COMMENTS

TRISTAN TELLIER*

Flood Risk Management: The Burden on Local Governments to Combat Sea Level Rise

Introduction 314
I. Brief History of Flood Prevention in the Netherlands 315
A. Port of Rotterdam 317
B. North Sea Flood of 1953 319
1. Delta Works 320
C. The Delta Programme 322
II. Flood Prevention Funding in the United States 324
A. National Oceanic and Atmospheric Administration 324
B. Federal Funding for Port Infrastructure 326
1. Port Infrastructure Development Program 326
2. PROTECT Program 327
C. Federal Emergency Management Agency 328
D. Federal Flood Risk Management Standards 329
III. Port of Houston 331
A. History 332
B. Environmental Concerns 334
C. Galveston Bay 336
IV. The Future of Flood Risk Management 339
A. Coastal Texas Project 341
Conclusion 344

* Tristan H. Tellier graduated from the University of Oregon School of Law in 2025. He extends his thanks to Professor Adams-Schoen for her thoughtful assistance in the early stages of this Comment, and to the diligent editors and staff of the Journal of Environmental Law and Litigation.

INTRODUCTION

The risk of flooding around port cities across the United States has grown exponentially over the last two centuries, and this incessant issue requires federal government intervention to mitigate and prevent looming environmental and financial disasters. Ocean shipping is the primary mode of transport for globally traded goods, with 90% of global trade conducted through ports.[1] Although the shipping industry accounts for roughly only 3% of total greenhouse gas emissions,[2] the collective effects of climate change around the world continue to pose hazards to ports. Warming ocean temperatures, the subsequent melting of polar ice caps, and the increased frequency and intensity of coastal storms in the American Southeast have caused surges in sea level heights near crucial port cities in the region. Annual climate assessment reports, highlighting sea level rise around economically vital ports, are necessary to better protect the American Southeast from future financial catastrophes. A federal port commission or agency tasked with developing comprehensive coastal resiliency strategy plans and with the ability to offer streamlined funding would be another step in the right direction toward adequate flood risk management.

The Netherlands' Delta Programme, which is designed to help its federal government combat sea level rise, offers a potential model for nationally funded coastal resiliency projects. Federal projects in the United States lack uniformity, with current funding provided by multiple agencies primarily through the Infrastructure Investment and Jobs Act. Accordingly, this Comment compares the Delta Programme with the patchwork of bipartisan funding for port infrastructure projects in the United States and uses current projects near Port Houston and Galveston Bay as a case study to identify the progress and shortcomings related to the current federal funding system.

The argument for federal government accountability has never been stronger, and this Comment urges the creation of a federal commission on coastal resiliency near our most vulnerable commercial ports. With a potential overhaul of the Federal Emergency Management Agency (FEMA) taking shape, it is imperative that the federal government

1 *Ocean*, OECD, https://www.oecd.org/ocean/topics/ocean-shipping/ (on file with the Journal of Environmental Law and Litigation) (last visited Jan. 15, 2026); Furhana Husani, *A Reintroduction to the Maritime Industry*, WATERFRONT ALL.: WATERWIRE (Jan. 29, 2025), https://waterfrontalliance.org/2025/01/29/a-reintroduction-to-the-maritime-industry/ (on file with the Journal of Environmental Law and Litigation).

2 *Id.*

take preemptive measures to prevent flooding around our most economically vital commercial ports. As rising sea levels continue to push American cities to elevations below sea level, it is critical to analyze the governance strategies used by other parts of the world that are already at or below sea level.

I
BRIEF HISTORY OF FLOOD PREVENTION IN THE NETHERLANDS

The Netherlands, historically known as the "low countries,"[3] is a Western European country situated along the North Sea, with an average elevation of thirty meters and roughly 26% of its land below sea level.[4] As the third-lowest country by elevation, behind only Qatar and the Maldives,[5] Holland comprises an incredibly large area of reclaimed land protected by dikes, also known as "polders," within its coastal lowlands. Due to its overwhelmingly flat topography, more than half of the Netherlands is at risk of flooding.[6] The Netherlands is also situated on four river deltas, which makes it inherently vulnerable to flooding.[7] A survey conducted by Statistics Netherlands, a Dutch governmental institution, reported that 71% of Dutch adults were concerned about the risk of significant flooding in the near future, and 76% were concerned about the impact of climate change on future generations.[8] However, this issue has been a topic of discussion in the Netherlands for centuries. The ongoing fight against the sea has a long history within the Netherlands, and the installation of dikes, as a means of controlling sea level, became common practice during the Iron Age.[9] The issue became far more pressing in the coastal regions of Flanders, Zeeland, and Friesland during the High Middle Ages, and a series of

3 *Netherlands*, MERRIAM-WEBSTER DICTIONARY (11th ed. 2003).

4 *Correction Wording Flood Risks for the Netherlands in IPCC Report*, PBL NETH. ENV'T ASSESSMENT AGENCY, https://www.pbl.nl/en/correction-wording-flood-risks-for-the-netherlands-in-ipcc-report [https://perma.cc/V2JY-YKLG] (last visited Nov. 15, 2025).

5 *The World Factbook*, CENT. INTEL. AGENCY, https://www.cia.gov/the-world-factbook/field/elevation/ [https://perma.cc/4MLL-FVXK] (last visited Nov. 15, 2025).

6 PBL NETH. ENV'T ASSESSMENT AGENCY, *supra* note 4.

7 *The Delta Act: Reinventing the Dutch Approach to Coastal Management*, CTR. FOR PUBLIC IMPACT (Sept. 2, 2019), https://www.centreforpublicimpact.org/case-study/delta-act-reinventing-dutch-approach-coastal-management [https://perma.cc/U2E8-XRC3].

8 *Three-Quarters of Dutch Adults Worry About Impact of Climate Change*, STAT. NETH. (Nov. 28, 2023, at 15:00 PST), https://www.cbs.nl/en-gb/news/2023/48/three-quarters-of-dutch-adults-worry-about-impact-of-climate-change [https://perma.cc/8EBY-8PYR].

9 ERIC-JAN PLEIJSTER ET AL., DUTCH DIKES 147 (Nai Publishers, 1st ed. 2014).

dikes, levees, and primitive sea walls were constructed in response to land lost to coastal erosion.[10]

The reclamation of marshland in the peat-bog area of Holland, which was lost to coastal erosion, began in the eleventh century, when the Dutch began building dikes along the present-day Markermeer, IJmeer, and IJsselmeer.[11] Hollanders adopted the Frisian method of marshland reclamation, which consisted of digging drainage ditches to lower the water table, leaving the ground dry enough for cattle grazing and arable farming.[12] The reclamation process took centuries to realize, and by the thirteenth century, a large area of land in the Holland-Utrecht peat-bog plain was made available for agriculture.[13] This process facilitated the rise of nonagricultural towns focused on other industries, allowing Holland to develop a nonfeudal social structure through trade and cooperation.[14] These changes in flood mitigation and prevention techniques led to one of the most important fundamental changes in Dutch governance:

> In Flanders, Zeeland, Holland, and Utrecht this struggle against the sea and the inland water was particularly noteworthy in that it led to the foundation of water boards, which in the 13th and 14th centuries were amalgamated to form higher water authorities (the *hoogheemraadschappen*). Mastery over the water had to be carried out on a large scale and in an organized fashion; the building of dikes required a higher authority and coordinated labour. Thus, various organizations emerged, acting independently in the field of canal and dike building and maintenance and responsible only to the government itself. These were *communitates*, with their own servants and their own managements (dike reeves and *heemraden*) and empowered to take necessary measures to maintain the waterworks, administer justice, and issue proclamations. This included the levy of taxes for this purpose, under the exclusive control of the landholders, who had to contribute proportionally to the area they possessed. The need of absolute solidarity, imposed by geography, thus created a system of communal organization based on full participation and equality exceptional in European terms. In the core of Holland, three large *hoogheemraadschappen* controlled the whole territory. They

10 C. van de Kieft, Wim Blockmans & Leendert P. Louwe Kooijmans, *The Development of the Territorial Principalities and the Rise of the Towns (925–c. 1350)*, ENCYC. BRITANNICA (July 29, 2022), https://www.britannica.com/topic/history-of-the-Low-Countries-prehistoric-times-to-1579-2157575/The-development-of-the-territorial-principalities-and-the-rise-of-the-towns-925-c-1350 [https://perma.cc/UNZ4-T4GM].

11 PLEIJSTER ET AL., *supra* note 9, at 150.

12 Kieft, Blockmans & Kooijmans, *supra* note 10.

13 *Id.*

14 *Id.*

> were headed by dike reeves who also were the count's bailiffs and thus functioned as high judges and administrators. They were assisted by *heemraden* elected by the landholders.[15]

Despite their efforts in protecting land from coastal erosion, St. Lucia's flood tore down most of the newly constructed dikes and seawalls in 1287.[16] One of the worst natural disasters in European history, St. Lucia's flood killed an estimated 50,000 to 80,000 people.[17] Morbidly ironic, however, this heavy storm over the North Sea flooded the Zuiderzee inlet and created direct sea access to Amsterdam, which allowed the city to develop into the major global hub it is today.[18] Nevertheless, these newly established water authorities became the governing body of local ports in the Netherlands. The governance structure changed over the years, and approximately 2,650 water authorities existed by 1950.[19] Today, there are currently twenty-one regional water authorities in the Netherlands,[20] which are overseen by the twelve provincial boards.[21] The provinces are, in turn, supervised by the Minister of Infrastructure and Water Management, a member of the Dutch Cabinet who oversees the Royal Netherlands Meteorological Institute, sets the national water policy, and creates guidelines with regard to water systems.[22] The Minister also sets national flood protection standards and regulates regional and provincial flood defense systems.[23]

A. Port of Rotterdam

Located in the Province of South Holland, the Port of Rotterdam (Port Rotterdam) is the largest deep-water port in Europe and among

---

15 *Id.* (British spelling in original).

16 *Zuiderzee Floods*, ENCYC. BRITANNICA (Dec. 7, 2025), https://www.britannica.com/event/Zuiderzee-floods [https://perma.cc/UV7K-U2ZL].

17 *Id.*

18 *Id.*

19 HERMAN HAVEKES ET AL., THE DUTCH WATER AUTHORITY MODEL 18 (Dutch Water Authorities 2017).

20 *Id.* at 9.

21 *Water Management in the Netherlands*, GOV'T OF THE NETH., https://www.government.nl/topics/water-management/water-management-in-the-netherlands [https://perma.cc/SZZ3-8GSY] (last visited Nov. 15, 2025).

22 *Id.*

23 *Id.*

the ten largest globally.[24] Initially constructed as a fishing port in the fourteenth century, Port Rotterdam became a major commercial port in the nineteenth century when the Nieuwe Waterweg was dug in 1872.[25] This waterway allowed Port Rotterdam to accommodate large-scale commercial ships, and by 1940, the port became one of Europe's main oil transshipment and processing facilities.[26] The economic rise of Port Rotterdam made it a prime target during World War II. During Germany's invasion of the Netherlands in May 1940, Rotterdam was severely damaged by German Luftwaffe bombings during the Rotterdam Blitz.[27]

Reconstruction of the port during the postwar era led to its modernization and the creation of new facilities in the Botlek area.[28] Reclamation of land, south of the Nieuwe Maas river, allowed for the development of the Europoort complex, "which shortly afterwards became the heart of Europe's petrochemical and oil-refining industry."[29] With the addition of the Europoort, Port Rotterdam surpassed New York to become the busiest port in the world during the 1960s.[30] Rapid expansion into the Maasvlakte area during the 1980s further solidified Port Rotterdam as Europe's most economically vital commercial port.[31]

Total cargo transported through Port Rotterdam in 2023 amounted to 438.8 million tonnes, which generated 841.5 million euros in revenue.[32] The port currently employs approximately 1,300 people, generates over 500,000 jobs, and provides an added value of over sixty billion euros for the Netherlands.[33] Accounting for 3.2% of the

---

24 *Rotterdam, Netherlands*, UNIS, https://www.unisco.com/international-ports/rotterdam-netherlands [https://perma.cc/R9KS-NPJ6] (last visited Jan. 16, 2026).

25 THEO NOTTEBOOM, ATHANASIOS PALLIS & JEAN-PAUL RODRIGUE, PORT ECONOMICS, MANAGEMENT AND POLICY 235 (Routledge 2022).

26 *Id.*

27 HUBERT SLINGS, A KEY TO DUTCH HISTORY: THE CULTURAL CANON OF THE NETHERLANDS 204 (Amsterdam University Press 2007).

28 *The History of the Port of Rotterdam*, WE BUILD VALUE (July 29, 2024), https://www.webuildvalue.com/en/infrastructure-news/port-of-rotterdam.html [https://perma.cc/LTG2-F6VD].

29 *Id.*

30 *Id.*

31 *Id.*

32 *Port of Rotterdam in Full Transition in 2023*, PORT OF ROTTERDAM (Feb. 20, 2024), https://www.portofrotterdam.com/en/news-and-press-releases/port-of-rotterdam-in-full-transition-in-2023 [https://perma.cc/5FFD-7QVC].

33 *Id.*

Netherlands' gross domestic product (GDP), Port Rotterdam sees "approximately 28,000 seagoing vessels and 90,000 inland vessels annually."[34] The current size of the port is just under 31,000 acres, and it stretches over forty kilometers in length.[35]

Port Rotterdam is one of the most flood-resilient ports in the world. However, scientists estimate that the sea level around Port Rotterdam could rise to 3.9 feet by 2100.[36] The intermediate scenarios suggest that the sea level in the North Sea will rise around 2 to 2.5 feet by 2100.[37]

B. North Sea Flood of 1953

On January 31, 1953, the Netherlands experienced a devastating flood in the southwest region of the country, near Port Rotterdam, which prompted the Dutch Parliament to introduce new regulations to better protect itself from future disasters.[38] The damage caused by the North Sea Flood of 1953 was immediately evident:

> The area that suffered the most direct hit was the Delta region, between Vlissingen and Hook of Holland. In total 187 km of sea defense was damaged, of which 48 km seriously. Most damage was caused by water flowing over the crest of the dikes and eroding the inner slope. Most breaches were found along the southern shores of the islands, where the freeboard of the dikes was less. (The dikes facing N and NW were designed higher so as to cope with wave run-up expected mainly from the NW.) Many deep polders were inundated to a depth of more than 5 m, most in the first night, but some later when sleeper dikes failed. In the meantime, the local people attempted to save their lives on roofs, in trees and on high spots. Others worked very hard to protect failing dikes and to repair breaches before they could grow into gullies.[39]

---

34 *Id.*

35 *Id.*

36 *Adaptation Strategy for Flood Risk Management*, PORT OF ROTTERDAM, https://www.portofrotterdam.com/sites/default/files/2023-04/adaptation-strategy-for-flood-risk-management-port-of-rotterdam.pdf [https://perma.cc/CL9V-94PF] (last visited Nov. 16, 2025).

37 *Id.*

38 *Delta Programme: Flood Safety, Freshwater and Spatial Adaptation*, GOV'T OF THE NETH., https://www.government.nl/topics/delta-programme/delta-programme-flood-safety-freshwater-and-spatial-adaptation [https://perma.cc/UG9Z-N7GC] (last visited Nov. 16, 2025).

39 Kees d'Angremond, *From Disaster to Delta Project: The Storm Flood of 1953*, TERRA ET AQUA, Mar. 2003, at 3, 4.

Over 400,000 acres were flooded, roughly 9% of the Netherlands, resulting in over 1,800 deaths and large-scale property damage.[40] Less than three weeks after the flood, on February 18, 1953, the Dutch Cabinet established the Delta Committee "to advise the Government on measures to be taken to prevent such a disaster in the future."[41]

1. Delta Works

Over the course of the next seven years following the North Sea Flood, the newly formed Delta Committee published five interim reports, which formed the basis for the legislation comprising the closure of the inlets in the southwest region of Holland.[42] The Delta Law was passed by the Dutch Parliament on November 5, 1957, and published on May 8, 1958.[43] The final committee report was published in 1960, and proposals set forth by the Delta Committee became known as the "Delta Works" project.[44] Revolutionary in coastal engineering design, the final report called for the required safety level of coastal areas to be "based on a comparison between the economic damage owing to failure of seawalls and the cost of strengthening the coastal defense works."[45] The report also set national guidelines for sea defense systems around port cities and other densely populated areas, mandating that the country's systems be able to withstand a return period, or flood recurrence interval, with a probability of exceedance of 10^{-4} per year.[46] In statistics, this formula for storm surges is known as the Weibull distribution, and a probability of exceedance of 10^{-4} per year translates to a one in 10,000-year chance. While an event like this is difficult to predict, the Netherlands has developed experimental facilities to test storm protection methods against extreme hypothetical scenarios.[47]

To achieve these ambitious safety goals, the Delta Committee recommended closing numerous inlets, constructing secondary dams in the Volkerak, Grevelingen, and Zandkreek, and renovating all

40 *North Sea Flood*, ENCYC. BRITANNICA (Jan. 24, 2025), https://www.britannica.com/event/North-Sea-flood [https://perma.cc/9B7C-EW4Z].

41 d'Angremond, *supra* note 39, at 3.

42 *Id.* at 6–7.

43 *Id.* at 7.

44 *Id.* at 6.

45 *Id.*

46 *Id.*

47 *Id.*

remaining dikes.[48] However, the final report highlighted three major works to be completed within twenty-five years.[49] The most controversial project, and largest of the three, was the closure of the Oosterschelde, a large estuary located in the province of Zeeland. Environmental concerns were raised over the potential loss of the oyster beds near Yerseke, and the issue quickly became a topic of debate during the 1973 parliamentary elections.[50] As a result of these concerns, the Delta Committee reconvened, a new coalition cabinet was formed, and the project was redesigned to take into account these environmental concerns over the oyster beds near Yerseke:

> After ample consideration, a compromise was achieved: instead of completely closing the Oosterschelde Estuary, a storm-surge barrier would be constructed in the mouth. During normal tidal conditions this barrier would reduce the tidal amplitude to a level that was considered adequate for the oyster cultures. During storms the barrier could be closed to provide the desired safety. In the upper reaches of the estuary, some compartment dams would be built to separate the Rhine-Scheldt canal from the now tidal Oosterschelde, and to reduce high current velocities in the Krammer. Although the new plan was far more costly than the old one, the idea was received favorably. This marked the dawn of a new age in which environmental impact assessments would become an integral part of any construction and dredging projects.[51]

The closure of the Oosterschelde Estuary was completed in 1986, marking the end of the Delta Works project.[52] In the three decades following the North Sea Flood, the Dutch successfully finished the construction of thirteen dams, four barriers, nine secondary dams, and several surrounding dikes, thus creating the largest flood protection system in the world.[53] In 1994, the Delta Works project was recognized by the American Society of Civil Engineers as one of the Seven Wonders of the Modern World.[54] Engineers around the world nominated these projects as the greatest civil engineering achievements

---

48 *Id.* at 7.

49 *Id.*

50 *Id.* at 8.

51 *Id.*

52 *Id.* at 9.

53 *Delta Works*, ENCYC. BRITANNICA (June 23, 2022), https://www.britannica.com/event/Delta-Works (on file with the Journal of Environmental Law and Litigation).

54 *Seven Wonders of the Modern World*, AM. SOC'Y OF CIV. ENG'RS (Apr. 2, 2010), https://web.archive.org/web/20100402072318/http://www.asce.org/history/seven_wonders.cfm [https://perma.cc/4HPT-GR2K].

of the twentieth century.[55] The Netherlands disbanded the Delta Committee upon the completion of the two remaining flood barriers in 1997. However, as times changed and the environmental effects from the destroyed estuaries were reconsidered, the Netherlands sought to create a more cohesive, environmentally responsible program that could adapt quickly to rising sea levels, while maintaining adequate budgets for proposed projects.

C. The Delta Programme

Concerns over the Netherlands' coastal resiliency strategies grew in the mid-2000s, and in 2007, the Dutch Cabinet established a second Delta Committee and appointed the former Minister of Agriculture, Cees Veerman, to lead the initiative.[56] The Dutch Cabinet also appointed other government officials and scientists to the second Delta Committee "to evaluate whether the Netherlands would cope in the most extreme projected climate scenarios."[57] In September 2008, the Delta Committee released its first report of recommendations, and in response, the Dutch Cabinet created the Delta Programme to manage flood risk, freshwater supply, and analyze the long-term impact of rising sea levels.[58] The first Delta Programme report was presented to the Dutch Parliament in September 2010, and an annual report has been presented to parliament every year since.[59] In its inaugural report, the Delta Commission made twelve recommendations for how the Netherlands should protect itself from flooding, which the national government then adopted through a second Delta Act.[60]

While the first Delta Law outlined specific projects that were to be completed within mandated timelines, the second Act, passed into law in 2012, set forth greater requirements for the newly formed Delta Programme and was amended into the Dutch Constitution to "ensure commitment to the programme's ongoing work."[61] Article 4.9, Section 2, of the Delta Act defines the programme's objectives as "[m]easures

55 *Id.*

56 *Delta Commission*, NAT'L DELTA PROGRAMME, https://english.deltaprogramma.nl/delta-programme/delta-commission [https://perma.cc/L5BB-5T6K] (last visited Jan. 16, 2026).

57 CTR. FOR PUBLIC IMPACT, *supra* note 7.

58 MINISTRY OF INFRASTRUCTURE & WATER MGMT., 2024 DELTA PROGRAMME: NOW FOR THE FUTURE (2023).

59 CTR. FOR PUBLIC IMPACT, *supra* note 7.

60 *Id.*

61 *Id.*

and provisions of national importance for the prevention and, if necessary, mitigation of floods and water shortage" and "[m]easures and provisions for the protection or improvement of the chemical and ecological quality of water systems, in as far as these are part of the aforementioned challenges."[62]

A comparison between the Netherlands' Delta Programme and current flood prevention standards in the United States shows how necessary it is to have a federal commission, equipped with both research and resiliency project funding budgets, to combat sea level rise near economically vital commercial ports. Section 2.1.2 of the 2024 Delta Programme report constitutes the "Sea Level Rise Knowledge Programme,"[63] which was created in 2019 by the Delta Commission and the Minister of Infrastructure and Water Management[64] to "establish a clearer picture of the possible consequences of accelerated sea level rise on flood risk management."[65] The Sea Level Rise Knowledge Programme synthesizes external reports conducted by governmental agencies and universities and examines updated laws mandating projects to determine what changes are necessary to improve flood resilience in the Rotterdam area of the Netherlands.[66]

One of the central ideas behind the Delta Act is to ensure national government accountability. One of its mandates requires the commissioner to provide parliament with a detailed plan each September, on the opening day of parliament. In the Netherlands, this is known as either "budget day" or "Prince's Day."[67] The annual report provides ministers and other members of parliament with "up-to-date recommendations needed to protect the Netherlands [from] . . . flooding."[68] These recommendations highlight weak points in current flood protection standards and methods, as well as identify the most proactive measures to prevent flooding. These proactive measures are funded through national taxes that go directly to the Delta Fund, which the Delta Act established.[69] The Committee bases its

62 *Id.*

63 MINISTRY OF INFRASTRUCTURE & WATER MGMT., *supra* note 58, at 37–38.

64 *Id.* at 37.

65 *Id.*

66 *Id.* at 38.

67 CTR. FOR PUBLIC IMPACT, *supra* note 7.

68 *Id.*

69 *Id.*

recommendations largely on scientific evidence from the Royal Netherlands Meteorological Institute and the Intergovernmental Panel on Climate Change.[70] The Delta Programme develops flood prevention projects in the Netherlands through research compiled by the Committee, and the national government fully finances *all* measures recommended by the Delta Programme through the Delta Fund.[71] The Delta Fund is expected to have 27.4 billion euros available for Delta Programme projects through 2050.[72]

II
FLOOD PREVENTION FUNDING IN THE UNITED STATES

Historically, the Federal Emergency Management Agency (FEMA) has retroactively funded flood prevention projects in the United States through its administration of disaster recovery and rebuilding efforts following extreme weather events. However, the Department of Defense, through the United States Army Corps of Engineers (USACE), and the Department of Transportation's Maritime Administration (MARAD) are responsible for funding various proactive flood prevention and coastal resiliency projects near American port cities. The National Oceanic and Atmospheric Administration (NOAA), an agency within the Department of Commerce, is tasked with compiling data regarding sea level rise and the effects of climate change on coastal communities. All of these agencies are responsible for funding various proactive projects around American coastal areas, and current grants are primarily being distributed through the Infrastructure Investment and Jobs Act (Bipartisan Infrastructure Law), which Congress passed in 2021 during the Biden Administration.[73] Unlike the Netherlands' Delta Programme, the United States is reliant upon a patchwork of federal and local governments to develop comprehensive coastal resiliency strategies and to fund projects aimed at combating sea level rise.

A. National Oceanic and Atmospheric Administration

NOAA is a federal regulatory and scientific agency that oversees six important line offices: (1) National Marine Fisheries Service (NMFS);

---

70 *Id.*

71 *Id.*

72 *Delta Fund*, GOV'T OF THE NETH., https://english.deltaprogramma.nl/delta-programme/delta-fund [https://perma.cc/6CJ7-PMQ7] (last visited Nov. 16, 2025).

73 Infrastructure Investment and Jobs Act, Pub. L. No 117-58, 135 Stat. 429 (2021).

(2) National Ocean Service (NOS); (3) National Environmental Satellite, Data, and Information Service (NESDIS); (4) National Weather Service (NWS); (5) Office of Marine & Aviation Operations (OMAO); and (6) Office of Oceanic & Atmospheric Research (OAR).[74] A subsidiary of NOS, the Office for Coastal Management, is tasked with developing the National Coastal Zone Management Program and the Natural Estuarine Research Reserve System.[75] Through these programs, NOAA is able to track the mean sea level (MSL) in different parts of the country and publish data compiled by scientists at various research institutions.

In fiscal year 2023, the Office for Coastal Management launched the "Climate Resilience Regional Challenge," a new competitive grant program with funding through the Inflation Reduction Act that made $575 million available to resiliency projects in qualifying coastal areas.[76] Concurrently, the Office for Coastal Management was tasked with distributing $832 million over a period of five years from the Bipartisan Infrastructure Law,[77] and in 2023, the office awarded $109 million "to support restoration and conservation projects through the National Coastal Zone Management Program and the National Estuarine Research Reserve System."[78] NOAA also established the National Coastal Resilience Fund, which highlights the making of a federal coastal resiliency program:

> Using infrastructure law funds, the National Coastal Resilience Fund, a partnership between NOAA and the National Fish and Wildlife Foundation, invested approximately $144 million, along with their annual appropriation, for 96 projects that will help communities prepare for increasing coastal flooding and more intense storms while improving coastal habitats. And approximately $21 million in infrastructure law funds was awarded to support regional ocean

74 *Organization*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.noaa.gov/about/organization [https://perma.cc/VJB3-88R3] (last visited Nov. 16, 2025).

75 *Office for Coastal Management*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.coast.noaa.gov/ [https://perma.cc/A2JL-WXRQ] (last visited Nov. 16, 2025).

76 *Office for Coastal Management: NOS Fiscal Year 2023 Year in Review*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/annualreport/2023/ocm.html [https://perma.cc/62SP-MFM7] (last visited Nov. 16, 2025).

77 Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429 (2021).

78 *Id.*

> partnership projects and data sharing, including four awards to tribes to enhance their ability to engage with regional ocean partnerships.[79]

Despite NOAA being the primary federal administration conducting research into sea level rise, funding for coastal resiliency projects around American ports has been delegated to a number of other agencies under the Bipartisan Infrastructure Law. The funds that came from the Bipartisan Infrastructure Law are statutorily required to be distributed by these agencies for different projects and purposes, but this process has created new challenges for port cities that desperately need to secure significant federal funding to adequately mitigate the inevitable sea level rise. The lack of streamlined funding has left these cities to look for funding elsewhere, primarily through state and local taxes.

B. Federal Funding for Port Infrastructure

The Environmental Protection Agency (EPA) lists forty-five general federal funding opportunities for ports and near-port communities, with an additional forty-five area-specific federal grants.[80] These federal funding opportunities, listed by the EPA, are offered through five different departments and agencies: (1) Department of Commerce, (2) Department of Defense, (3) Department of Energy, (4) Department of Transportation, and (5) Environmental Protection Agency.[81] It is important to note, however, that this list provided by the EPA is "not an all-inclusive list as there may be other federal, state, regional, or local funding opportunities that are not listed."[82] While these funds are critical to preventing catastrophic sea level rise near American ports, they lack uniformity, and it often takes years for port authorities to secure proper federal funding.

1. Port Infrastructure Development Program

The most important federal grant program for the purposes of combating sea level rise around commercial ports is MARAD's Port Infrastructure Development Program (PIDP). A discretionary

---

79 *Office for Coastal Management: NOS Fiscal Year 2023 Year in Review*, *supra* note 76.

80 *Funding Opportunities for Ports and Near-Port Communities*, ENV'T PROT. AGENCY (Nov. 5, 2025), https://www.epa.gov/ports-initiative/funding-opportunities-ports-and-near-port-communities [https://perma.cc/TU3V-4VHL].

81 *Id.*

82 *Id.*

grant program administered by MARAD, PIDP grants are awarded to "projects that improve the safety, efficiency, or reliability of the movement of goods into, out of, around, or within a port."[83] Congress established the PIDP in 2010, through the National Defense Authorization Act, and as part of the legislation, the Office of Port Infrastructure Development was to be established within MARAD.[84] The Bipartisan Infrastructure Act provided $2.25 billion to PIDP in 2022, to be paid out each fiscal year until 2026, with $450 million being made available in 2025.[85] On November 3, 2023, MARAD announced over $653 million in grants to fund forty-one port improvement projects across the country under PIDP.[86] Despite their efforts to provide these funding opportunities for coastal resiliency projects, most ports chose to spend their grant money on expansion projects to increase productivity and outflow.[87]

2. PROTECT Program

Another important grant program funded through the Bipartisan Infrastructure Law is the "Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation Program" (PROTECT Program).[88] The PROTECT Program, which is administered by the Federal Highway Agency and overseen by the Department of Transportation, is designed to help make transportation facilities more resilient to natural disasters, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters, through "competitive resilience improvement grants" for coastal infrastructure.[89] The PROTECT Program provides $1.4 billion in funding over five years, and its most recent annual program funding

83 *Port Infrastructure Development Program*, U.S. DEP'T OF TRANSP. MAR. ADMIN. (July 25, 2025), https://www.maritime.dot.gov/PIDPgrants [https://perma.cc/6P5J-4CXF].

84 National Defense Authorization Act for Fiscal Year 2010, Pub. L. No. 111-84, 123 Stat. 2207 (2009); 46 U.S.C. § 50302; *see* 46 U.S.C. § 54301.

85 Pub. L. No. 117-58, 135 Stat. 1442 (2021).

86 *Biden-Harris Administration Invests More than $653 Million in Ports to Strengthen American Supply Chains*, U.S. DEP'T OF TRANSP. (Nov. 3, 2023), https://www.transportation.gov/briefing-room/biden-harris-administration-invests-more-653-million-ports-strengthen-american-supply [https://perma.cc/5HEE-6H89]; *see* 46 U.S.C. § 54301.

87 *FY 2023 Port Infrastructure Development Grant Awards*, U.S. DEP'T OF TRANSP. MAR. ADMIN. (Nov. 3, 2023), https://www.maritime.dot.gov/sites/marad.dot.gov/files/2023-11/PIDP%202023%20Awards%20Fact%20Sheets_0.pdf [https://perma.cc/HG8U-BCUN].

88 23 U.S.C. § 176.

89 23 U.S.C. § 176(b)(2)(C).

budget for 2025 was set at $876 million.[90] However, the PROTECT Program offers grant funding to three types of distinctly different projects: (1) highway projects eligible under Title 23, U.S.C.; (2) public transportation facility or service projects eligible under chapter 53 of title 49, U.S.C.; or (3) port facility projects, including facilities that connect ports with other modes of transportation, that improve the efficiency of evacuations and disaster relief, or aid transportation.[91] The PROTECT Program requires each State to use at least 2% of its PROTECT Program funding each fiscal year for specified types of resilience-related planning activities, such as developing a resilience improvement plan; resilience planning, predesign, or design; technical capacity-building; or evacuation planning and preparation.[92] In addition, the PROTECT Program places a 40% limit on award funds to be used for the construction of new capacity.[93]

C. Federal Emergency Management Agency

The Disaster Relief Act of 1974, signed into law by President Richard Nixon, established the process of presidential disaster declarations and permitted the President to authorize federal grants not to exceed half of the cost to improve, maintain, and update State disaster assistance plans.[94] Prior to its enactment, disaster relief funding was provided through dozens of agencies, and the purpose of the Disaster Relief Act of 1974 was to create uniformity. Many of these guidelines were consolidated into FEMA, established in 1979 through an executive order by President Jimmy Carter.[95] The newly formed agency was reformed extensively by the Disaster Relief Emergency Assistance Amendments of 1988 (The Stafford Act),[96] which led to its expansion. The Stafford Act provided much-needed clarity on

90 *Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation Program (PROTECT)*, U.S. DEP'T OF TRANSP., https://www.transportation.gov/rural/grant-toolkit/promoting-resilient-operations-transformative-efficient-and-cost-saving [https://perma.cc/BYT4-6CSX] (last visited Nov. 16, 2025).

91 23 U.S.C. § 176(c)(3)(B).

92 23 U.S.C. §§ 176(c)(2), 173(d)(3).

93 23 U.S.C. § 176(c)(5)(G)(i)(I).

94 Disaster Relief Act of 1974, Pub. L. No. 93-288 (1974).

95 Exec. Order No. 12127, 44 C.F.R. § 19367 (1979).

96 Robert T. Stafford Disaster Relief and Emergency Assistance Amendments of 1988, Pub. L. No. 100-707, 42 U.S.C. § 5121 (1988).

emergency management and established the current statutory framework for disaster response and recovery.

The events of September 11, 2001, led to the enactment of the Homeland Security Act, which established the Department of Homeland Security (DHS).[97] As a result, FEMA was placed under the jurisdiction of DHS, where it remains today. Hurricane Katrina, the worst natural disaster in the United States in terms of total economic loss,[98] led Congress to enact the Post-Katrina Emergency Management Reform Act of 2006.[99] The widespread destruction caused by Hurricane Katrina, which resulted in over $200 billion in economic loss, forced Congress to re-establish FEMA as a distinct office within DHS and clarify its mission toward disaster mitigation and prevention. In the aftermath of Hurricane Sandy, which caused $88.5 billion in economic loss,[100] Congress passed the Sandy Recovery Improvement Act of 2013 to streamline the recovery of public infrastructure.[101] As an appropriations bill, the Sandy Recovery Improvement Act of 2013 authorized $60 billion for disaster relief agencies and amended the borrowing authority of the National Flood Insurance Program.[102]

D. Federal Flood Risk Management Standards

Subsequent executive orders issued by President Barack Obama established universal flood risk management standards and furthered FEMA's purpose toward prevention. President Obama saw Hurricane Sandy's rebuilding efforts as an opportunity to reshape the East Coast in a way that would better prepare the United States for future natural disasters. President Obama asked Shaun Donovan, the Secretary of Housing and Urban Development, to lead a task force on flood

---

97 Homeland Security Act of 2002, Pub. L. No. 107-296, 116 Stat. 2135 (2002) (codified as amended at 6 U.S.C. §§ 111–15).

98 Adam Smith, Neal Lott & Tom Ross, *U.S. Billion-Dollar Weather & Climate Disasters 1980–2024*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.ncei.noaa.gov/access/billions/events.pdf [https://perma.cc/NE7C-KVUF] (last visited Nov. 16, 2025).

99 Post-Katrina Emergency Management Reform Act of 2006, Pub. L. No. 109-295, 120 Stat. 1394 (2006).

100 Smith, Lott & Ross, *supra* note 98.

101 Sandy Recovery Improvement Act of 2013, Pub. L. No. 113-2 (2013) (codified as amended at 42 U.S.C. § 5121).

102 *Id.*

mitigation and prevention.[103] Six weeks following Hurricane Sandy, Donovan met with Henk Ovink, director of the Netherlands' office of Spatial Planning and Water Management and a researcher within the Delta Programme.[104] This meeting brought Ovink to the United States, where he oversaw "Rebuild by Design," a multifaceted planning and design competition launched by the Hurricane Sandy Rebuilding Task Force in June 2013.[105] The project targeted the Manhattan and New Jersey Harbors, which at the time were the busiest ports in the United States, and led to the development of New York's BIG U project.[106]

These meetings with the Netherlands' cabinet had a profound effect on American politics. In January 2015, President Obama established the Federal Flood Risk Management Standard (FFRMS) through an executive order.[107] This order brought together the Water Resources Council, Federal Interagency Floodplain Management Task Force, Council on Environmental Quality, and FEMA in an effort to issue regulations and set national standards for flood risk management near our most vulnerable coastal areas.[108] The FFRMS required agencies to select one of the three approaches for establishing the flood elevation and corresponding flood hazard area used for proposed projects: (1) the Climate Informed Science Approach; (2) the Freeboard Value Approach; or (3) the 500-year Floodplain Approach.[109] The Climate Informed Science Approach involves establishing floodplains based on "the elevation and flood hazard area that result from using . . . the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science."[110] The Freeboard Value Approach establishes a floodplain by "the elevation and flood hazard area that result from using the freeboard value, reached by adding an additional 2 feet to the base flood elevation for non-critical actions and by adding an additional 3 feet to the base

103 Russell Shorto, *How to Think like the Dutch in a Post-Sandy World*, NEW YORK TIMES (Apr. 9, 2014), https://www.nytimes.com/2014/04/13/magazine/how-to-think-like-the-dutch-in-a-post-sandy-world.html [https://perma.cc/TL8L-XYCH].

104 *Id.*

105 *See id.*; Chris Iovenko, *Dutch Masters: The Netherlands Exports Flood-Control Expertise*, EARTH MAG. (Aug. 31, 2018), https://www.earthmagazine.org/article/dutch-masters-netherlands-exports-flood-control-expertise/ [https://perma.cc/CDF4-MG99].

106 Iovenko, *supra* note 105.

107 Exec. Order No. 13690, 80 C.F.R. § 6425 (2015).

108 *Id.*

109 *Id.*

110 *Id.*

flood elevation for critical actions."[111] The last approach requires a proposed project to be confined to "the area subject to flooding by the 0.2 percent annual chance flood."[112]

Upon recommendations and insight from the Netherlands, President Obama's executive order was revolutionary for setting parallel national flood prevention standards. However, this executive order was subsequently revoked by President Donald Trump in August 2017.[113] Despite being reinstated in January 2021 by President Joe Biden on his first day in office,[114] it has since been rescinded by President Trump for the second time.[115]

III
PORT OF HOUSTON

Port Houston, located in the Galveston Bay, supports 3.37 million jobs and holds roughly $439.2 billion in total statewide economic value, which accounts for 18.6% of Texas's GDP.[116] Moreover, the Port generated $10.6 billion in state and local taxes in 2022.[117] The port also generated $906 billion in nationwide economic value and contributed $62.7 billion in national tax revenue.[118] With more than 200 private and eight public terminals,[119] Port Houston transported 207 million short tons of foreign waterborne cargo in 2022.[120] Total domestic and foreign waterborne cargo transported through the port totaled 293.8 million short tons.[121] Port Houston is the busiest port in

111 *Id.*

112 *Id.*

113 Exec. Order No. 13807, 82 C.F.R. § 40463 (2017).

114 Exec. Order No. 13990, 86 C.F.R. § 7037 (2021).

115 Exec. Order No. 14148, 90 C.F.R. § 8237 (2025).

116 MARTIN ASSOCS., 2022 ECONOMIC IMPACT OF HOUSTON SHIP CHANNEL ACTIVITY 3 (Apr. 7, 2023), https://porthouston.com/wp-content/uploads/2023/05/2022-Economic-Impact-Report_Final.pdf [https://perma.cc/9DJ6-FZ49].

117 *Id.*

118 *Id.* at 12.

119 *Port Statistics*, PORT HOU., https://porthouston.com/about/our-port/statistics/ [https://perma.cc/NJT5-J23Y] (last visited Nov. 17, 2025).

120 *Tonnage of Top 50 U.S. Water Ports, Ranked by Total Tons*, BUREAU OF TRANSP. STAT., https://www.bts.gov/content/tonnage-top-50-us-water-ports-ranked-total-tons [https://perma.cc/4WTX-JMAV] (last visited Nov. 17, 2025).

121 *Id.*

the United States due to its export productivity, and total foreign cargo value peaked at $242.3 billion in 2023.[122]

The economic viability of Port Houston and its close proximity to major metropolitan areas have made it one of the busiest ports in the United States. However, the burden of the port's governance is left largely up to state laws and local commissions. As a "navigation district" under the Texas Constitution, "[t]he laws governing Port Houston are found primarily in Chapter 5007 of the Texas Special District Local Laws Code, the Texas Water Code and the Texas Local Government Code."[123] A local commission consisting of "[s]even Harris County residents serve as Port Commissioners of the Port of Houston Authority, setting policies and guiding executive staff to ensure that Port Houston continues to be a strategic leader for the Houston Ship Channel."[124]

A. History

Originally located at the confluence of the Buffalo and White Oak Bayous in central Harris County, Texas, the Port of Houston was officially established in June 1841 by a city council ordinance.[125] The original dock, known as "Allen's Landing," serviced oceangoing ships, steamers, and sailing vessels, and quickly became a valuable commercial port in the latter half of the nineteenth century.[126] In 1910, the federal government approved funding for the dredging of a ship channel from the Gulf of Mexico to the Turning Basin, located four miles to the east of Allen's Landing.[127] Former representative Thomas Ball collaborated with fellow congressmen on the Congressional Rivers and Harbors Committee to get the project approved in what became known as the Houston Plan.[128] The Houston Plan was a compromise created by the Mayor of Houston, Horace Baldwin Rice,

122 *Id.*

123 *Governance Overview*, PORT HOU., https://porthouston.com/about/governance/overview/ [https://perma.cc/Z99B-D9AB] (last visited Nov. 17, 2025).

124 *The Port Commission*, PORT HOU., https://porthouston.com/about/governance/the-port-commission/ [https://perma.cc/E439-KB8F] (last visited Nov. 17, 2025).

125 Diana J. Kleiner, *Discover Allen's Landing: Houston's Historic Waterfront*, TEX. STATE HIST. ASS'N (Nov. 29, 2017), https://www.tshaonline.org/handbook/entries/allens-landing-tx (on file with the Journal of Environmental Law and Litigation).

126 *Id.*

127 *Id.*

128 *Background & History*, PORT HOU., https://porthouston.com/about/our-port/background-history/ [https://perma.cc/R3AV-G8SY] (last visited Nov. 17, 2025).

under which the federal and local governments would each pay half the cost of dredging the channel to a depth of twenty-five feet.[129] Congress accepted the offer, and the Texas legislature passed a bill enabling Harris County to establish the area as a navigation district.[130] In 1911, a political campaign was launched to encourage Harris County voters to approve $1.25 million in bonds.[131] These bonds were approved, the waterway was dredged, and the Harris County Houston Ship Channel Navigation District was formed.[132] The project was completed in September 1914, and the port opened for business two months later in November.[133]

By the early 1920s, Port Houston had become the leading cotton port in the United States and began regularly engaging in international trade with foreign markets.[134] The discovery of oil in Texas during the early twentieth century radically changed Port Houston, leading to the industrialization of the waterfront and the construction of numerous oil refineries along the channel.[135] Nine oil refineries operated along the channel by 1930, and by 1939, Port Houston was ranked the third busiest port in the United States by total amount of tonnage carried. The Texas Legislature established the Harris County Flood Control District (Flood Control District), a special-purpose district, in 1937.[136] The Harris County Commissioners Court governs the Flood Control District, which was created in response to two disastrous floods in 1929 and 1935.[137] The Flood Control District does not have sole jurisdiction over flood-related matters in Harris County, as the City of Houston is one of the local floodplain administrators for the community's participation in the National Flood Insurance Program.[138] The City of Houston's governance structure when it comes to flood risk management is deeply complex:

---

129 Marilyn M. Sibley, *The History and Significance of the Houston Ship Channel*, TEX. STATE HIST. ASS'N (Mar. 22, 2017), https://www.tshaonline.org/handbook/entries/houston-ship-channel (on file with the Journal of Environmental Law and Litigation).

130 *Id.*

131 *Id.*

132 *Id.*

133 *Id.*

134 *Id.*

135 *Id.*

136 *About the Flood Control District*, HARRIS CNTY. FLOOD CONTROL DIST., https://www.hcfcd.org/about [https://perma.cc/5F92-ZSHN] (last visited Nov. 17, 2025).

137 *Id.*

138 *Id.*

> In all, there are 34 floodplain administrators in the county. The Flood Control District is not one of them. To complete the jurisdiction picture, there are four county commissioners' precincts. In all, with 34 floodplain administrators reporting to separate entities of government, there are nearly 250 elected officials involved in the administration of drainage and flooding issues in the county, including each municipality's building permit program.[139]

Congress approved a project to widen the channel in 1945, and the Department of Defense recommended that the entire channel be deepened to forty feet in 1957.[140] These projects were completed by 1964, with the federal government expending $64 million for channel improvement and maintenance, and the local government investing $28 million in port facilities.[141] Port Houston has since become the economic lifeline of Texas, but heavy traffic along the channel highlights growing environmental concerns. Oil spills, explosions, collisions between tankers, and heavy pollution continue to pose a serious threat to local residents. A number of civil lawsuits were filed against various companies that were contributing to these environmental problems. In response to the growing number of lawsuits, the legislature passed a bill in 2015 that limited the amount of penalty money from environmental cases that a county could collect.[142] These controversial amendments to the Texas Water Code limited the amount to $4.3 million and called for any remaining balance to be sent to the state general fund.[143]

B. Environmental Concerns

Port Houston has been challenged with unprecedented sea level rise in recent years, as it is estimated that the sea level off the coast of Texas, specifically in Galveston Bay, is about eighteen inches higher than it was in 1950.[144] Sea level rise is expected to be the most significant and costly hazard for global ports in the next century, and the median sea level (MSL) in the Gulf of Mexico is rising higher than global

---

139 *Id.*

140 Sibley, *supra* note 129.

141 *Id.*

142 TEX. WATER CODE ANN. § 7.107 (West 2025).

143 *Id.*

144 *Tides & Currents*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://tidesandcurrents.noaa.gov/waterlevels.html?id=8771450&units=standard&bdate=19500101&edate=20221231&timezone=GMT&datum=MSL&interval=m&action=data [https://perma.cc/UQ72-TFQ2] (last visited Nov. 17, 2025).

averages.[145] Globally, MSL has increased by 1.5 millimeters per year since 1900.[146] The global melting of polar ice caps and glaciers has accelerated this unprecedented rise in global MSL, resulting in a rate of three millimeters every year since 1992.[147] The MSL of the Gulf of Mexico, on the other hand, rose an average of 11.1 millimeters every year from 2000 to 2021,[148] and tidal flooding in certain areas along the Gulf Coast has increased by 490%.[149]

In 2017, Hurricane Harvey made landfall near Rockport, Texas, causing disastrous flooding and roughly $155 billion in damages.[150] Relief funding for Hurricane Harvey was primarily paid out through FEMA.[151] It is estimated that had the sea level been lower, or if more adequate precautions had been taken, Hurricane Harvey's eleven-foot storm surge would have also been considerably lower and less damaging.[152] In 2019, record-high water levels on the Mississippi River disrupted one of the most pivotal transport networks for exporting U.S. agricultural goods, causing additional losses valued at almost $1 billion.[153]

Despite the significant risk of flooding, Port Houston does not put out an annual assessment report regarding sea level rise. In fact, the last time the City of Houston released a Climate Impact Assessment was in August 2020.[154] The annual sustainability and financial reports issued

---

145 Sönke Dangendorf et al., *Acceleration of U.S. Southeast and Gulf Coast Sea-Level Rise Amplified by Internal Climate Variability*, NATURE COMMC'NS, Apr. 2023, at 1, 1.

146 *Id.*

147 *Id.*

148 *Id.* at 2.

149 WILLIAM V. SWEET ET AL., 2017 STATE OF U.S. HIGH TIDE FLOODING WITH A 2018 OUTLOOK 4–5 (June 6, 2018).

150 *U.S. Billion-Dollar Weather and Climate Disasters*, NOAA NAT'L CNTRS. FOR ENV'T INFO. (NCEI), https://www.ncei.noaa.gov/access/billions/ [https://perma.cc/QT2U-HXCS] (last visited Nov. 17, 2025).

151 *Hurricane Harvey Funding Dashboard*, RICE UNIV. KINDER INST. FOR URB. RSCH., https://resilience.rice.edu/harvey-dashboard [https://perma.cc/CSH3-NHFR] (last visited Nov. 17, 2025).

152 *Hurricane Harvey & Its Impacts on Southeast Texas (August 25–29, 2017)*, NAT'L WEATHER SERV., https://www.weather.gov/hgx/hurricaneharvey [https://perma.cc/8YCY-SAYG] (last visited Nov. 17, 2025).

153 GEORGE VAN HOUTVEN ET AL., ENV'T DEF. FUND, ACT NOW OR PAY LATER: THE COSTS OF CLIMATE INACTION FOR PORTS AND SHIPPING 5 (Mar. 2022), https://www.edf.org/sites/default/files/press-releases/RTI-EDF%20Act%20Now%20or%20Pay%20Later%20Climate%20Impact%20Shipping.pdf [https://perma.cc/T697-5DDN].

154 ANNE STONER & KATHARINE HAYHOE, CLIMATE IMPACT ASSESSMENT FOR THE CITY OF HOUSTON (Aug. 2020).

by Port Houston make no mention of sea level rise or strategies on how to stay on top of it. The only report in recent years that mentions coastal resiliency strategies is the Port Houston 2040 Plan, a comprehensive long-range plan that was created by Port Houston's Facility Planning Department and adopted by the Port Commission in November 2020.[155] The Port Houston 2040 Plan mentions the Harris County Flood Resilience Plan, set to be completed in 2025.[156] However, as of January 2025, a majority of the projects being conducted by the Flood Control District are still in the planning or preconstruction phase.[157]

Although only 1,600 people in Houston live on exposed land below seven feet,[158] the risk of not taking adequate precautions could be detrimental to commercial ports in the United States when another hurricane or heavy precipitation event occurs in the area. The consequences of sea level rise can already be felt in the area, but the largest consequences will be compounded over the long term. The lack of formal climate and sea level assessments is alarming for an area that *regularly* experiences extraordinary storm surges.

C. Galveston Bay

An inlet of the Gulf of Mexico, Galveston Bay is home to the largest estuary in Texas.[159] Stretching over 600 square miles in surface area, Galveston Bay is commonly divided into four major sub-bays: (1) Galveston Bay; (2) Trinity Bay; (3) West Bay; and (4) East Bay. Galveston Bay receives freshwater from the Trinity and San Jacinto rivers, as well as from the Buffalo Bayou.[160] Unlike most other major commercial bays in the United States, Galveston Bay is broad and extremely shallow. The bay is typically only six to twelve feet deep on average, except for dredged channels, and the circulation of the bay is

155 *Port Houston 2040 Plan*, PORT HOUSTON, https://www.porthouston.com/wp-content/uploads/2022/11/Port-Houston-2040-Plan.pdf [https://perma.cc/9NGM-8BF5] (last visited Nov. 17, 2025).

156 *Id.*

157 *See generally Multi-Watershed Projects*, HARRIS CNTY. FLOOD CONTROL DIST., https://www.hcfcd.org/Activity/Projects/Countywide-or-Multi-Watershed [https://perma.cc/29YJ-2C54] (last visited Nov. 17, 2025).

158 *Surging Seas Risk Finder: Houston, Texas, USA*, CLIMATE CENT., https://riskfinder.climatecentral.org/place/houston.tx.us?comparisonType=place&forecastType=NOAA2017_int_p50&level=7&unit=ft [https://perma.cc/HRQ7-RQ4Q] (last visited Nov. 19, 2025).

159 *About Galveston Bay*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://gnome.orr.noaa.gov/doc/location_files/galveston_bay_tech.html [https://perma.cc/2N9H-WT8L] (last visited Nov. 19, 2025).

160 *Id.*

dominated by the winds and tides. These meteorological tides, or storm surges, significantly raise and lower sea levels, "causing extensive flooding and currents that can overcome the tides."[161] Lacking flood resiliency strategies, "even modest storms can affect sea level more than the astronomical tides when there is a persistent onshore or offshore wind."[162]

In 1989, Galveston Bay was included in the National Estuary Program (NEP).[163] The NEP provides grants to states where their governors have identified nationally significant estuaries that are being threatened by climate change or other external factors.[164] Currently, there are twenty-eight nationally identified estuaries in the United States under the NEP.[165] Most of these twenty-eight identified estuaries are situated near the largest ports in the country, such as the San Francisco Bay, Puget Sound, and the New York-New Jersey Harbor.[166] Congress created the NEP in the 1987 amendments to the Clean Water Act (CWA).[167] Grants are awarded to these states to develop comprehensive management reports and to combat issues such as sea level rise, and projects are funded through the Environmental Protection Agency (EPA).[168] While the NEP shares some similarities with the Netherlands' Delta Programme, such as providing funding directly to projects, the NEP targets a much broader range of issues and tends to work more effectively with local community organizations. This has created a bigger burden on local governments, and national management could make it more cohesive. Local community leaders and staff manage each estuary organization, and these participating organizations often include local universities, nonprofit organizations,

161 *Id.*

162 *Id.*

163 GALVESTON BAY ESTUARY PROGRAM, THE GALVESTON BAY PLAN, 2ND EDITION: COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN FOR THE GALVESTON BAY ESTUARY (Oct. 17, 2018), https://gbep.texas.gov/wp-content/uploads/2019/08/CCMP_2ndEdition_FINAL-TCEQ-Approved-DRAFT.pdf [https://perma.cc/9DCP-JQAN].

164 *Overview of the National Estuary Program*, U.S. ENV'T PROT. AGENCY (May 22, 2025), https://www.epa.gov/nep/overview-national-estuary-program [https://perma.cc/HK44-UWMS].

165 *Id.*

166 *Id.*

167 *Id.*

168 *Id.*

and government agencies.[169] The twenty-eight nationally identified estuaries "develop and implement Comprehensive Conservation and Management Plans (CCMPs), which are long-term plans that contain sustained actions to protect and restore water qualities and living resources."[170] However, the NEP is a "non-regulatory program" that was established by Congress and authorized through Section 320 of the CWA.[171] Non-regulatory guidance is "not binding and does not impose any new requirements beyond those in the law and regulations."[172]

The Galveston Bay Plan, which was the first project to be funded through the NEP, was approved by both the EPA and Texas's governor in 1995.[173] The Plan is designed to be evaluated only every five years.[174] The second edition of the Plan, published in 2018, highlighted sea level rise as one of "multiple emerging priorities; . . . [noting that], resilience and sea level change were mentioned with the greatest frequency across all categories."[175] Resolution eight in the Plan also suggested three separate coastal resiliency projects.[176] The Plan's latest project included an Estuary Resilience Assessment, which began in September 2018 and concluded in June 2023.[177] This project was contracted through the GeoTechnology Research Institute at the Houston Advanced Research Center and was awarded a $136,108 budget through the EPA.[178] The goal of this project was for its research to serve as a companion document to the Galveston Bay Plan and to provide resiliency adaptation considerations for implementers of the Galveston Bay Plan.[179]

A study conducted in 2023, led by a team of researchers at Tulane University, revealed that the sea level around Galveston Bay and other

---

169 *Exploring Estuaries: How Does the National Estuary Program Help?*, U.S. ENV'T PROT. AGENCY (Apr. 15, 2025), https://www.epa.gov/nep/exploring-estuaries-how-does-national-estuary-program-help [https://perma.cc/R5WP-QTTG].

170 *Overview of the National Estuary Program*, *supra* note 164.

171 *Id.*

172 *Id.*

173 GALVESTON BAY ESTUARY PROGRAM, *supra* note 163, at 3.

174 *Id.* at 156.

175 *Id.* at 172.

176 *Id.* at 136.

177 TEX. COMM'N ON ENV'T QUALITY, FISCAL YEAR 2022 WORK PLAN SECTION 320 GALVESTON BAY ESTUARY PROGRAM 23 (Mar. 11, 2022), https://gbep.texas.gov/wp-content/uploads/2022/04/GBEP-FY22-Work-Plan_Rev3.1.pdf [https://perma.cc/6XHM-GW7J].

178 *Id.*

179 *Id.*

areas along the Gulf Coast has been rising by a half inch every year since 2010.[180] The study writes that sea level rise is "one of the most severe consequences of a warming climate, threatening hundreds of millions of people living in low-lying coastal communities."[181] Scientists predict that the sea level in the Gulf of Mexico could rise another six inches within the next ten years.[182] In comparing this data to other ports within the United States, it is evident that federal action is most urgently necessary in ports along the Gulf of Mexico. However, the risk should not be underestimated in ports located along the Pacific Ocean. The 2024 "State of California Sea-Level Rise Guidance" report, produced by the California Ocean Protection Council, in partnership with the California Ocean Science Trust, estimated the sea level rise of Los Angeles in five different scenarios.[183] Home to the two most trafficked ports in the United States, the Port of Los Angeles and the Port of Long Beach, the intermediate scenario estimates that the sea level around Los Angeles will rise six inches by 2040 from its 2020 baseline measurements.[184] While these numbers are alarming, it is palpably apparent that the issue remains most prevalent along the Gulf Coast.

IV
THE FUTURE OF FLOOD RISK MANAGEMENT

While implementing all the Delta Commission's recommendations in the United States would be unfeasible, certain aspects of the second Delta Act would benefit all countries with major commercial ports that deal with rising sea levels. As one of those countries, the United States should seek to first implement a federal commission that brings together national government, local and state authorities, and water authorities, as the Netherlands has done.[185] The differences in flood

180 Dangendorf et al., *supra* note 145, at 1.

181 *Id.*

182 Scott A. Kulp & Benjamin H. Strauss, *New Elevation Data Triple Estimates of Global Vulnerability to Sea-Level Rise and Coastal Flooding*, 10 NATURE COMMC'NS 1, 1–12 (2019).

183 CAL. OCEAN PROTECTION COUNCIL, STATE OF CALIFORNIA SEA LEVEL RISE GUIDANCE: 2024 SCIENCE & POLICY UPDATE (2024), https://opc.ca.gov/wp-content/uploads/2024/01/SLR-Guidance-DRAFT-Jan-2024-508.pdf?utm_medium=email&utm_source=govdelivery [https://perma.cc/HN5F-582D].

184 *Id.* at 100.

185 MINISTRY OF INFRASTRUCTURE & WATER MGMT., *supra* note 58.

protection standards between the United States and the Netherlands are a matter of federal government action. The Netherlands has made a program specifically for sea level rise that clearly outlines resolutions, strategies, and suggestions for projects moving forward. Furthermore, their projects are funded through the same federal program that makes these yearly assessments. These assessments are then used to highlight critical weaknesses in areas that can negatively affect the Netherlands' economy, should a heavy precipitation event occur.

The United States, on the other hand, has failed to exercise its authority to make vital changes where they are most needed, leaving local governments to bear the burden of lobbying the federal government and its agencies for funding for desperately needed projects. One major dissimilarity between the two countries is that the United States tends to work retroactively when it comes to storm surges and heavy precipitation events. Rather than fund relief efforts through FEMA or incorporate funding through national defense budgets, the solution should be to create a federal commission under the supervision of the EPA, Department of Commerce, or the Department of Transportation, to better understand what areas of the United States are more susceptible to flooding.

One potential solution would be to consolidate NOAA's Office for Coastal Management, the EPA's National Estuary Program, and MARAD's Port Infrastructure Development Program into a single line office within either the USACE, EPA, NOAA, or MARAD, and to relieve the Federal Highway Administration of its power to fund port projects related to coastal resiliency, to create one comprehensive agency that can effectively manage sea level rise around our economically vital commercial ports and surrounding estuaries. This would help facilitate projects and ensure their completion within ample timeframes, thus protecting the United States economy from unnecessary risks, damages, and costs. Moreover, an all-encompassing coastal management commission could offer streamlined funding. The National Coastal Zone Management Program and the National Estuarine Research Reserve System, which are both overseen by the Office for Coastal Management, would be well equipped to handle the research and strategic planning related to coastal resiliency. The EPA's National Estuary Program and MARAD's Port Infrastructure Development Program need to be able to work together on a larger scale to create comprehensive coastal resiliency plans, as most of our nationally identified estuaries are located near our largest commercial

ports. By consolidating these agencies into one comprehensive coastal management administration, preferably within USACE, funding for all projects related to coastal resiliency and sea defense would stem directly from only one agency.

First and foremost, however, the United States needs to reimplement the Federal Flood Risk Management Standards that were established during the Obama administration. The Trump Administration can continue to fervently and foolishly debate climate change until the cows come home, but it desperately needs to acknowledge the fact that our sea levels are rising. If the current administration is unwilling to do so through an executive order, the burden falls upon Congress to reimplement the FFRMS. These standards are necessary to bring together research institutions and implement regulations to adequately mitigate flooding near our economically vital commercial ports. As current ports continue to expand with grant funding from the Bipartisan Infrastructure Law, the United States needs to establish regulations on projects conducted in vulnerable floodplains. The reimplementation of the FFRMS would be a step in the right direction toward flood prevention and mitigation.

A. Coastal Texas Project

Perhaps the most exciting and ingenious idea proposed in recent years stems from a collaborative effort by the United States Army Corps of Engineers, the Gulf Coast Protection District, and the Texas General Land Office. The "Ike Dike" is a proposed coastal barrier that would build upon the existing Galveston Seawall and would come complete with armored floodgates to protect Port Houston and the entire Galveston Bay.[186] The proposed coastal barrier takes its name from Hurricane Ike, which occurred in 2008, one of the most devastating hurricanes in American history that killed seventy-four people and caused roughly $29.5 billion in damage.[187] In response to Hurricane Ike, USACE partnered with the Texas General Land Office on the Coastal Texas Protection and Restoration Feasibility Study, and its subsequent Environmental Impact Statement as required by the

186 *About Ike Dike*, TEX. A&M UNIV. AT GALVESTON, https://www.tamug.edu/ikedike/About_Ike_Dike.html [https://perma.cc/QP7E-QMJ7] (last visited Nov. 19, 2025).

187 *Hurricanes Ike & Dolly Action Plan*, TEX. GEN. LAND OFF., https://www.glo.texas.gov/disaster-recovery/action-plans/hurricanes-ike-dolly-action-plan [https://perma.cc/BEK2-663Z] (last visited Nov. 19, 2025).

National Environmental Policy Act, to develop the Coastal Texas Project:

> This six-year, $20 million comprehensive study sought to identify feasible, cost-effective, and ecologically sound projects to reduce risks to public health and the economy, to restore critical ecosystems, and to advance coastal resiliency. These efforts culminated in Lt. Gen. Scott Spellmon, USACE commanding general, signing the Chief's Report on Sept. 16, 2021, representing the largest single investment recommendation to Congress in USACE history. Subsequently, as part of the Water Resources Development Act of 2022 (WRDA), Congress formally authorized the Coastal Texas Project to advance into design and construction, pending appropriation of funding.[188]

While this study was being conducted, the Texas Legislature established the Gulf Coast Protection District "to oversee the implementation of an integrated and comprehensive coastal resilience strategy for the upper Texas coast."[189] In doing so, the Gulf Coast Protection District (GCPD) assumed the role of non-federal sponsor for projects under the Coastal Texas Project. The GCPD Board of Directors is appointed by the Harris County Commissioners Court and works in tandem with the USACE.

In December 2022, President Biden signed the National Defense Authorization Act (NDAA) for the 2023 Fiscal Year into law, which included the Water Resources Development Act of 2022 (WRDA).[190] The bill, which totaled $847 billion, approved a $34 billion proposal for the Coastal Texas Project, with $16 billion allocated to the Galveston Bay Storm Surge Barrier System, a concrete gate system colloquially known as the "Ike Dike."[191] The Coastal Texas Project is "the largest of the coastal protection projects in the NDAA, [and] includes deepening shipping channels" to better protect Port Houston.[192] It should be noted, however, that this project was first

188 *About the Project*, COASTAL TEX. PROJECT, https://coastaltexasproject.com/about/ [https://perma.cc/U4VP-MZ24] (last visited Nov. 19, 2025).

189 *Water Resources Development Act of 2022 Signed into Law, Authorizing Advancement of Coastal Texas Program*, GULF COAST PROT. DIST. (Dec. 23, 2022), https://gcpdtexas.com/press-releases/water-resources-development-act-of-2022-signed-into-law-authorizing-advancementof-coastal-texas-program/ [https://perma.cc/QX6H-5CD3].

190 Water Resources Development Act of 2022, Pub. L. No. 117-263, 136 Stat. 3691 (codified as amended at 36 U.S.C. § 2201); Taylor Bounds, *Defense Bill Passes, Includes Ike Dike*, TEX. A&M UNIV. (Jan. 10, 2023), https://news.galveston.tamu.edu/ike-dike-approved-in-ndaa-newsroom/ [https://perma.cc/DP5K-K3KK].

191 Bounds, *supra* note 190.

192 *Id.*

proposed in 2009,[193] and despite its necessity—took nearly fourteen years for the project to receive promises of funding from the federal government.

The Coastal Texas Project comprises eighteen distinctly different projects, and the USACE estimates that it will take up to twenty years to complete.[194] The three main projects are the Galveston Bay Storm Surge Barrier System, South Padre Island Beach Nourishment, and the Coastwide Ecosystem Restoration Plan.[195] The estimated total cost of the Coastal Texas Project is $34.38 billion, with the federal government being responsible for only 65% of the funding.[196] Although the WRDA promised federal funding for the Coastal Texas Project, USACE allocated its first installment of federal funding, a mere $500,000, in May 2024, "to support the preconstruction engineering and design of the first segment of the Bolivar Peninsula and West Bay Gulf Intracoastal Waterway Shoreline and Island Protection feature, also known as Ecosystem Restoration feature G-28, and to prepare the project for construction."[197] The State of Texas, conversely, provided $226 million in funding for the project to commence.[198] In November 2024, Representatives Randy Weber and Dennis Paul told local newspapers that they were still hoping to secure federal funding during the upcoming 119th Congressional Session for 2025.[199]

To secure federal funding for the Coastal Texas Project, Congress would need to pass a new appropriation bill allocating funds to USACE. Despite promises of federal funding, the project may secure funding only through legislation. Moreover, USACE is the sole federal sponsor of the Coastal Texas Project, which means only they are authorized to distribute funds for the project. This infuriating cycle of federal funding only exacerbates the ongoing problem, and as things

193 TEX. A&M UNIV. AT GALVESTON, *supra* note 186.

194 *About the Project*, *supra* note 188.

195 *Id.*

196 *Id.*

197 *Coastal Texas Project Provided Funding in FY 2024 Work Plan*, GULF COAST PROT. DIST. (May 15, 2024), https://gcpdtexas.com/posts/2024-05-15/news-release-coastal-texas-project-provided-funding-in-fy-2024-work-plan/ [https://perma.cc/8SBX-QZS3].

198 James T. Norman & Rachel Leland, *After Active Hurricane Season, Coastal Texas Project Waits for More Federal Funding*, CMTY. IMPACT (Nov. 26, 2024, at 9:00 CST), https://communityimpact.com/houston/bay-area/development/2024/11/26/after-active-hurricane-season-coastal-texas-project-waits-for-more-federal-funding/ [https://perma.cc/9AUL-LSCB].

199 *Id.*

stand, it is unlikely that the Coastal Texas Project will be completed within twenty years. Unlike the Netherlands' Delta Fund, which is funded directly through national taxes, the United States lacks the ability to streamline funds directly toward urgently needed projects.

CONCLUSION

The United States port industry has grown consistently in the twenty-first century. In 2021, almost 44,800 U.S.-flagged maritime vessels were operating on the waterways—a 10.5% increase from 2010.[200] Vitally important to the United States economy, commercial ports contributed $2.89 trillion to the GDP, a 9% share of the total, in 2024.[201] The port and maritime industry in the United States employs 21.81 million workers,[202] accounting for 13% of all American jobs.[203] This rapid growth will inevitably lead to expansion projects that will seek to increase the productivity and output of the United States port industry. If this trend is to continue, the Federal Flood Risk Management Standards need to be reimplemented, and coastal resiliency projects need to be prioritized to avoid potential environmental and financial catastrophes. Once these standards are reimplemented, the focus may then shift toward amending the project funding process.

Federal funding for port infrastructure, coastal management, and resiliency projects needs to be streamlined through a single administration. American coastal areas, particularly those located along the Gulf of Mexico, have spent decades attempting to secure federal funding for desperately needed sea defense projects. However, these areas are often forced to create their own local management commissions that can provide immediate funding for proposed projects through state and local taxes. Rather than provide federal funding through FEMA, for proactive projects only *after* a major disaster occurs, the United States should look to establish a comprehensive

200 U.S. DEP'T OF TRANSP., BUREAU OF TRANSP. STAT., TRANSPORTATION STATISTICS ANNUAL REPORT 2023, at 1-29 (2023), https://www.bts.gov/sites/bts.dot.gov/files/2023-12/TSAR-2023_123023.pdf [https://perma.cc/W6RH-NL6G].

201 AM. ASS'N OF PORT AUTH., U.S. PORT & MARITIME INDUSTRY: ECONOMIC CONTRIBUTION REPORT 3 (2024), https://aapa.cms-plus.com/files/2024%20Economic%20Contribution%20Report%20AAPA.pdf [https://perma.cc/EBR3-EQMY].

202 *Id.*

203 *Employment Status of the Civilian Population by Sex and Age*, U.S. BUREAU OF LAB. STAT., https://www.bls.gov/news.release/empsit.t01.htm [https://perma.cc/M2UL-J8GW] (last visited Nov. 19, 2025).

coastal management administration, similar to the Netherlands' Delta Programme, that can adapt quickly to rising sea levels while maintaining a steady national budget for project funding. As sea levels continue to rise globally, it is important to look at countries like the Netherlands to understand the best course of action to mitigate and prevent flooding around our economically vital commercial ports. Retroactive funding, through appropriation bills, is not a viable long-term solution to flood prevention, and the burden now falls upon the federal government, as it is their choice whether to act now or pay the price of rebuilding in the future.