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The U.S. Tsunami Program: A Brief Overview

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February 20, 2015

Congressional Research Service

7-5700

www.crs.gov

R41686

Summary

The National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS) manages two tsunami warning centers that monitor, detect, and issue warnings for tsunamis. The NWS operates the Pacific Tsunami Warning Center (PTWC) at Ewa Beach, Hawaii, and the National Tsunami Warning Center (NTWC) at Palmer, Alaska.

The tsunami warning centers monitor and evaluate data from seismic networks and determine if a tsunami is likely based on the location, magnitude, and depth of an earthquake. The centers monitor coastal water-level data, typically with tide-level gauges, and data from NOAA's network of Deep-ocean Assessment and Reporting of Tsunamis (DART) detection buoys to confirm that a tsunami has been generated or to cancel any warnings if no tsunami is detected. As of January 20, 2015, 12 of the United States' 39 DART buoys were not operational. According to NOAA, the inoperable stations would not prevent the issuance of tsunami warnings, which are primarily a function of seismic data from an earthquake or landslide, combined with location information about the event. However, lacking these stations could mean the warnings encompass a larger area than would be the case if all stations were operating, and it could lengthen the time a warning remains in effect.

On January 7, 2015, the House passed by unanimous consent H.R. 34, the Tsunami Warning, Education, and Research Act of 2015. The bill would amend the Tsunami Warning and Education Act (P.L. 109-424) and authorize appropriations for the National Tsunami Hazard Mitigation Program (NTHMP) through FY2017. Authorization for NTHMP appropriations expired in FY2012. H.R. 34 would not make fundamental changes to the NTHMP, but it would broaden the program to include an increased focus on tsunami research and outreach, among other alterations. The Senate has not acted on the legislation.

The NTHMP assists states in emergency planning and in developing maps of potential coastal inundation for a tsunami of a given intensity. A goal of the program is to ensure adequate advance warning of tsunamis along all U.S. coastal areas and appropriate community response to a tsunami event. The NTHMP formed in 1995 in response to the recognition of a tsunami threat to Oregon, Washington, and Northern California from a large earthquake on the Cascadia subduction zone, which lies off the northwest coast of the United States and is capable of generating earthquakes as large as magnitude 9 or greater. The NTHMP also operates tsunami disaster outreach and education programs through NOAA's TsunamiReady program.

For FY2015, \$27 million was appropriated for the NTHMP, which represents "full funding," according to NOAA. As part of the \$27 million total, the House Appropriations Committee report included \$6 million in funding above NOAA's FY2015 request to restore proposed reductions to tsunami grant funds.

Key issues for Congress include maintenance and availability of the DART buoy network. P.L. 109-424 states that "maintaining operational tsunami detection equipment is the highest priority within the program carried out under this Act." This requirement also was included in a Senate bill that would have reauthorized the tsunami program in the 113th Congress, S. 2181. Differences between S. 2181, which would have authorized \$36 million per year for five years, and H.R. 34, which would authorize \$27 million per year for three years, indicate that what constitutes "full funding" for the tsunami program also may be an issue for the 114th Congress.

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Introduction: U.S. Tsunami Warning Centers

The United States has two centers that monitor, detect, and issue warnings for tsunamis. The National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS) manages both centers. The NWS operates the Pacific Tsunami Warning Center (PTWC) at Ewa Beach, Hawaii, and the National Tsunami Warning Center (NTWC) at Palmer, Alaska. (Before October 1, 2013, the NTWC was known as the West Coast and Alaska Tsunami Warning Center, or WC/AKTWC).¹

The PTWC monitors for tsunamis and issues warnings for the Hawaiian Islands, the U.S. Pacific territories, and other U.S. and international interests in the Pacific basin. Following the 2004 Indian Ocean tsunami, the PTWC took on responsibility for monitoring the Indian Ocean, South China Sea, Caribbean Sea, and, temporarily, the U.S. Virgin Islands and Puerto Rico (until June 2007, when responsibility was passed to what was then known as the WC/AKTWC).² The PTWC was established in 1949 after a strong earthquake and massive landslides off the coast of Southwest Alaska caused a disastrous tsunami that hit the Hawaiian Islands only hours later. The PTWC issued tsunami warnings to Alaska until 1967, when the WC/AKTWC was established.

The WC/AKTWC (now the NTWC) was established in the aftermath of the magnitude 9.2 Good Friday earthquake that struck Anchorage, Alaska, in 1964 and caused major earthquake and localized tsunami damage.³ The NTWC is responsible for issuing tsunami warnings to emergency management officials in Alaska, British Columbia (Canada), Washington State, Oregon, and California. In 2007, the NTWC expanded its scope to include the U.S. Atlantic and Gulf of Mexico coasts, Puerto Rico, the U.S. Virgin Islands, and the Atlantic coast of Canada. **Figure 1** shows the areas of responsibility for the PTWC and the NTWC.

¹ National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), National Tsunami Warning Center (NTWC), "Tsunami Warning Center History," at <http://wcatwc.arh.noaa.gov/?page=history>.

² Ibid. The Pacific Tsunami Warning Center (PTWC) provided interim tsunami warning service from 2005 to 2013 for the Indian Ocean, and it has discontinued that service. Tsunami warning services for the Indian Ocean currently are provided by regional tsunami service providers in Australia, India, and Indonesia. See NOAA, NWS, Pacific Tsunami Warning Center, "PTWC Responsibilities," at <http://ptwc.weather.gov/responsibilities.php>.

³ See NOAA, NWS, "TsunamiReady Helps Communities at Risk," at <http://www.tsunamiready.noaa.gov/>.

Figure 1. Areas of Responsibility for the Pacific Tsunami Warning Center (PTWC) and the National Tsunami Warning Center (NTWC)



Source: National Oceanic and Atmospheric Administration, National Weather Service, National Tsunami Hazard Mitigation Program, at <http://nws.weather.gov/nthmp/>.

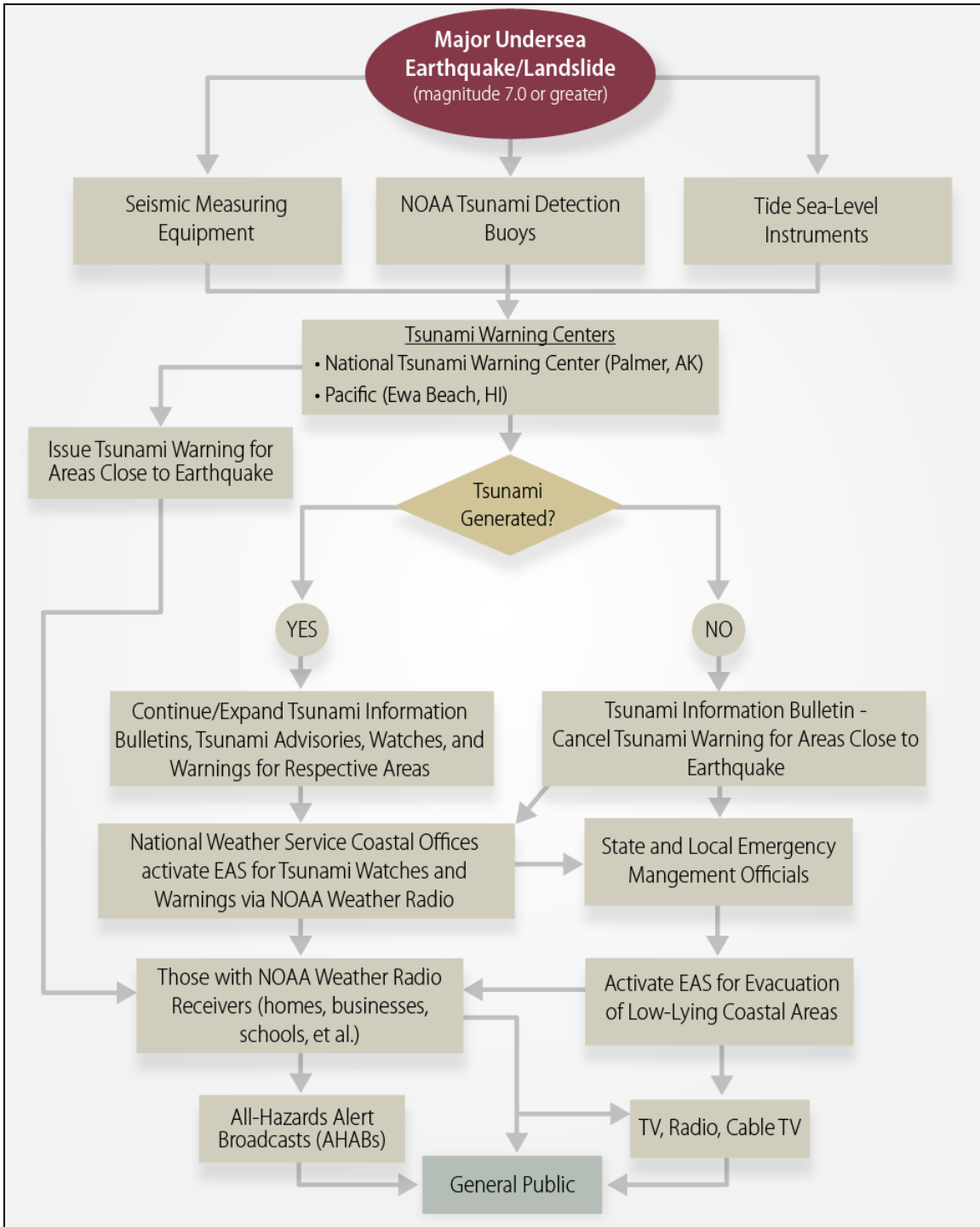
Detecting Tsunamis and Issuing Warnings

The tsunami warning centers monitor and evaluate data from seismic networks and determine if a tsunami is likely based on the location, magnitude, and depth of an earthquake.⁴ If a center determines that a tsunami is likely, it transmits a warning message to NOAA's weather forecasting offices and state emergency management centers, as well as to other recipients. The centers monitor coastal water-level data, typically with tide-level gauges, and data from NOAA's network of Deep-ocean Assessment and Reporting of Tsunamis (DART) detection buoys to confirm that a tsunami has been generated or, if one has not been generated, to cancel any warnings.⁵ **Figure 2** shows a generalized decision tree network for the earthquake-detection-through-warning process.

⁴ Nearly all tsunamis are triggered by subsea earthquakes, although some may be caused by underwater volcanic eruptions or landslides.

⁵ U.S. Government Accountability Office, *U.S. Tsunami Preparedness: NOAA Has Expanded Its Tsunami Programs, but Improved Planning Could Enhance Effectiveness*, GAO-10-490, April 2010, p. 5.

Figure 2. Flow Chart of the Tsunami Warning System



Source: National Oceanic and Atmospheric Administration (NOAA), *How Does the Tsunami Warning System Work?*, <http://www.tsunami.noaa.gov/images/warning-system-smaller.jpg>. Modified by CRS.

Note: EAS = Emergency Alert System.

The DART Buoy Network

NOAA first completed a six-buoy DART array in 2001 in the Pacific Ocean. Shortly after the 2004 Indian Ocean earthquake and tsunami that killed more than 200,000 people, Congress passed P.L. 109-424, the Tsunami Warning and Education Act, to enhance and modernize the existing Pacific Tsunami Warning System and broaden coverage, reduce false alarms, and increase the accuracy of forecasts and warnings, among other purposes. In part, the 2004 tsunami provided the impetus to expand and upgrade the DART system and to improve the U.S. capability to detect and issue warnings for tsunamis generally. As a result, the DART array was expanded to a total of 39 U.S. DART buoys in March 2008.⁶ (See **Figure 3**.) In addition, 8 other countries operate 21 additional DART buoys positioned near faults in the seafloor beneath the Indian and Pacific Oceans, bringing the global total to 60 buoys.⁷

As of January 20, 2015, 12 of the 39 U.S. buoys (31%) were not operational and were in need of repair. However, P.L. 109-424 requires that NWS ensure that maintaining operations of tsunami detection equipment is the highest priority within the tsunami forecasting and warning program at NOAA. Further, P.L. 109-424 requires the NOAA administrator to notify Congress⁸ within 30 days of (1) impaired regional forecasting capabilities due to equipment or system failures and (2) significant contractor failures or delays in completing work associated with the tsunami forecasting and warning system.⁹

According to NOAA, the inoperable stations would not prevent the issuance of tsunami warnings, which are primarily a function of seismic data from an earthquake or landslide, combined with location information about the event. However, lacking these stations could mean the warnings encompass a larger area than would be the case if all stations were operating, and it could lengthen the time a warning remains in effect. NOAA's current plan is to repair the majority of the stations in spring 2015 and to finish repairing all DART buoys by the end of September 2015.¹⁰

⁶ According to NOAA, 33 of the Deep-ocean Assessment and Reporting of Tsunami (DART) buoys are deployed in the Pacific Ocean and the rest are deployed in the Atlantic Ocean and the Caribbean. NOAA, National Data Buoy Center, "Deep-ocean Assessment and Reporting of Tsunamis (DART) Description," at <http://www.ndbc.noaa.gov/dart/dart.shtml>.

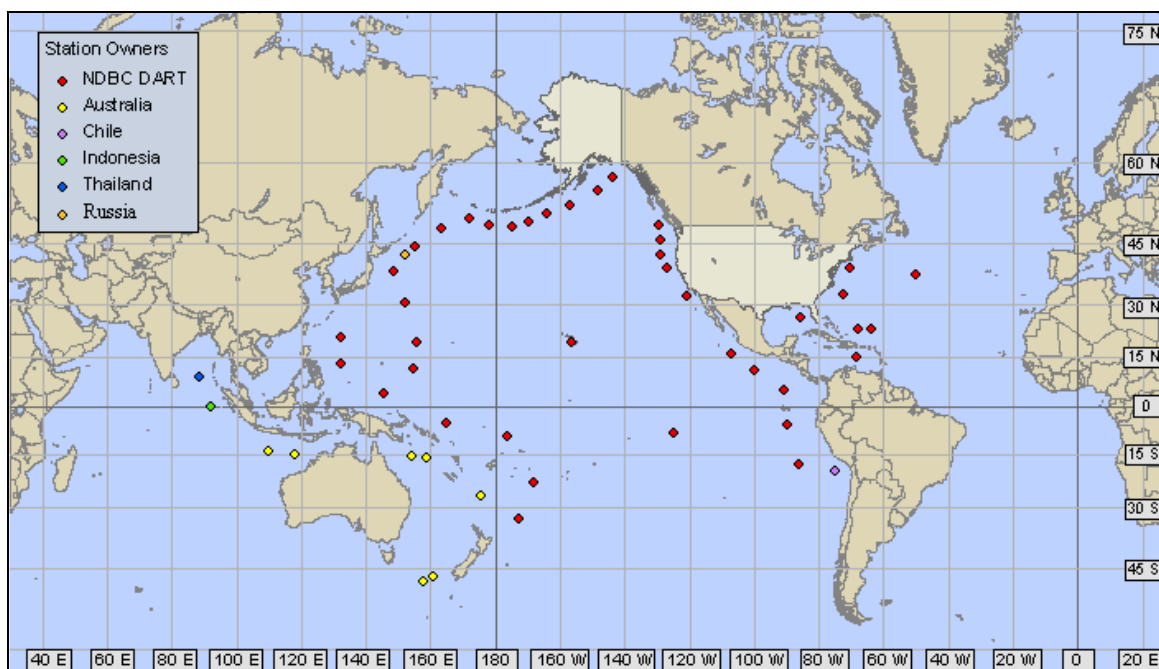
⁷ Personal communication from Mackenzie Tepel, Congressional Affairs Specialist, Office of Legislative and Intergovernmental Affairs, NOAA, January 16, 2015.

⁸ Specifically, P.L. 109-424 requires the NOAA administrator to notify the Committee on Commerce, Science, and Transportation in the Senate and the Committee on Science (now Science, Space, and Technology) in the House.

⁹ The statute does not define what is considered impairment of the forecasting abilities or specify a threshold for significant contractor failures or delays. However, the committee report accompanying the bill states that the NWS is required to notify Congress when the tsunami forecasting capabilities are impaired for more than three months; U.S. Congress, House Science, *United States Tsunami Warning and Education Act*, report to accompany H.R. 1674, 109th Cong., 2nd sess., 2006, H.Rept. 109-698, p. 10. The NWS uses an 80% operational threshold as its internal guideline; telephone conversation with Laura Furgione, Deputy Director, NWS, March 15, 2011.

¹⁰ Personal communication from Matthew Borgia, Congressional Liaison for Weather, Office of Legislative and Intergovernmental Affairs, NOAA, January 27, 2015.

Figure 3. Locations of Deep-ocean Assessment and Reporting of Tsunamis (DART) Buoys



Source: National Oceanic and Atmospheric Administration, National Data Buoy Center, at <http://www.ndbc.noaa.gov/dart.shtml>.

Note: The United States owns and operates 39 of the world's 60 DART buoys.

The National Tsunami Hazard Mitigation Program

According to NOAA, the National Tsunami Hazard Mitigation Program (NTHMP) was formed in response to the recognition of a tsunami threat to Oregon, Washington State, and Northern California from a large earthquake on the Cascadia subduction zone, which lies off the northwest coast of the United States and is capable of generating earthquakes as large as magnitude 9 or greater.¹¹

Among other activities, the NTHMP assists states in emergency planning and in developing maps of potential coastal inundation for a tsunami of a given intensity. The NTHMP also operates tsunami disaster outreach and education programs through NOAA's TsunamiReady¹² program.¹³ NOAA's primary goals for the NTHMP are as follows:

1. raise awareness of the affected population;

¹¹ Ibid.

¹² TsunamiReady is a NOAA/NWS program designed to help cities, towns, counties, universities, and other large sites in coastal areas reduce the potential for disastrous tsunami-caused damage. See <http://www.tsunamiready.noaa.gov/>.

¹³ NOAA, *National Tsunami Hazard Mitigation Program: 2013-2017 Strategic Plan*, May 21, 2013, p. 4, at <http://nws.weather.gov/nthmp/documents/NTHMPStrategicPlan.pdf>. See also NOAA, NWS, "TsunamiReady Helps Communities at Risk," at <http://www.tsunamiready.noaa.gov/>.

2. develop integrated tsunami maps and recognize models that can be used to develop improved warning guidance and evacuation maps;
3. improve tsunami warning systems; and
4. incorporate tsunami planning into state and federal multi-hazard programs.¹⁴

The Tsunami Warning and Education Act, P.L. 109-424, further focused the NTHMP and charged NOAA with addressing the nation's priorities in tsunami detection, warning, and mitigation. As authorized by P.L. 109-424, the NTHMP assumed responsibility for planning and executing NOAA's tsunami activities, namely detection, warning, forecasts, communication, outreach and education, and research.¹⁵ The program coordinates activities among NOAA organizational entities and outside partners.

Issues for Congress

Maintenance and availability of the DART buoy network have been key issues for Congress. In its report accompanying the FY2015 Commerce, Justice, Science, and Related Agencies appropriations bill, the House Appropriations Committee admonished NOAA for failing to maintain its own 80% availability standard for the network, despite receiving full funding in FY2014.¹⁶ In P.L. 109-424, Congress stated that “maintaining operational tsunami detection equipment is the highest priority within the program carried out under this Act.” This requirement also was included in a Senate bill that would have reauthorized the tsunami program in the 113th Congress, S. 2181. In the 114th Congress, H.R. 34, the Tsunami Warning, Education, and Research Act of 2015, which the House passed by unanimous consent on January 7, 2015, would modify that requirement somewhat, instead requiring that NOAA “ensure that the Administration’s operational tsunami detection equipment is properly maintained.” However, H.R. 34 includes language that would require the NWS to ensure that resources are available to fulfill the obligations of P.L. 109-424, which presumably would include maintaining the DART buoys.

In addition, there may be differing views in Congress about what constitutes “full funding” for the tsunami program. One of the contrasts between H.R. 34 and the legislation introduced in the 113th Congress, S. 2181, is the level of authorized appropriations in each bill. S. 2181 would have authorized one-third more funding per year—\$36 million versus \$27 million—and it would have done so for five years instead of the three years authorized by H.R. 34.

Another issue is whether NOAA is considering a third warning center and on what basis. Currently, the tsunami program includes two warning centers, the NTWC in Alaska and the PTWC in Hawaii. H.R. 34 would authorize the NWS to consider “any additional forecast and warning centers determined by the National Weather Service to be necessary.” It is not clear what

¹⁴ NOAA, NWS, “About the National Tsunami Hazard Mitigation Program (NTHMP),” at http://nws.weather.gov/nthmp/about_program.html.

¹⁵ Ibid.

¹⁶ U.S. Congress, House Committee on Appropriations, Subcommittee on Commerce, Justice, Science, and Related Agencies, *Commerce, Justice, Science, and Related Agencies Appropriations Bill, 2015*, 113th Cong., 2nd sess., May 15, 2014, 113-448 (Washington: GPO, 2014), p. 27.

the arguments are for siting a warning center in a particular geographic location, given that the DART buoy system and seismometer network are located in the Pacific Ocean, Atlantic Ocean, Caribbean, Gulf of Mexico, and other locations around the globe. However, there may be advantages to siting warning centers in tsunami-prone regions to take advantage of local or regional expertise and experience, and possibly to attract researchers to a particular region to bolster the understanding of the causes and consequences of tsunamis.

Reauthorization of the National Tsunami Hazard Mitigation Program in the 114th Congress

H.R. 34 would amend the Tsunami Warning and Education Act and authorize appropriations for the NTHMP through FY2017. Authorization for the program's appropriations in P.L. 109-424 expired in FY2012. H.R. 34 apparently would not make fundamental changes to the NTHMP, but it would broaden the program to include an additional focus on tsunami research and outreach, among other alterations. The Senate has not acted on the bill.

The following summarizes the changes H.R. 34 would make to P.L. 109-424 on a section-by-section basis.

Section 1: Short Title

H.R. 34 would add the term *research* to the title of the act.

Section 2: Definitions

P.L. 109-424 defined *NOAA* and the *NOAA administrator*. H.R. 34 would omit the section on definitions.

Section 3: Purposes

H.R. 34 would streamline and update the language in several subsections and add a new subsection (4) that focuses on research as part of the program: "to improve research efforts related to improving tsunami detection, forecasting, warnings, notification, mitigation, resiliency, response, outreach, and recovery."

Section 4: Tsunami Forecasting and Warning Program

H.R. 34 would streamline and update the language in several subsections and rename subsection (c) Tsunami Warning System (previously System Areas). This subsection would require the system to be capable of forecasting tsunamis in the Pacific, Arctic, and Atlantic Oceans, including the Caribbean Sea and Gulf of Mexico. Subsection (c) also would require a system that supports other international forecasting and warning efforts.

Subsection (d) explicitly names the NTWC (formerly the WC/AKTWC); includes a requirement that, to the extent practicable, the tsunami warning centers use a range of models to predict tsunami arrival times and flooding estimates; and adds four new subsections, 4(d)(3) through 4(d)(6). The new subsections would require a fail-safe warning capability, meaning the two

tsunami centers would perform back-up duties for each other. It also would require the tsunami warning centers to coordinate with the NWS; the NTHMP to develop uniform operational procedures for both centers; and NOAA to ensure that resources, including supercomputing resources, are made available to fulfill the obligations of H.R. 34.

Subsection (e) would omit requirements for a report to Congress regarding integration of the tsunami warning system with other U.S. observational systems and for a report to Congress on how technology developed under the tsunami research program is being transferred to operations.

H.R. 34 further would omit subsections (g) through (k) in Section 4 of P.L. 109-424.

Section 5: National Tsunami Hazard Mitigation Program

In subsection (a) of Section 5, H.R. 34 would require consultation with the Federal Emergency Management Administration and other agencies that NOAA deems relevant in conducting a community-based tsunami hazard mitigation program to improve tsunami preparedness and resilience in at-risk areas of the nation. Current law does not specify that NOAA consult with any particular agency.

Section 5 would omit subsection (b) of current law, which established a coordinating committee for the NTHMP,¹⁷ and would include expanded and modified requirements for program components as the new subsection (b). For example, subsection b(1) would require the NTHMP to provide technical and financial assistance to coastal states, territories, tribes, and local governments to develop and implement activities under Section 5.

Section 5 would add a new subsection (c) of authorized activities that the program may include, such as multidisciplinary vulnerability research, education, and training; risk management training for local officials and community organizations; development of applications for existing or emerging technologies; risk management, risk assessment, resilience data and information services; and risk notification systems.

Section 5 also would include a new subsection (d) that would allow states to designate at-risk areas in addition to those designated by the federal program based on knowledge of local conditions.

In addition, Section 5 would require a report on accreditation of the TsunamiReady program within 180 days of enactment. The report would indicate which authorities and activities would be needed to have the TsunamiReady program accredited by the Emergency Management Accreditation Program.¹⁸

¹⁷ Section 11(b) of H.R. 34 would establish the coordinating committee, similar to the one established by P.L. 109-424 (discussed in more detail below in “Section 11: Outreach Responsibilities”).

¹⁸ The Emergency Management Accreditation Program (EMAP) is a voluntary standards, assessment, and accreditation process for disaster preparedness programs in the United States. See <http://www.emaponline.org/>.

Section 6: Tsunami Research Program

H.R. 34 would modify the research program authorized under P.L. 109-424 in several ways. It would task NOAA with supporting and maintaining the research program in consultation with other federal agencies, state and territorial governments, academic institutions, the coordinating committee established in Section 11 (see “Section 11: Outreach Responsibilities”), and the scientific advisory committee established in Section 8 (see “Section 8: Tsunami Science and Technology Advisory Panel”).

Section 6 of H.R. 34 also would broaden the responsibilities of the research program; for example, the section specifies that the program shall consider other research to mitigate the impacts of a tsunami, including the improvement of near-field tsunami detection and forecasting abilities, which may include use of the Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys and NOAA supercomputers. In addition, Section 6 would add a new subsection to require development of the technical basis for validation of tsunami maps, numerical tsunami models, digital elevation models, and forecasts. Section 6 also would allow NOAA to launch a pilot project to examine a specific area, the Cascadia region along the northwest coast of the United States, and develop near-field tsunami forecasting capability for that region.

Section 7: Global Tsunami Warning and Mitigation Network

H.R. 34 would update the language of this section and require that NOAA coordinate with the U.S. State Department to provide technical assistance and training to the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific, and Cultural Organization and other international entities.

Section 8 of P.L. 109-424 authorized appropriations for the NTHMP. Section 7 of H.R. 34 would shift authorization of appropriations to Section 10 in the legislation and add new sections 8, 9, and 11 (discussed below). Section titles listed below reflect titles in H.R. 34 and not in existing law.

Section 8: Tsunami Science and Technology Advisory Panel

H.R. 34 would establish a new advisory panel in Section 8 by requiring the NOAA administrator to “designate an existing working group within the Science Advisory Board of the Administration to serve as the Tsunami Science and Technology Advisory Panel.” The panel would advise NOAA on tsunami science, technology, and regional preparedness. The panel would meet at least once every four years to review the tsunami-related activities of the federal government and would submit its review findings to NOAA, along with any recommendations. The NOAA administrator, in turn, would submit the panel’s report to the Senate Committee on Commerce, Science, and Transportation and the House Committee on Science, Space, and Technology.

Section 9: Report on Implementation of Tsunami Warning and Education Act

H.R. 34 would require that NOAA submit to Congress a report on progress in implementing the Tsunami Warning and Education Act with a detailed description of three sections of the proposed legislation:

- Section 4(d)(6), available resources—requirement that NOAA ensure that resources are available to fulfill the obligations in H.R. 34;
- Section 5(b)(6), dissemination of guidelines and standards for community planning; education; and training products, programs, and tools, including standards for mapping products, inundation models, and effective emergency exercises; and
- Section 6(b)(4), development of the technical basis for validation of tsunami maps, numerical tsunami models, and forecasts.

Section 9 also would require that the report to Congress include a description of the ways in which tsunami warnings and warning products issued by the program can be standardized and streamlined with warnings for other natural hazards, specifically hurricanes, coastal storms, and other coastal flooding events.

Section 10: Authorization of Appropriations

H.R. 34 would authorize appropriations for the tsunami activities for three years—FY2015 through FY2017—in the amount of \$27 million each year. As in current law, the bill specifies that no less than 27% of the amount appropriated would be for the NTHMP under Section 5 of the bill and that no less than 8% of the appropriated amount should be for the Tsunami Research Program under Section 6.

Section 11: Outreach Responsibilities

H.R. 34 would require NOAA to coordinate with state and local emergency managers to develop and carry out formal outreach activities with the goals of improving tsunami education and awareness and fostering the development of resilient communities. Section 11 also would reauthorize the NOAA administrator to convene a coordinating committee, originally established under Section 5(b) of P.L. 109-424, that would assist with the administration of the NTHMP. Section 11 would require the committee to have representatives from each of the states at risk from tsunamis in addition to other representatives that the NOAA administrator deems appropriate. The coordinating committee would contribute to the program as follows:

- provide feedback on how funds should be prioritized to carry out the NTHMP as established by Section 5 of P.L. 109-424 and modified by H.R. 34;
- ensure that the areas encompassed by the tsunami warning system in the Pacific, Arctic, and Atlantic Oceans, Caribbean Sea, and Gulf of Mexico have the opportunity to participate in the program;
- provide recommendations to the NOAA administrator on how to improve and advance the TsunamiReady program; and
- ensure that all components of the NTHMP are integrated with state-based hazard warning, risk management, and resilience activities.

Legislation in the Senate

The Senate has not acted upon H.R. 34 or introduced its own companion bill in the 114th Congress. In the 113th Congress, however, S. 2181—the Tsunami Warning and Education Reauthorization Act of 2014—was introduced and referred to the Senate Commerce, Science, and Transportation Committee. S. 2181 was similar to H.R. 34 as introduced in the 114th Congress, with some differences. The following section summarizes some of the differences between S. 2181 (113th Congress) and H.R. 34 (114th Congress).

One significant difference between the two bills is the amount and duration of appropriations authorization: S. 2181 would have provided a five-year authorization (through FY2019) at \$36 million per year. H.R. 34 would provide a three-year authorization (through FY2017) for a lesser annual amount of \$27 million per year. Both bills allocate the authorization in the same way by instructing that no less than 27% of the amount appropriated shall be for activities under the NTHMP and no less than 8% shall be for the Tsunami Research Program.

Another difference between the bills is the option in H.R. 34 for the NOAA administrator to develop a pilot project specifically for improving the forecast capability for tsunamis in the Cascadia region along the west coast of the United States. The Cascadia subduction zone lies offshore of Washington State, Oregon, and Northern California, and it has the potential to generate major earthquakes of similar magnitudes to the magnitude 9 Great Sendai Earthquake that struck Japan on March 11, 2011, and generated a devastating tsunami that killed thousands of Japanese citizens. Forensic evidence has shown that one of the world's largest earthquakes occurred along the Cascadia subduction zone in the year 1700, generated a large tsunami that struck the northwest coast of the United States, and traveled across the Pacific and damaged coastal villages in Japan.¹⁹ S. 2181 did not contain a similar provision for a pilot project.

Both H.R. 34 and S. 2181 include provisions to create a tsunami science and technology advisory panel to advise the NOAA administrator regarding tsunami science, technology, and regional preparedness. H.R. 34 would require that the panel review the tsunami program activities and provide a report to Congress at least once every four years. S. 2181 would have required a similar review and report more frequently, at least once every two years. The reports would be submitted to the Senate Commerce, Science, and Transportation Committee and the House Science, Space, and Technology Committee.

Funding for the Tsunami Program

For FY2015, the Senate Appropriations Committee instructed NOAA to maintain funding at the FY2014 level for the NTHMP.²⁰ The committee report rejected a proposal from NOAA to terminate funding for tsunami preparedness within the program. The House Appropriations

¹⁹ U.S. Geological Survey, Earthquakes Hazards Program, *Historic Earthquakes-The M9 Cascadia Megathrust Earthquake of January 26, 1700*, http://earthquake.usgs.gov/earthquakes/states/events/1700_01_26.php.

²⁰ U.S. Congress, Senate Committee on Appropriations, Subcommittee on Commerce, Justice, Science, and Related Agencies, *Departments of Commerce and Justice, and Science, and Related Agencies Appropriations Bill, 2015*, 113th Cong., 2nd sess., June 5, 2014, 113-81 (Washington: GPO, 2014), pp. 43-44.

Committee instructed NOAA to allocate \$27 million for the NTHMP.²¹ According to NOAA, \$27 million represents “full funding” for the program.²² The House report noted that the funding amount fully supports planned maintenance for the DART buoy network (discussed above) and that the committee expects NOAA to maintain availability at no fewer than 80% of the stations. (Currently, fewer than 70% of the stations are operational, as noted above.) In addition, the House report included instructions to include \$6 million above NOAA’s request for FY2015 to restore Administration-proposed reductions to tsunami grant funds.

Funding for the NOAA tsunami program historically has supported three main categories of activities: (1) *warning*, such as the activities of the tsunami warning centers and DART network; (2) *mitigation*, such as the activities of the NTHMP; and (3) *research*, including activities conducted by the Pacific Marine Environmental Laboratory and the National Buoy Data Center.²³ In the NOAA budget, these activities have been cross-cutting among different activities under the NWS line item. The Government Accountability Office (GAO), which analyzed funding data for the three general categories in 2010, noted that total funding for all these activities ranged from \$5 million to \$10 million annually between FY1997 and FY2004 but increased after the 2004 Indian Ocean tsunami from approximately \$27 million in FY2005 to \$42 million in FY2009. According to GAO, the proportion of funding allocated to warning activities increased from about 40% of the total in FY2004 to approximately 70% of the funding in FY2009.²⁴ The proportion allocated to mitigation decreased from approximately 50% of the total in FY2004 to about 30% in FY2009, whereas the proportion for research remained steady between about 6% and 10%.

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²¹Ibid., p. 27.

²² Personal communication from Matthew Borgia, Congressional Liaison for Weather, Office of Legislative and Intergovernmental Affairs, NOAA, January 27, 2015.

²³ U.S. Government Accountability Office, *U.S. Tsunami Preparedness: NOAA Has Expanded Its Tsunami Programs, but Improved Planning Could Enhance Effectiveness*, GAO-10-490, April 28, 2010, p. 7.

²⁴ Ibid., p. 8.