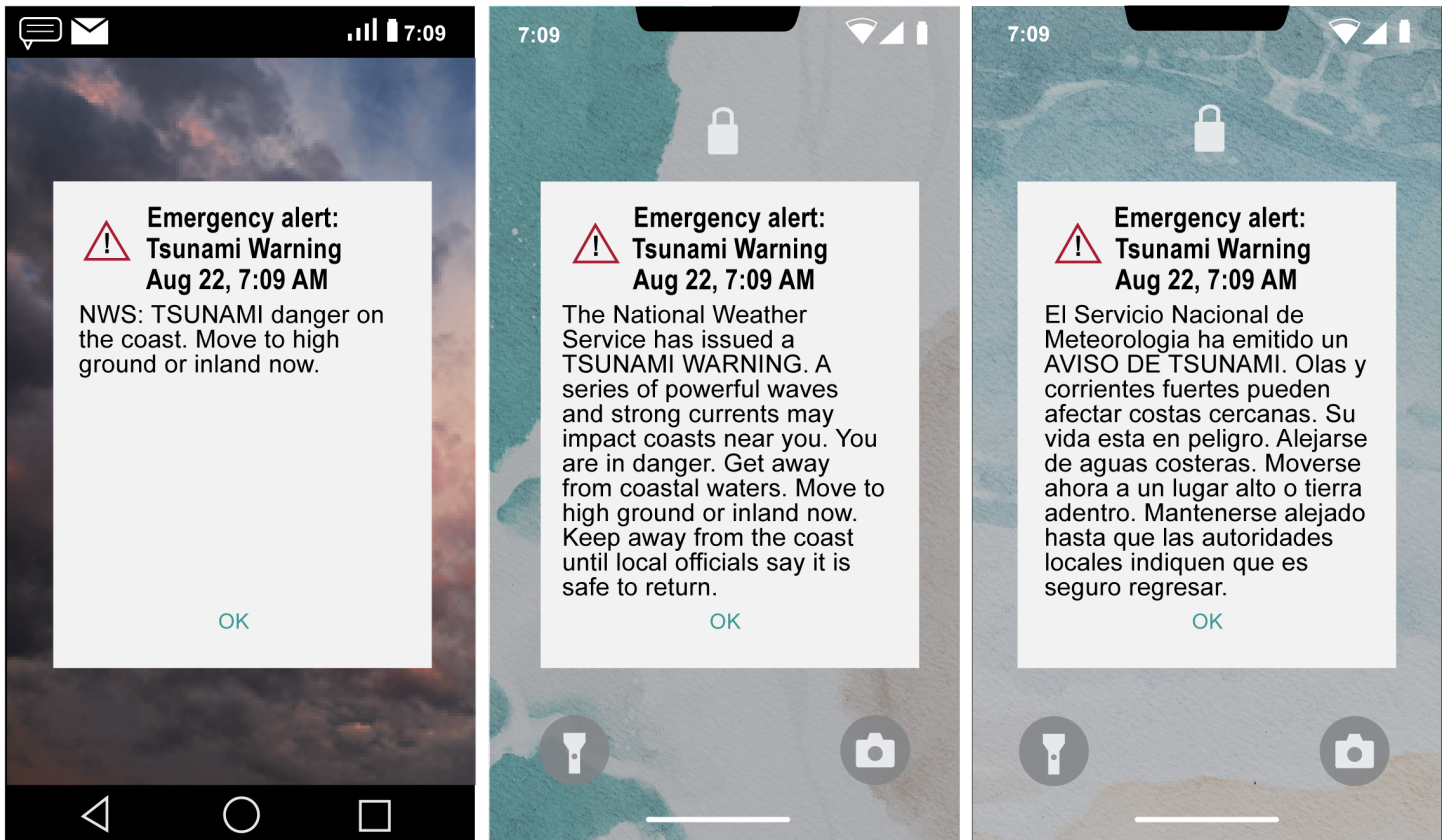
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<sup>24</sup>Wireless provider participation in WEAs is voluntary, but according to FCC, participation is widespread.

<sup>25</sup>Polygons depict wireless providers’ coverage areas.

<sup>26</sup>FCC rules do not refer to WEA technical capabilities in terms of “versions.” Rather, according to FCC officials, “versions” is a marketing term used by the wireless industry.

**Figure 4: Examples of Tsunami Alert Wording Used by the National Oceanic and Atmospheric Administration’s National Weather Service (NWS) for Wireless Emergency Alerts**



Source: GAO analysis of National Oceanic and Atmospheric Administration information. Images Hanna/stock.adobe.com and Warawut/stock.adobe.com. | GAO-23-105961

**Text for Figure 4: Examples of Tsunami Alert Wording Used by the National Oceanic and Atmospheric Administration’s National Weather Service (NWS) for Wireless Emergency Alerts**

- **Emergency alert:  
Tsunami Warning  
Aug 22, 7:09 AM**  
NWS: TSUNAMI danger on the coast. Move to high ground or inland now.
- **Emergency alert:  
Tsunami Warning  
Aug 22, 7:09 AM**  
The National Weather Service has issued a TSUNAMI WARNING. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high

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ground or inland now. Keep away from the coast until local officials say it is safe to return.

- **Emergency alert:  
Tsunami Warning  
Aug 22, 7:09 AM**

El Servicio Nacional de Meteorología ha emitido un AVISO DE TSUNAMI. Olas y corrientes fuertes pueden afectar costas cercanas. Su vida esta en peligro. Alejarse de aguas costeras. Moverse ahora a un lugar alto o tierra adentro. Mantenerse alejado hasta que las autoridades locales indiquen que es seguro regresar.

Source: GAO analysis of National Oceanic and Atmospheric Administration information. Images Hanna/stock.adobe.com and Warawut/stock.adobe.com. | GAO-23-105961

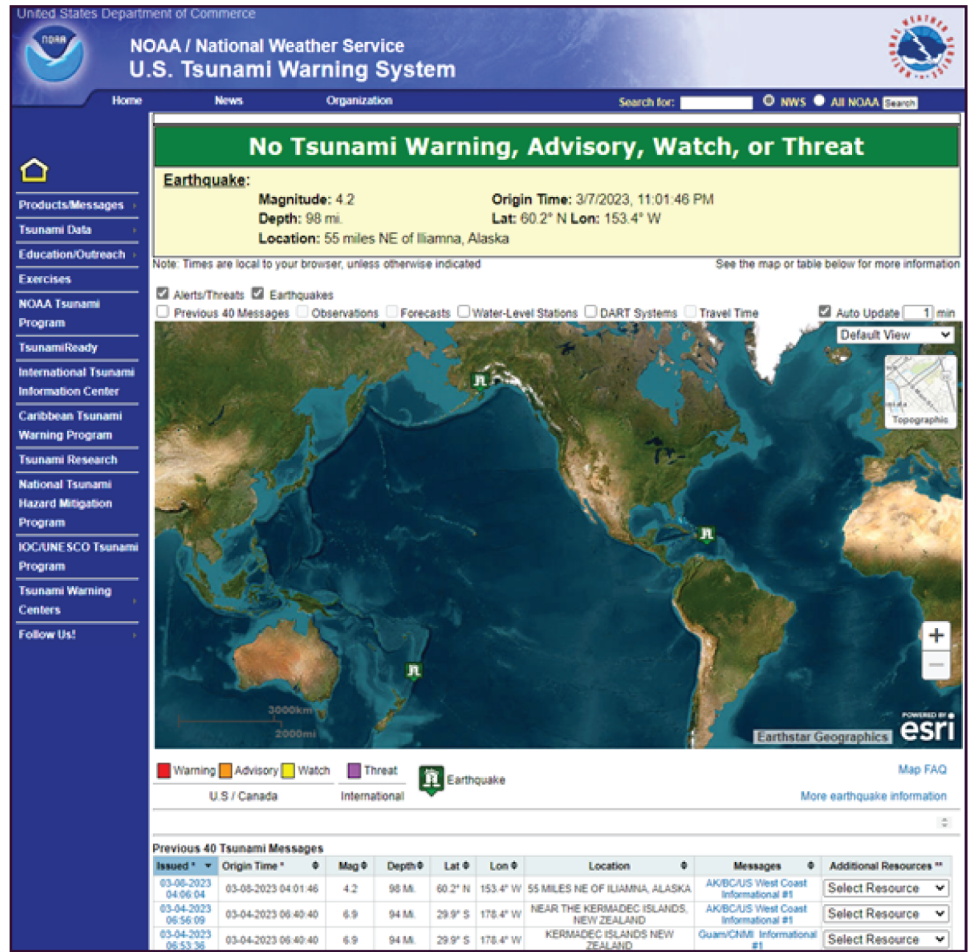
Note: The alert message that a person receives is affected by the specifications of the mobile device. Specifically, the message that a person will receive varies depending on the version of Wireless Emergency Alert (WEA) supported by the person's mobile device. For example, WEA 1.0 allows for a 90-character, English-language text only message; WEA 2.0 and WEA 3.0 allow for a 360-character message and Spanish-language alerts.

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## Internet

NOAA also uses the internet to send tsunami alerts to the public. For example, NOAA uses the internet to post tsunami alerts directly from its tsunami warning centers to its website, tsunami.gov. Tsunami.gov includes information on events that can generate a tsunami, such as earthquakes, and related alert information, such as the time and location of the events (see fig. 5). At the time of our review, NOAA also used the internet to post tsunami alerts to Twitter and Facebook. Some state and local emergency managers we interviewed added that social media has become increasingly popular method in their communities for receiving emergency alerts, like NOAA's tsunami alerts.

Figure 5: Screenshot of Tsunami.gov, Taken March 9, 2023



Source: National Oceanic and Atmospheric Administration (NOAA) website. | GAO-23-105961

## NOAA Has Taken Steps to Address Some Challenges with Sending Tsunami Alerts, But

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## Opportunities Exist to Improve NOAA's Ability to Reach the At-Risk Public

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### NOAA Has Taken Steps to Address Challenges Sending Alerts via the Internet and Targeting of Alerts to At-Risk Populations

NOAA has taken actions to address some challenges with tsunami alerting identified by recent government advisory reports and stakeholders we interviewed. In particular, we found that NOAA has taken action on challenges related to (1) improving the resilience of NOAA's website, tsunami.gov, and (2) broadcasting tsunami alerts more accurately to at-risk populations.

#### **Improving the Resilience of Tsunami.gov**

In December 2021, a NOAA advisory board reported that NOAA's website for broadcasting tsunami information and alerts, tsunami.gov, has a history of crashing during tsunamis. The report noted that this has occurred when a large number of people visit the website at the same time to learn more about the risk they may face from a tsunami hazard.<sup>27</sup>

NOAA has previously identified this challenge. For example, in reports summarizing lessons learned following earthquakes and tsunamis on January 23, 2018 and November 30, 2018 in Alaska, NOAA reported similar challenges with its tsunami.gov website. During the January 2018 earthquake and tsunami NOAA reported the tsunami.gov website slowed and became unresponsive and automated social media posts fed from the webpage, which broadcasts tsunami alerts to the public, were not posted. NOAA concluded that these challenges delivering tsunami alerts via its website and related social media affected the delivery of up-to-date information to state and local emergency managers, government partners, media, and the general public. Further, during the November 2018 earthquake and tsunami NOAA found that tsunami.gov received over 26 million visitors and visitors continued to face challenges with the

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<sup>27</sup>In this report, the board identified a variety of challenges with NOAA's tsunami warning system and put forth recommendations to address these challenges. NOAA is required to provide a report to relevant congressional committees, no less than once every four years, on the findings and recommendations received from the board. 33 U.S.C. § 3206a(d). NOAA officials told us that the agency was in the process of preparing the report at the time of our review.

website, including non-responsiveness, long load times, and an inability to access the website from mobile devices.

Some states' emergency management officials we interviewed also told us about challenges with tsunami.gov, including that the website has a history of crashing during tsunami events. One official told us it is important for the website to remain accessible because the state's emergency management officials rely on it for detailed information about tsunami hazards to help prepare for and respond to tsunami events. Another state official told us that the state refers local emergency managers and the general public to the website to provide information on tsunami risks and to identify areas that may be subject to evacuation.

NOAA has taken a number of steps to address challenges with the resilience of tsunami.gov. For example, following the January 2018 tsunami, NOAA contracted with a company to make changes to tsunami.gov to allow users to more easily access the website and reduce the effect of the large spikes in demand that occur during tsunami events. NOAA reported that the website performed better during the November 2018 tsunami; however, there were still reports of non-responsiveness, long load times, and inability to access the website from mobile devices, as previously discussed. In addition, NOAA plans to award a contract to determine how tsunami.gov could be re-designed to be more effective at disseminating tsunami information and alerts. NOAA officials told us they anticipate awarding this contract in 2023. We did not assess the effectiveness of NOAA's steps to improve the resilience of tsunami.gov as NOAA was implementing these steps at the time of our review.

#### **Risks of Over-Alerting**

- Unnecessary concern and panic: individuals receive alerts that do not apply to them and may take unnecessary actions, including evacuation.
- Warning fatigue and complacency: individuals think alerts do not apply to them and therefore ignore future alerts.
- Opting-out of Wireless Emergency Alerts: unnecessary alert messages delivered to mobile devices are viewed as a sufficient irritation to opt

out of receiving the messages entirely.

Source: GAO interviews and Department of Homeland Security | GAO-23-105961

## Broadcasting Tsunami Alerts More Accurately to At-Risk Populations

NOAA’s advisory board noted in December 2021 that another challenge related to NOAA’s tsunami alerting system is that NOAA sometimes over-alerts the public with its alert dissemination methods. Over-alerting occurs when an alert reaches a population it is not intended for, such as people who are not in an area at risk of a tsunami. Some state emergency managers and other stakeholders we interviewed also cited over-alerting as a concern and added that alerts should be more accurately targeted to at-risk populations. Stakeholders we interviewed and prior research has identified a number of risks associated with over-alerting (see sidebar).<sup>28</sup>

The NOAA advisory board’s report recommended that NOAA better target its tsunami alerts in areas with complicated waterways, such as Puget Sound and San Francisco Bay, to avoid over-alerting.<sup>29</sup> These and other large or uniquely shaped areas are most prone to over-alerting because they include regions at high risk of tsunamis effects, such as along certain coastlines, and nearby regions at low to no risk of tsunami effects, such as inland areas high above sea level.

With regard to WEAs in particular, over-alerting may occur with some mobile devices. This situation occurs because cell towers will deliver WEAs to any WEA-compatible mobile device within range of the tower. Some older devices—that is, those that only support WEA 1.0 or 2.0—may unnecessarily display an alert if the device is within range of the tower but located outside of the warned area (see fig. 6). However, the majority of active mobile devices support WEA 3.0 capabilities, which include improved geo-targeting features—that is, they are capable of determining if the device is located within the warned area.<sup>30</sup> These mobile devices will therefore only display an alert when they are located within, or immediately adjacent to, the warned area.<sup>31</sup>

<sup>28</sup>Department of Homeland Security, *Exploring the Effect of the Diffusion of Geo-Targeted Emergency Alerts, July 2015*. Department of Homeland Security, *Geo-Targeting Performance of Wireless Emergency Alerts in Imminent Threat Scenarios* (May 2016).

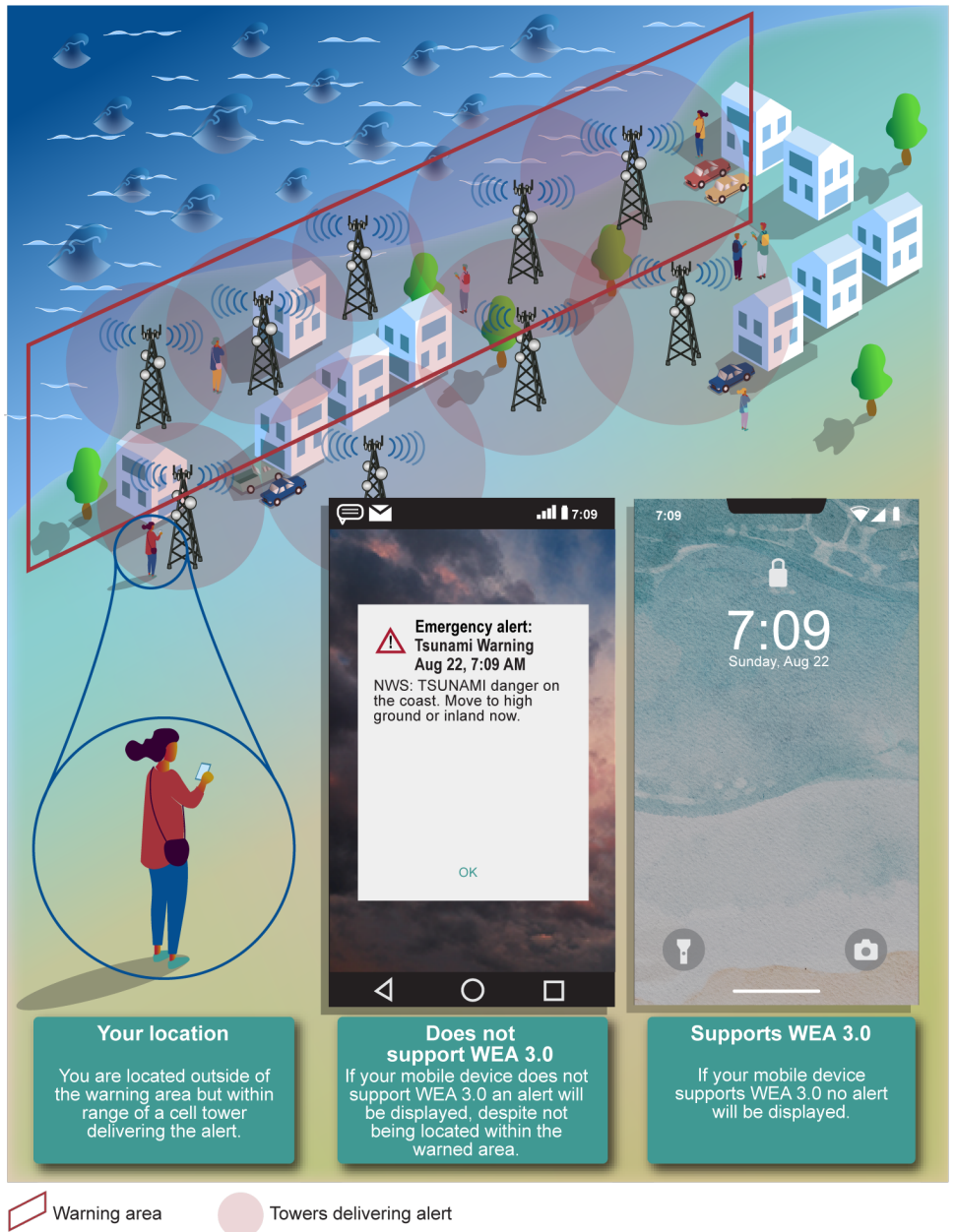
<sup>29</sup>This report also included a number of recommendations to NOAA related to tsunami detection, forecasting, warning, preparedness, and research.

<sup>30</sup>According to CTIA, a wireless industry association, as of the first quarter of 2022, approximately 60 percent of active smartphones were WEA 3.0 compatible, an increase from 34 percent of active smartphones in 2021.

<sup>31</sup>This geo-targeting feature allows for alerts only to be displayed on mobile devices located within 1/10<sup>th</sup> of a mile of the warned area.



**Figure 6: Wireless Emergency Alerts May Reach Some Mobile Devices Outside the Tsunami Threat Area**



Source: GAO analysis of National Oceanic and Atmospheric Administration information. | GAO-23-105961

**Text for Figure 6: Wireless Emergency Alerts May Reach Some Mobile Devices Outside the Tsunami Threat Area**

- **Your location**

- You are located outside of the warning area but within range of a cell tower delivering the alert.
- **Does not support WEA 3.0**
  - If your mobile device does not support WEA 3.0 an alert will be displayed, despite not being located within the warned area.
- **Supports WEA 3.0**
  - If your mobile device supports WEA 3.0 no alert will be displayed.

Source: GAO analysis of National Oceanic and Atmospheric Administration information. | GAO-23-105961

Note: There are three versions of Wireless Emergency Alerts (WEA) each with different capabilities. Among other things, WEA 3.0 allows for enhanced geotargeting of alerts, a capability not offered by WEA 1.0 and 2.0.

NOAA Weather Radio and EAS alerts can also over alert the public. For example, some NOAA Weather Radio receivers may not include a technology that allows the user to narrow the areas for which they would like to receive alerts.<sup>32</sup> As a result, the public may receive alerts despite being located in an area that is not considered at risk.<sup>33</sup> In addition, tsunami alerts are generally broadcast to an entire county or number of counties. This means that even if only a small portion of a county is at risk of a tsunami hazard, the entire county receives the alert. According to NOAA officials, the alert message that people receive more specifically describes the area at risk, but the risks of over-alerting, described above, are still present.

EAS can also over alert the public because EAS interrupts television, radio, and cable broadcasts for all viewers and listeners in the broadcaster's coverage area—an area that can be much larger than the tsunami hazard area. Like a NOAA Weather Radio broadcast, an EAS broadcast specifies the hazard area in the alert message, but the risks of over-alerting are still present. For example, according to NOAA, in one large county people received alerts from EAS despite being located nearly 100 miles from the threat area.

NOAA has taken some steps to better target tsunami alerts to at-risk populations. For wireless alerts, NOAA officials said NOAA created maps

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<sup>32</sup>These receivers lack Specific Area Message Encoding technology, an audio-based alerting protocol, available in certain NOAA Weather Radio receivers. Receivers that have this technology can be programmed to allow the user to only receive alerts for a specific county or counties.

<sup>33</sup>In addition, since NOAA Weather Radio is used to send alerts to EAS, radio and television broadcasters using these older receivers may transmit EAS alerts to viewers and listeners outside of the area NOAA considers to be at risk.

in 2019 of geographic areas at risk of tsunamis, using boundaries that were more specific than county lines. These mapped areas, referred to as “polygons,” were intended to be used by wireless providers to better target NOAA’s tsunami alerts to at-risk populations. Wireless providers, however, were unable to use these polygons because they did not meet IPAWS technical requirements that limit the size and shape of polygons.<sup>34</sup> NOAA is working to develop a capability to divide tsunami alerts covering large areas into multiple alerts covering smaller areas to conform to the IPAWS requirements.<sup>35</sup> NOAA officials said the agency expects to complete deployment of this capability by 2025.

For alerts sent via NOAA Weather Radio and EAS, NOAA recently launched a “partial county alerting” initiative which allows counties to be subdivided into two to nine sections. NOAA officials told us this initiative would allow alerts sent via NOAA Weather Radio and EAS to be targeted to only the sections of a county determined to be most at risk of a tsunami or other hazard. According to NOAA, this initiative could therefore allow for alerts to more accurately target at-risk populations and avoid the risks of over-alerting portions of a county well inland or otherwise not at risk of a tsunami. However, NOAA officials added that local officials, emergency managers, and broadcasters, among others, are responsible for deciding whether to participate in NOAA’s partial county alerting initiative.

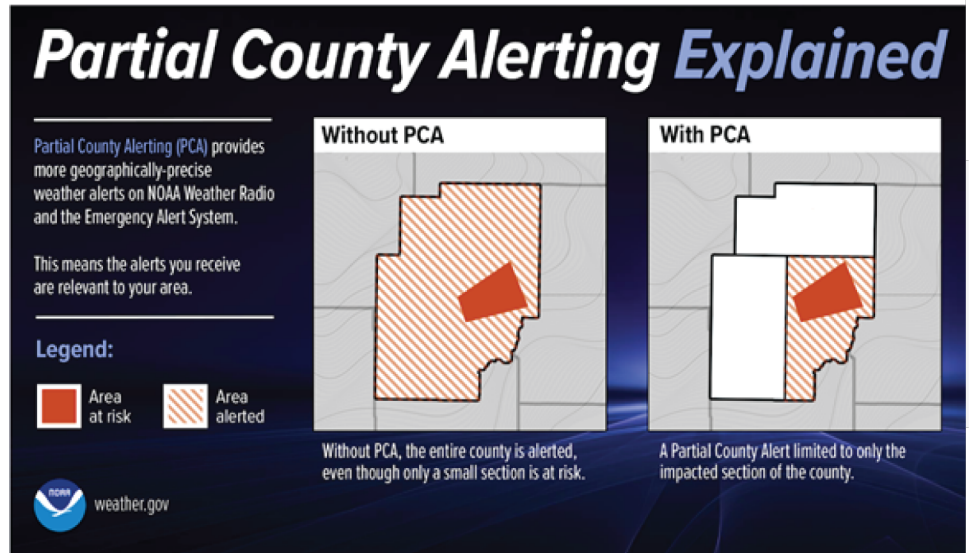
In 2021, NOAA piloted partial county alerting in Clark County, Nevada, and, according to NOAA officials, broadcasters reported sending more relevant and better targeted alerts to their broadcast areas. According to NOAA, the partial county alerting initiative will be expanded nationwide for select counties beginning in late 2023. Figure 7 illustrates how NOAA’s partial county alerting initiative works.

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<sup>34</sup>IPAWS will reject alerts with more than 10 polygons and more than 100 total coordinates used to define the polygon. According to NOAA officials, typically, a tsunami alert requires a larger number of coordinates to accurately describe the threat area. The Alliance for Telecommunications Industry Solutions, a global standards development and technical-planning organization, developed these limitations. According to this organization, these limitations were established following an engineering analysis of the WEA system to reduce delays in sending alerts and the likelihood of overwhelming the system. FEMA officials added that these limitations are a tradeoff that enable WEA to support the 360-character message length and more precise geo-targeting of messages.

<sup>35</sup>According to NOAA officials, this capability will also leverage the wireless industry’s implementation of WEA 3.0 capabilities that are intended to ensure alerts are displayed only when the recipient’s mobile device is within one-tenth mile of the alert area.

**Figure 7: Description of the National Oceanic and Atmospheric Administration’s (NOAA) Partial County Alerting Initiative for Warnings about Tsunamis or Other Hazards**



Source: NOAA. | GAO-23-105961

**Text for Figure 7: Description of the National Oceanic and Atmospheric Administration’s (NOAA) Partial County Alerting Initiative for Warnings about Tsunamis or Other Hazards**

**Partial County Alerting Explained**

Partial County Alerting (PCA) provides more geographically-precise weather alerts on NOAA Weather Radio and the Emergency Alert System.

This means the alerts you receive are relevant to your area.

Without PCA, the entire county is alerted, even though only a small section is at risk.

A Partial County Alert limited to only the impacted section of the county.

Source: NOAA. | GAO-23-105961

NOAA officials added that the agency has multiple other efforts underway to better target alerts in Alaska—one of the states at highest risk of tsunamis. Specifically, following concerns of widespread over-alerting during the January 2018 earthquake and tsunami, NOAA took steps to reduce unintended EAS and WEA alerting for residents in Anchorage,

and to improve the accuracy of forecasting and alerts, including tsunami warnings. According to NOAA officials, these steps included better aligning forecasts to geographic boundaries. NOAA officials added that further improvements, including the use of partial county alerting are being considered to mitigate over-alerting in Alaska, but no timeframe was provided for deciding whether to implement these improvements.

While stakeholders we interviewed and the recent government advisory reports cited the risks of over-alerting, under-alerting may also occur. Under-alerting occurs when alerts are not received by people in the area at risk of a tsunami. For example, in areas with limited cellular infrastructure, such as cell towers, a person may not receive a WEA. As discussed previously, receiving WEAs also requires a person to have a phone or other mobile device capable of and configured to receive them. As discussed later in our report, under-alerting can also occur when NOAA Weather Radio coverage does not extend to all at-risk areas.

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## Assessing Weather Radio Coverage and Enhancing Collaboration Could Improve How NOAA Reaches the Public at Risk of Tsunamis

We identified two opportunities for NOAA to improve its tsunami-alerting efforts based on our review of recent government advisory reports and interviews with stakeholders: (1) assessing NOAA Weather Radio coverage in areas at risk of tsunamis and (2) enhancing its collaborative efforts to determine how to use IPAWS to deliver tsunami alerts to EAS for broadcast to television and radio audiences.

### **Assessing NOAA Weather Radio Coverage in Areas at Risk of Tsunamis**

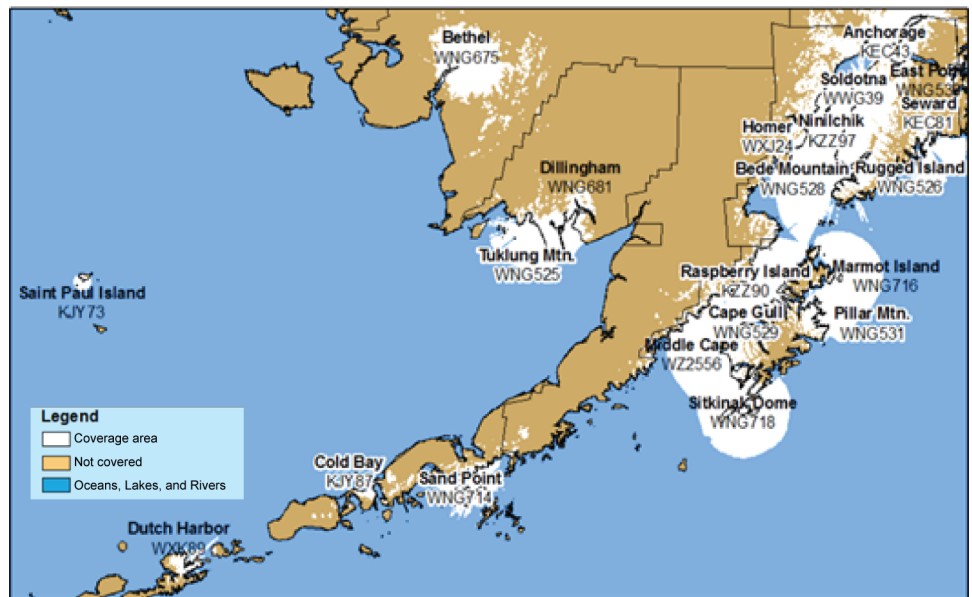
NOAA officials and some state emergency managers who we interviewed told us that NOAA Weather Radio serves as a vital information source for tsunami alerts. The state emergency managers noted that NOAA Weather Radio can be particularly vital in tribal, remote, and rural areas that may lack access to other alerting methods. While NOAA officials told us they are anecdotally aware of some areas at risk of tsunamis that lack NOAA Weather Radio coverage, NOAA has not assessed the extent of coverage gaps.

An emergency management official in Alaska told us that NOAA Weather Radio is one of the primary methods of alerting many Alaskans of tsunami risks because many parts of the state lack coverage from other methods—such as WEAs and the internet. However, NOAA Weather

Radio does not provide coverage to all populations in the state at risk of tsunamis. This official also expressed concern that some NOAA Weather Radio transmitters in the state are offline due to weather damage or lack of maintenance resulting in coverage gaps with NOAA Weather Radio. As discussed earlier, NOAA officials acknowledge challenges in quickly repairing damaged NOAA Weather Radio transmitters located in remote areas with harsh weather conditions, such as parts of Alaska.

Another emergency management official in Alaska told us that NOAA Weather Radio’s coverage in the state does not reach some of the state’s most rural and isolated communities. These areas, the official noted, sometimes lack access to other alerting methods, such as WEAs. For example, the official said that NOAA Weather Radio coverage does not extend to all populations in the Aleutian Islands, an island chain in southwest Alaska that, as of the 2020 Census, had a population of approximately 8,600. Our review of NOAA Weather Radio coverage maps identified gaps in coverage in the Aleutian Islands, as shown in figure 8.

**Figure 8: Gaps in the National Oceanic and Atmospheric Administration’s (NOAA) Weather Radio Coverage, as of February 16, 2023—Aleutian Islands, Alaska**



Source: GAO analysis of NOAA information. | GAO-23-105961

Members of Congress have recognized the importance of NOAA Weather Radio. In 2023, legislation was introduced in the House of Representatives that would direct NOAA to address outdated NOAA Weather Radio technology and systems serving areas with no or limited

reliable cellular coverage—that is, areas where WEAs may not be reliably received.<sup>36</sup> This bill states that NOAA Weather Radio should provide equal access and availability to broadcasts of weather and non-weather hazards to every person located within the U.S. and its territories and on tribal lands.

NOAA does not control the infrastructure that supports people’s access to EAS, WEA, and internet-based alerting methods, and NOAA lacks information on the extent to which people have access to these methods. NOAA does, however, manage and maintain NOAA Weather Radio, and is therefore best positioned to assess whether NOAA Weather Radio is capable of reliably broadcasting alerts to areas at risk of tsunamis. NOAA officials told us the agency has not assessed the extent to which NOAA Weather Radio coverage extends to populated areas at risk of tsunamis; however, the officials agreed it would be beneficial to do so. The officials said that NOAA had not seen a need to do so previously because there are currently no plans to extend NOAA Weather Radio’s coverage footprint. Without assessing the extent to which NOAA Weather Radio coverage reaches populations at risk of tsunamis, NOAA cannot be assured that the U.S. Tsunami Warning System is capable of disseminating alerts to remote and isolated communities at risk of tsunamis.

Federal internal control standards state that quality information is vital to achieving agency objectives and management should use this information to make informed decisions and achieve key objectives. In the case of NOAA, key objectives include delivery of weather and hazard alerts, such as tsunami alerts, across the nation. Management should also externally communicate the necessary quality information to achieve these objectives.<sup>37</sup> Furthermore, the Tsunami Warning and Education Act established that NOAA should provide a capability for disseminating alerts to communities at risk of tsunamis, through rapid and reliable notifications. By assessing this information and publicly communicating it, NOAA could help ensure that the public, state and local emergency managers, and key decision-makers, such as Congress, have information on the extent to which at-risk communities have access to tsunami alerts.

### **Using IPAWS to Deliver Tsunami Alerts to EAS**

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<sup>36</sup>NOAA Weather Radio Modernization Act of 2023, H.R. 1482, 118th Cong. (2023).

<sup>37</sup>GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

NOAA does not use IPAWS to deliver tsunami alerts to EAS; however, officials from NOAA, FCC, and FEMA, and state emergency managers, as well as other stakeholders we interviewed, identified several benefits of doing so. For example, FEMA officials and a broadcasting association we spoke with highlighted benefits of the Common Alerting Protocol format, a digital format used by IPAWS for broadcasting emergency alerts.<sup>38</sup> According to FEMA, this format allows alerts to include photographs, maps, video, and clear, digital audio messages. This format also provides the capability to issue alerts in multiple languages, and because it can incorporate text and audio, better serves the needs of those who are hearing or visually impaired.

In addition, a state emergency manager and representative from a State Emergency Communications Committee from Alaska told us that using IPAWS to deliver tsunami alerts to EAS would provide a critical redundancy if NOAA Weather Radio is offline due to transmitter damage. In a 2018 email to NOAA, this emergency manager underscored the importance of using IPAWS to deliver alerts to EAS after a January 2018 tsunami alert was not received in some areas of Alaska because NOAA Weather Radio was offline or affected areas lacked NOAA Weather Radio coverage. Although a NOAA official said in 2018 that the agency was working to better understand and identify a solution, this issue remained unresolved at the time of our review.

While FEMA launched IPAWS in 2010 to modernize and integrate the nation's public alert and warning systems, according to NOAA officials, the agency does not use IPAWS to deliver its alerts for broadcast via EAS.<sup>39</sup> NOAA has used IPAWS since 2012 to get its alerts to the public's mobile devices via WEAs, but NOAA officials said that the agency does not use IPAWS to deliver alerts to EAS because of technical challenges. Specifically, NOAA officials told us that using IPAWS to deliver alerts to EAS, in addition to using NOAA Weather Radio, could result in duplicate

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<sup>38</sup>By comparison, most NOAA Weather Radios use Specific Area Message Encoding technology. NOAA Weather Radio was launched in the 1960s. In the 1990s, NOAA Weather Radio and EAS began using Specific Area Message Encoding to broadcast alerts. The Common Alerting Protocol format was developed in the early 2000s to distribute alerts.

<sup>39</sup>As previously discussed, according to FEMA officials, most alert originators use IPAWS to deliver alerts to EAS.



alerts being broadcast to radio and television audiences.<sup>40</sup> Duplicate alerts might lead to confusion as alerts transmitted to the public from multiple sources could appear to be discrete alerts rather than duplicate alerts covering the same event. In addition, duplicate alerts might lead to alert fatigue as the public becomes ambivalent towards the alerts they receive. NOAA officials acknowledged the benefits inherent to using IPAWS, but noted that some EAS participants are reliant on NOAA Weather Radio. Consequently, according to NOAA officials, any solution needs to allow both IPAWS and NOAA Weather Radio to be sources of alerts for EAS participants.

NOAA has taken several steps to determine how it can address the challenges of duplicate alerts in order to use IPAWS to deliver tsunami alerts to EAS. In particular, NOAA has initiated an internal process, which includes determining the technical requirements necessary to begin using IPAWS to deliver alerts to EAS. Further, NOAA officials said they meet periodically with FCC and FEMA—two agencies with key roles for using EAS and IPAWS, respectively<sup>41</sup>—to discuss the challenge and how to address it.

NOAA, FCC, and FEMA officials told us, however, that the agencies do not have regularly scheduled meetings dedicated to the issue, nor have the agencies agreed on a solution or implementation strategy. In addition, the agencies have not clarified or documented their responsibilities or a decision-making process for finding a solution. Officials from all three

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<sup>40</sup>Duplicate alerts occur due to technical differences in the processes for generating, distributing and broadcasting of alerts between NOAA and devices used to disseminate EAS alerts. In 2019, FCC tasked a federal advisory committee with recommending a solution to resolve this duplication issue. In 2021, this committee issued a report that included a series of recommendations directed at FCC as well as proposals to FEMA and NOAA, among others. See Communications Security, Reliability, and Interoperability Council VII, Working Group 1, *Report on Recommendations to Resolve Duplicate National Weather Service Alerts* (March 2021). In December 2022, FCC issued a final rule requiring EAS participants that receive both legacy-formatted alerts and duplicate Common Alerting Protocol (CAP) alerts to distribute the CAP-formatted alert. The rule also requires EAS participants to poll IPAWS for any available CAP alert at least once 10 seconds after the incoming legacy-formatted alert and to distribute the CAP alert, if available. See Amendment of Part 11 of the Commission's Rules Regarding the Emergency Alert System, PS Docket No. 15-94, FCC 22-75, 86 Fed. Reg. 67,808 (2022).

<sup>41</sup>FCC establishes EAS regulations, which include technical standards and operational procedures. 47 C.F.R. pt 11. FEMA maintains and operates IPAWS and is required by statute to establish or adopt common alerting and warning protocols, standards, terminology, and operating procedures for IPAWS. Integrated Public Alert and Warning System Modernization Act of 2015, Pub. L. No. 114-143, § 2(a), 130 Stat. 327, 327 (codified at 6 U.S.C. § 321o(a)).

agencies told us that, while they have discussed addressing the challenge, greater collaboration could improve their efforts to identify a solution and implementation strategy.

Our prior work has found that agencies can strengthen their commitment to work collaboratively by following selected key practices such as (1) clarifying their respective responsibilities—including articulating and agreeing to a process for making and enforcing decisions—and (2) documenting their agreements to work together.<sup>42</sup> Following these key practices could help NOAA effectively collaborate with FCC and FEMA to identify a solution and strategy for using IPAWS to deliver its alerts to EAS. This, in turn, could allow for more informative alerts and add a key redundancy to NOAA's efforts to alert at-risk populations of tsunamis.

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## Conclusions

Tsunamis can be powerful and destructive, making it critical that the public is alerted to tsunami hazards. NOAA uses multiple methods to distribute its tsunami alerts. However, given the threat that tsunamis pose, it is essential for NOAA to ensure that its alerts reach the public most at risk. Tribal, rural, and remote areas often rely on NOAA Weather Radio to receive tsunami alerts, but it is unclear whether NOAA Weather Radio covers all at-risk areas. Until NOAA has a better understanding of the extent to which areas at risk of tsunamis are covered by NOAA Weather Radio, it cannot be assured that the public—especially those living in tribal, rural, and remote areas—has reliable access to NOAA Weather Radio tsunami alerts. In addition, IPAWS could introduce a key redundancy in NOAA's efforts to broadcast tsunami alerts to television and radio audiences and allow for more informative alerts. By enhancing its collaboration with key federal agencies, NOAA could improve its efforts to more fully utilize this method of broadcasting alerts.

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## Recommendations for Executive Action

We are making the following two recommendations to NOAA:

The NOAA Administrator should assess the extent to which NOAA Weather Radio coverage extends to populated areas at risk of tsunamis,

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<sup>42</sup>GAO, *Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms*, [GAO-12-1022](#) (Washington, D.C.: Sept. 27, 2012).

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and publicly communicate the results of the assessment.  
(Recommendation 1)

The NOAA Administrator, in collaboration with FCC and FEMA, should clarify and document the agencies' responsibilities and a decision-making process for determining how to use IPAWS to deliver tsunami alerts to EAS. (Recommendation 2)

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## Agency Comments

We provided a draft of this report to NOAA, FCC, and FEMA for review and comment. In written comments provided by the Department of Commerce (reproduced in appendix I), NOAA concurred with our recommendations. NOAA, FCC, and FEMA provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretaries of Commerce and Homeland Security, the Chairwoman of FCC, and other interested parties. In addition, the report is available at no charge on the GAO website at <https://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or [vonaha@gao.gov](mailto:vonaha@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 II.



Andrew Von Ah  
Director, Physical Infrastructure Issues

## Appendix I: Comments from the Department of Commerce



UNITED STATES DEPARTMENT OF COMMERCE  
Office of the Acting Chief Financial Officer and  
Assistant Secretary for Administration  
Washington, D.C. 20230

April 27, 2023

Mr. Andrew Von Ah  
Director  
Physical Infrastructure  
U.S. Government Accountability Office  
441 G Street, NW  
Washington, DC 20548

Dear Mr. Von Ah:

Thank you for the opportunity to review and comment on the Government Accountability Office's (GAO) draft report entitled *EMERGENCY ALERTING: NOAA Should Take Additional Actions to Help Ensure Tsunami Alerts Reach the Public at Risk* (GAO-23-105961).

The Department of Commerce agrees with GAO's recommendations directed to the National Oceanic and Atmospheric Administration (NOAA). Enclosed is our response to the draft report.

Should you have any questions, please contact MaryAnn Mausser, GAO Liaison, at (202) 482-8120 or [MMAusser@doc.gov](mailto:MMAusser@doc.gov).

Sincerely,

JEREMY PELTER Digitally signed by JEREMY PELTER  
Date: 2023.04.27 10:50:45 -0400

Jeremy Pelter  
Acting Chief Financial Officer  
and Assistant Secretary for Administration

Enclosure

**Department of Commerce  
National Oceanic and Atmospheric Administration  
Response to the GAO Draft Report Entitled  
EMERGENCY ALERTING: NOAA Should Take Additional Actions to Help Ensure  
Tsunami Alerts Reach the Public at Risk  
(GAO-23-105961, May 2023)**

**General Comments**

The Department of Commerce’s National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review the Government Accountability Office’s (GAO) report on Emergency Alerting to Help Ensure Tsunami Alerts Reach the Public at Risk. Overall, GAO was thorough in their approach in assessing the ability for NOAA to alert those at risk for tsunamis. The report’s discussion on various tsunami alerting and dissemination methods are generally well informed and balanced.

**NOAA Response to GAO Recommendations**

The draft report made two recommendations pertaining to NOAA:

**Recommendation 1:** “The NOAA Administrator should assess the extent to which NOAA Weather Radio coverage extends to populated areas at risk of tsunamis, and publicly communicate the results of the assessment.”

**NOAA Response:** NOAA agrees with the recommendation. The National Weather Service (NWS) already has the NOAA Weather Radio (NWR) Propagation Coverage areas for all NWR transmitters. Using the NWS Tsunami Program’s threat areas can easily yield an overlay of NWR coverage with Tsunami Threat Areas. NWS will need to determine and plan how to best communicate this information to the public. In simplest form, a map or maps of the Tsunami Threat Areas with noted NWR coverage can be easily provided on the NWR website.

**Recommendation 2:** “The NOAA Administrator, in collaboration with FCC and FEMA, should clarify and document the agencies’ responsibilities and a decision-making process for determining how to use IPAWS to deliver tsunami alerts to EAS.”

**NOAA Response:** NOAA agrees with the recommendation and plans to meet regularly with FCC and FEMA to determine how to use IPAWS to deliver tsunami alerts to the Emergency Alert System (EAS). In particular, NWS is moving forward with its software requirements and development process to make required changes to the Advanced Weather Interactive Processing System (AWIPS) to responsibly commence the delivery of tsunami alerts to IPAWS for the EAS.

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## Text for Appendix I: Comments from the Department of Commerce

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Washington, D.C. 20230

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Sincerely,

Jeremy Pelter  
Acting Chief Financial Officer and Assistant Secretary for Administration

**Enclosure**

**Department of Commerce  
National Oceanic and Atmospheric Administration  
Response to the GAO Draft Report Entitled**

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## Appendix II: GAO Contact and Staff Acknowledgments

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### GAO Contact

Andrew Von Ah, (202) 512-2834 or [vonaha@gao.gov](mailto:vonaha@gao.gov)

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### Staff Acknowledgments

In addition to the contact named above, Sally Moino (Assistant Director); James Leonard (Analyst-in-Charge); Aditi Archer; Melissa Bodeau; Melanie Diemel; Elizabeth Dretsch; Kristen Farole; Jason Jackson; Tracey King; and Michael Soressi made key contributions to this report.



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