

**COMPENDIUM OF
FEDERAL NATURE-BASED
RESOURCES FOR
COASTAL COMMUNITIES,
STATES, TRIBES, AND
TERRITORIES**

APRIL 2022



**THE WHITE HOUSE
WASHINGTON**



White House Coastal Resilience Interagency Working Group

National Oceanic and Atmospheric Administration

Federal Emergency Management Agency

Department of Housing and Urban Development

Department of Defense

Army Corps of Engineers

Department of the Interior

Department of Transportation

Environmental Protection Agency

National Aeronautics and Space Administration

Department of Agriculture

AmeriCorps

Department of Homeland Security



Summary

At the coast, the impacts of climate change and more frequent and severe extreme weather events, along with sea level rise, erosion, and other stressors, are challenging—and in some cases, devastating—coastal communities, infrastructure, and the resources our economy depends on. The effects of ocean warming and sea level rise are threatening the natural and built environment, requiring strategic investments in mitigation measures that account for changing conditions. Our nation is guarding against the effects of the climate crisis by investing in resilience to climate change, through a focus on environmental justice and conservation.

Nature-based solutions are often defined as actions to protect, sustainably manage and restore natural or modified ecosystems (land, water, coastal, or ocean) that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (e.g., coastal protection, reduced flooding, decreased heat-island effects).

The strategic and effective use of nature-based solutions plays an important role in addressing coastal resilience challenges. To aid in the use and implementation of nature-based solutions for coastal resilience, the Biden-Harris Administration has established the Coastal Resilience Interagency Working Group (IWG), one of five IWGs focused on priority extreme climate change events. The Coastal Resilience IWG is co-led by the White House Council on Environmental Quality (CEQ) and the National Oceanic and Atmospheric Administration (NOAA) and it works to coordinate and accelerate the federal government's efforts to increase resilience in the country's coasts and coastal communities that are impacted by climate change.

Nature-based solutions offer significant benefits, monetary and otherwise, often at a lower cost than more traditional infrastructure. To ensure that the advantages of infrastructure investments, including nature-based solutions, are received by historically disadvantaged and marginalized communities, the White House established the Justice40 Initiative. Justice40 is a whole-of-government effort that aims to deliver 40 percent of the overall benefit of federal investments in climate to disadvantaged communities. For nature-based solutions, these benefits include economic growth, green jobs, increased property values, and improvements to public health, including better disease outcomes and reduced injuries and loss of life.

There are many existing programs and funding sources for nature-based solutions that can target coastal resiliency. Notably, the Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act), a once-in-a-generation investment in our nation's infrastructure and competitiveness, includes \$50 billion for climate resiliency programs.

This compendium streamlines access to recommended federal resources and guidance on coastal green infrastructure, nature-based solutions, and habitat restoration that are available to assist coastal communities, states, tribes, and territories in evaluating, enabling, and investing in nature-based adaptation strategies.



Abbreviation	Definition
BIA	Bureau of Indian Affairs
BOEM	Bureau of Ocean Energy Management
BRIC	Building Resilient Infrastructure and Communities
CDBG	Community Development Block Grant
CoSMos	Coastal Storm Modeling System
CSO	Coastal States Organization
DOD	Department of Defense
DOT	Department of Transportation
EDA	Economic Development Administration
ELI	Environmental Law Institute
EPA	Environmental Protection Agency
FARG	Federal Adaptation and Resilience Group
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
HUD	Department of Housing and Urban Development
NFWF	National Fish and Wildlife Foundation
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	Naturally Resilient Communities
NRCS	Natural Resource Conservation Service
NSTC	National Science and Technology Council
NWF	National Wildlife Federation
RiskMAP	Risk Mapping, Assessment, and Planning
TNC	The Nature Conservancy
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGCRP	US Global Change Research Program
USGS	US Geological Survey



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Agency	Title	Type	Link	Summary	Year
General Resources on Nature-Based Solutions and Green/Natural Infrastructure					
DOD/ USACE	Engineering with Nature: Supporting Mission Resilience and Infrastructure Value at Department of Defense Installations	Reference Report	https://ewn.ercd.dren.mil/wp-content/uploads/2021/10/ERDC-SR-21-9-ebook-web-release.pdf	Book on engineering with nature opportunities at DOD installations to reduce risk to natural hazards.	2021
DOT	Nature-Based Solutions for Coastal Highway Resilience: An Implementation Guide	Implementation Guidance	https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/implementation_guide/fhwahep19042.pdf	Comprehensive guide on utilization of nature-based solutions for coastal highway resilience including technical fact sheets, planning and funding considerations, site assessment, engineering considerations, materials, construction, monitoring and maintenance information. Produced by the DOT FHWA.	2019
DOT	Nature-Based Solutions for Coastal Highway Resilience	Whitepaper	https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/nature_based_solutions/fhwahep18037.pdf	White paper on utilization of nature-based solutions for coastal highway resilience.	2018



Agency	Title	Type	Link	Summary	Year
DOT	Peer Exchange Summary Report - Nature-Based Solutions for Coastal Highway Resilience	Peer-Exchange Summary Report	https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/coastal_highways/	Report summarizing key takeaways from four regional peer exchanges conducted by FHWA on NBS for improving coastal highway resilience. This peer exchange summary provides a synthesis of: key examples of NBS; recommendations for successful planning and implementation; and challenges that can arise across planning, permitting, partnerships and engagement, engineering and design, and monitoring and maintenance.	2018
DOT	Nature-Based Solutions Pilot Reports	Report	https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/	Five reports describing FHWA's partnerships with state departments of transportation (DOTs) and others on five pilot projects to assess the potential for natural infrastructure to protect specific locations along coastal roads from climate change impacts such as sea level rise and storm surge flooding.	2017/2018
EPA	Watershed Planning and Green Infrastructure in State Hazard Mitigation Plans	Implementation Guidance	https://www.epa.gov/sites/default/files/2019-04/documents/final4_good_reasons_for_shmps_to_inc_gi_into_shmps_-_508.pdf	Guide on why including green infrastructure and watershed planning into hazard mitigation plans is important.	-



Agency	Title	Type	Link	Summary	Year
EPA	Green Infrastructure Modeling Toolkit	Tool	https://www.epa.gov/water-research/green-infrastructure-modeling-toolkit	Website from EPA featuring tools and resources like innovative models, tools, and technologies for communities to manage water runoff in urban and other environments. The resources in this toolkit incorporate green or a combination of green and gray infrastructure practices to help communities manage their water resources in a more sustainable way, increasing resilience to future changes.	2021
EPA	Tools, Strategies and Lessons Learned from EPA Green Infrastructure Technical Assistance Projects	Report	https://www.epa.gov/sites/default/files/2016-01/documents/gi_tech_asst_summary_508final1010515_3.pdf	Report from EPA summarizing practical, successful solutions to inspire city managers, community leaders and engaged citizens looking to design their community space for better health, abundant water resources, and improved quality of life.	2015
EPA	EPA Green Infrastructure Resources	Broader Resource	https://www.epa.gov/green-infrastructure	Website on EPA's green infrastructure highlighting a variety of tools, resources, and partnerships.	-
FEMA	Compiled Resources on Future Conditions and Nature-based Solutions	Broader Resource	https://www.fema.gov/sites/default/files/2020-08/fema_bric-and-nature-based-solutions_resource-materials_July_2020.pdf	Table outlining available resources for FEMA's BRIC program.	2020



Agency	Title	Type	Link	Summary	Year
FEMA	Building Community Resilience with Nature-Based Solutions: A Guide for Local Communities	Implementation Guidance	https://www.fema.gov/sites/default/files/documents/fema_riskmap-nature-based-solutions-guide_2021.pdf	Guidebook to utilizing nature-based solutions for hazard mitigation describing: what are nature-based solutions, what is the business case for using them, planning and policy considerations, implementation considerations, and federal funding opportunities, produced by FEMA RiskMAP for BRIC.	2021
HUD	Green Infrastructure and the Sustainable Communities Initiative	Report	https://www.hud.gov/sites/documents/GREENINFRASTRUCTSCIPDF	Report sharing the green infrastructure best practices and outputs of HUD grantees under the HUD Sustainable Communities Initiative grant programs as part of HUD's commitment under the Green Infrastructure Collaborative. These profiles present a high-level snapshot of the grantees' green infrastructure work and link to other resources with more detailed information on plans and projects.	2011
HUD	Navigating Federal Funding for Green Infrastructure and Nature-Based Solutions	Training Webinar	https://www.hudexchange.info/trainings/courses/navigating-federal-funding-for-green-infrastructure-and-nature-based-solutions1/	Training webinar hosted by the Green Infrastructure Federal Collaborative federal agencies discussed funding and technical assistance opportunities that advance the implementation of green infrastructure and nature-based solutions.	2021



Agency	Title	Type	Link	Summary	Year
NOAA	Fast Facts on Natural Infrastructure	Fact Sheet	https://coast.noaa.gov/sites/fast-facts/natural-infrastructure.html	NOAA Digital Coast webpage displaying quick facts, figures, statistics, benefits, and examples of nature-based solutions.	-
NOAA	Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction	Implementation Guidance	https://coast.noaa.gov/data/digitalcoast/pdf/gi-reduce-flooding.pdf	Guidebook featuring an overview of types of green infrastructure used to reduce flooding with benefits, limitations and maintenance outlined for each, planning considerations for green infrastructure projects, tips on estimating storage potential and costs, and additional resources.	2015
NOAA	Green Infrastructure Protective Services Animation	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/gi-animation.html	Video explaining green infrastructure—what it is and how it protects communities from coastal storm impacts. The video also provides information about actions communities can take to reap the benefits from this nature-based storm protection technique.	-
NOAA	Nature-Based Solutions for Coastal Hazards: The Basics	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/nbs-basics.html	NOAA Digital Coast self-guided online module to identify a community’s coastal hazard issues, ecosystem services that can reduce hazard impacts, and green infrastructure practices that can provide those services, and develop the beginnings of a community green infrastructure plan.	-



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NOAA	Nature-Based Solutions for Coastal Hazards	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/green.html	NOAA Digital Coast training to prepare coastal planners and managers for implementing green or natural infrastructure projects to reduce coastal natural hazards in their communities.	-
NOAA	Green Infrastructure Effectiveness Database	Database	https://coast.noaa.gov/digitalcoast/training/gi-database.html	Database of literature sources from NOAA containing information on the effectiveness of green infrastructure to reduce the impacts of coastal hazards, such as inundation and erosion from tropical storms and cyclones, more frequent precipitation events, and sea level rise.	2021
NOAA	Green Infrastructure Mapping Guide	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/gi-mapping.html	NOAA Digital Coast self-guided online module to learn a process for mapping green infrastructure priorities using spatial data and consider climate and hazard impacts.	-
NOAA	Green Infrastructure Peer-to-Peer Case Studies	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/	Case studies that illustrate community implementation of green infrastructure and lessons learned along with way.	-
NOAA	How to Map Open Space for Community Rating System Credit	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/crs.html	Tool that walks communities through interactive steps to map their existing and potential open space for credit through FEMA's Community Rating System.	-



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NOAA/ BOEM	Ocean Report Web Tool	Tool	https://coast.noaa.gov/digitalcoast/tools/ort.html	Web-based, report-centric tool from NOAA and BOEM that provides coastal and ocean planners with a high-level analysis for their custom-drawn area of interest. It provides summary statistics and infographics for six main topics: general information, energy and minerals, natural resources and conservation, oceanographic and biophysical, transportation and infrastructure, and economics and commerce.	-
NOAA/ EPA	Coastal & Waterfront Smart Growth	Training and Learning Resources	https://coastalsmartgrowth.noaa.gov/welcome.html	Tools, techniques, and case studies regarding resiliency options for coastal & waterfront communities.	2009
NPS	Planning Tools for Green Infrastructure	Training and Learning Resources	https://www.nps.gov/articles/000/c2-nps-planning.htm	Planning tools for utilizing green infrastructure.	2021
NPS	Coastal Adaptation Strategies Handbook	Broader Resource	https://irma.nps.gov/D ataStore/Reference/Profile/2239245	Handbook from NPS that captures current understanding of a rapidly developing field as it relates to coastal parks; identifies tools and strategies; provides examples of approaches that the NPS as an agency and individual parks are using to address coastal vulnerabilities and climate change impacts; and provides policy and decision-making guidelines.	2016



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NSTC	Research Needs for Coastal Green Infrastructure	Report	https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/cgies_research_agenda_final_082515.pdf	Report from NSTC outlining the needs for prioritized federal research to support the integration of green infrastructure into resilience and risk reduction planning, and decision making.	2015
USACE	International Guidelines on NNBF for Flood Risk Management	Implementation Guidance	https://ewn.ercdc.dren.mil/?page_id=5630	USACE International Guidelines on natural and nature-based solutions for Flood Risk Management	2021
USACE	Engineering with Nature: Atlas	Reference	https://ewn.ercdc.dren.mil/?page_id=4174	USACE Atlas 1 and 2 of Engineering with Nature principles and practices in action through illustrations and descriptions of a combined 118 constructed projects around the world. Fifty of these projects were built by USACE at sites across the country.	2018/ 2021
USACE	Engineering with Nature: Project Mapper	Tool	https://ewn.ercdc.dren.mil/?page_id=2549	Website featuring a map developed by the USACE to provide case studies of water resource projects that incorporate sustainability or supplemental environmental or social benefits into their design in addition to the primary navigation, shore protection, or other civil works project purpose. In addition to EWN project sites, ProMap also incorporates Working with Nature (WwN) and EcoShape case studies.	-



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USACE	Use of Natural and Nature-based Features (NNBF) for Coastal Resilience	Report	https://hdl.handle.net/11681/19336	Report on uses of natural and nature-based features for coastal resilience.	2015
USACE	Natural Infrastructure Opportunities Tool	Tool	https://www.arcgis.com/apps/MapSeries/index.html?appid=18079f5b628b4a7bb52acbe089d80886	Online tool from USACE outlining available resources for natural infrastructure projects including the movement and content of dredged material through placement area capacities, dredging plans, and sediment characteristic descriptions and help to identify beneficial use and infrastructure opportunities.	-
USDA	Compendium of Adaptation Approaches	Implementation Guidance	https://www.fs.usda.gov/ccrc/climate-projects/adaptation-approaches	Compendium of adaptation approaches to help natural resource managers and landowners identify actions for responding to climate change, produced by the USDA USFS.	-
USDA	Identification, Mitigation, and Adaptation to Salinization on Working Lands in the U.S. Southeast	Reference	https://www.climatehubs.usda.gov/index.php/hubs/southeast/topic/saltwater-intrusion-and-salinization-coastal-forests-and-farms	Reference website from USDA with report on identifying, mitigating, and adapting to salinization on working agricultural lands, with additional resources to learn more about salt water inundation, sea level, rise and adaptation strategies.	2021



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Climate Adaptation Resources to Inform Nature-Based Solution Projects					
NOAA	Climate Resilience Toolkit	Broader Resource	https://toolkit.climate.gov/	Comprehensive NOAA website/toolkit providing resources, tools, and studies on resilience, climate science, and adaptation.	2021
USDA	Climate Change Resource Center	Broader Resource	https://www.fs.usda.gov/ccrc/	Website on USDA climate resource center with regionally and topically specific resources.	-
USDA	Conservation Webinar Portal	Training and Learning Resources	https://conservationwebinars.net/	Conservation webinar portal with resources on upcoming trainings and current resources on land and resource management.	-
USDA	Climate Adaptation Actions for Urban Forests and Human Health	Training and Learning Resources	https://www.climatehubs.usda.gov/hubs/northern-forests/topic/climate-adaptation-actions-urban-forests-and-human-health	USDA Hub which describes diverse actions that address climate change in urban forest management, while recognizing the fundamentally interconnected nature of human health and well-being. This flexible resource synthesizes a wide range of peer-reviewed research, evidence-based reports, and emerging best practices on climate change adaptation, urban forest management, and human health impacts.	-



Agency	Title	Type	Link	Summary	Year
USDA and partners	The Adaptation Workbook	Training and Learning Resources	https://adaptationworkbook.org/	Workbook from USDA with adaptation strategies and approaches applicable to land stewardship and conservation in rural and urban areas.	-
Funding, Financing, and Valuing Nature-Based Solution Projects					
NOAA	Economic Guidance for Coastal Management Professionals	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/econ-guidance.html	NOAA Digital Coast training which provides information about a benefits-cost analysis, economic impact analysis, cost-effectiveness analysis, and more. Understanding these basics will help participants identify the appropriate approach and the data needed.	2021
NOAA	Economic Valuation Self-Guided Module and Associated Guidance Documents	Training and Learning Resources	http://coast.noaa.gov/digitalcoast/training/econ-decisions.html	NOAA Digital Coast training to provide information about benefit-cost analysis, economic impact analysis, and cost-effectiveness analysis, and to identify further data needed.	2021
NOAA	Funding and Financing Coastal Resilience Webinars	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/funding-webinars.html	NOAA Digital Coast learning products that provide audiences with the recordings, panel highlights, and resources from webinars on financing coastal resilience projects, including nature-based solutions.	-



Agency	Title	Type	Link	Summary	Year
NOAA	Funding and Financing: Options and Considerations for Coastal Resilience Projects	Implementation Guidance	https://coast.noaa.gov/data/digitalcoast/pdf/financing-resilience.pdf	Outlines a wide variety of funding opportunities for coastal resilience projects, with an eye toward opportunities for nature-based solution projects.	2021
NOAA	Economic Valuation of Shoreline Protection within the Jacques Cousteau NERR	Technical Memo	https://coastalscience.noaa.gov/data_reports/economic-valuation-shoreline-protection-within-jacques-cousteau-national-estuarine-research-reserve/	Technical memo from NOAA focused on the ecosystem of coastal habitats (e.g., seagrass beds, marshes, and coastal forests), which operate as natural infrastructure, and can benefit coastal communities, other types of human development, and economic activity by reducing the impacts of coastal hazards.	2017
NOAA	Nature-Based Solutions: Benefits, Costs, and Economic Assessments	Training and Learning Resources	https://coast.noaa.gov/digitalcoast/training/gi-practices-and-benefits.html	Series of quick references on green infrastructure practices and benefits, installation and maintenance costs, and tips for conducting an economic assessment.	-
Coastal Hazards and Coastal Change Resources to Inform Nature-Based Solution Projects					
EPA	Clearinghouse for Environmental Finance	Funding Resource Hub	https://www.epa.gov/waterfinancecenter/water-finance-clearinghouse	The Water Finance Clearinghouse provides a database with more than \$10 billion in water funding sources and over 550 resources to support local water infrastructure projects, including stormwater/green infrastructure funding.	-



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NOAA	Coastal Flood Exposure Mapper	Tool	https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html	Interactive map from NOAA that helps communities see where people, places, and natural resources are exposed to flood hazards and where natural areas can provide protection.	-
NOAA	Coastal Change Analysis Land Cover Atlas	Tool	https://coast.noaa.gov/digitalcoast/tools/lca.html	Online data viewer for user-friendly access to coastal land cover and land cover change information. The tool summarizes general change trends (such as forest losses or new development) and provides tables, maps, and reports to enhance communication and decision-making.	-
USDA	Hurricane Preparation and Recovery Commodity Guides	Tool	https://www.climatehubs.usda.gov/index.php/hubs/southeast/topic/hurricane-preparation-and-recovery-southeast-us	Interactive tool to help producers remain resilient and productive in the face of this threat, the USDA Southeast Climate Hub, along other USDA agencies and university extension experts, developed the following guides to help you prepare for and recover from hurricane events.	-
USGS	Coastal Storms - Prediction of Flooding Now and Into the Future	Training and Learning Resources	https://wim.usgs.gov/geonarrative/cch-floodfut/	Story map on future of coastal flooding and USGS CoSMoS tool.	-



Agency	Title	Type	Link	Summary	Year
USGS	National Shoreline Change - Exploring Shoreline Positions of the United States From the 1800s To the Present	Training and Learning Resources	https://wim.usgs.gov/gconarrative/cch-shline/	Story map of national shoreline change and data highlights of USGS data.	-
USGS	Real-time Forecasts of Coastal Change	Training and Learning Resources	https://wim.usgs.gov/gconarrative/cch-rtstorms/	Story map of real-time forecast of coastal change and hazards.	-
USGS	USGS Coastal Change Hazards Portal	Tool	https://marine.usgs.gov/coastalchangehazardsportal/ui/item/JoDCAjXG	Map application on the USGS Coastal Hazards Portal with info on specific hurricanes, extreme storms, sea level rise, and shoreline change.	2021
USGS	Sea-Level Change: An Interactive Guide to Global and Regional Sea Level Rise Scenarios for the United States	Tool	http://arcg.is/1He0Tz	Story map from USGS on sea level change, featuring regional and global sea level rise scenarios.	-
Guidance on Nature-Based Coastal Habitat Restoration					
Ameri Corps	Impact Evaluation on WA Conservation Corps Restoration Methods	Report	https://americorps.gov/sites/default/files/document/2018_10_25_WAStateDeptofEcologyWAConservationCorpsImpactEvaluationReport_19ES208650_Report2_Revised_508_ORE.pdf	Report from the AmeriCorps Evidence Exchange that evaluates techniques to improve plan survival and reduce invasive species, including in coastal areas.	-



Agency	Title	Type	Link	Summary	Year
Ameri Corps	Impact Evaluation on EarthCorps Restoration Methods	Report	https://americorps.gov/evidence-exchange/impact-evaluation-report-earthcorps-restoration-methods	Report from the AmeriCorps Evidence Exchange that evaluates techniques to improve plan survival and reduce invasive species, including in coastal areas.	-
NOAA	Monitoring and Evaluation for Restoration Projects	Monitoring & Evaluation Guidance	https://www.fisheries.noaa.gov/national/habitat-conservation/monitoring-and-evaluation-restoration-projects	Website with guidance on restoration, monitoring, evaluation, and feedback for habitat restoration projects. Website managed by the NOAA Fisheries Restoration Center.	2021
NOAA	Restoration Atlas	Map	https://www.fisheries.noaa.gov/resource/map/restoration-atlas	An interactive map that helps users find habitat restoration projects by habitat type, location, or congressional district.	-
NOAA	Science-Based Restoration Monitoring of Coastal Habitat Volume 1 (2003): Framework for Monitoring Plans Under the Estuaries and Clean Water Act of 2000	Monitoring & Evaluation Guidance	https://repository.library.noaa.gov/view/noaa/439	Monitoring framework from NOAA that provides technical assistance, outlines necessary steps, and provides useful tools for the development and implementation of sound scientific monitoring of coastal restoration efforts.	2003



Agency	Title	Type	Link	Summary	Year
NOAA	Science-Based Restoration Monitoring of Coastal Habitat Volume 2 (2005): Tools for Monitoring Coastal Habitats	Monitoring & Evaluation Guidance	https://coastalscience.noaa.gov/data_reports/science-based-restoration-monitoring-of-coastal-habitats-volume-two-tools-for-monitoring-coastal-habitats/	Monitoring framework from NOAA that provides technical assistance, outlines necessary steps, and provides useful tools for the development and implementation of sound scientific monitoring of coastal restoration efforts.	2005
NOAA/USFWS	Restoration Webinar Series	Training and Learning Resources	https://nctc.fws.gov/topic/online-training/webinars/restoration.html	Webinar series from the National Conservation Training Center (hosted by NOAA and USFWS) on specific nature-based projects from urban wetlands to oyster reef implementation.	2021
USDA	Coastal Zone Soil Survey	Fact Sheet	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd1369610.pdf	Fact sheet discussing the Coastal Zone Soil Survey and why it is important, featuring photos of oyster cultivation, produced by USDA NRCS.	2020
USDA	Soil Survey Web Tool	Tool	https://casoilresource.lawr.ucdavis.edu/gmap/	Interactive map allows you to explore USDA-National Cooperative Soil Survey data for locations throughout the U.S.	-
USGS/USFWS	Monitoring Habitat Restoration Projects: U.S. Fish and Wildlife Pacific Region Partners	Monitoring Guidance	https://pubs.usgs.gov/tm/tm2a11/pdf/tm2a11.pdf	Guide on techniques and methods for monitoring habitat restoration projects from USFWS programs.	2011



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Nature-Based Solutions in Barrier Island and Island Environments					
NFWF/ USACE/ USGS	Alabama Barrier Island Restoration Assessment	Tool	https://cesamusace.maps.arcgis.com/apps/MapSeries/index.html?appid=ea29cd4e1f3b432e8c520df3fb7a9f8b	Interactive tool to depict an Alabama barrier island restoration project from USACE, USGS, and NFWF.	-
NPS	Coastal and Barrier Network Geomorphological Monitoring Protocol	Monitoring Guidance	https://irma.nps.gov/D ataStore/DownloadFile /649620	Protocols for shoreline monitoring for coastal and barrier NPS shorelines.	2010
NPS	Fire Island National Seashore Breach Management Plan/EIS	Management Plan	https://parkplanning.nps.gov/documentsList.cfm?projectID=58824	Planning and monitoring resources and protocols from NPS for management of Fire Island.	-
USFWS/ USGS	Impacts of Sediment Removal from and Placement in Coastal Barrier Island Systems	Fact sheet	https://www.fws.gov/cbra/documents/FAQs-USGS-FWS-Coastal-Barrier-Report.pdf	Question and answer report on impacts of sediment removal in coastal barrier island systems, outlining the 5 key findings of the report, prepared by USGS and USFWS.	2021
USGS	Research Monitoring of Barrier Islands	Training and Learning Resources	https://wim.usgs.gov/geonarrative/cch-bi/	Story map on barrier islands.	-
USGS/ USFWS	Impacts of Sediment Removal from and Placement in Coastal Barrier Island Systems	Report	https://pubs.er.usgs.gov/publication/ofr20211062	Report on the impact of sediment removal and placement in the Coastal Barrier Island System from USGS and USFWS.	2021



Agency	Title	Type	Link	Summary	Year
<h2 style="text-align: center;">Beach Nourishment and Sediment Removal Resources to Inform Nature-Based Solution Projects</h2>					
BOEM	Economic and Geomorphic Comparison of Sand for Coastal Restoration Projects	Report	https://espis.boem.gov/final%20reports/BOEM_2020-035.pdf	Report comparing nearshore and offshore sand for utilization in coastal restoration projects.	2020
BOEM	BOEM Marine Minerals Overview	Fact Sheet	https://www.boem.gov/sites/default/files/documents/newsroom/factsheets/BOEM-FactSheet-Marine-Minerals_1.pdf	Fact sheet BOEM's approach, tools and programs critical to outer continental shelf non-energy marine mineral management which are key to coastal restoration projects.	2021
BOEM	BOEM Marine Minerals Program	Fact Sheet	https://www.boem.gov/sites/default/files/documents/marine-minerals/MMP-Factsheet-FastFacts.pdf	Fact sheet on BOEM Marine Minerals program and why and how non-energy marine minerals are important and managed.	2020
BOEM	Marine Minerals Information System (MMIS)	Fact Sheet	https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/MMIS-Factsheet.pdf	Fact sheet on BOEM's Marine Mineral Information System, available tools, how it works, who utilizes it and information it can provide.	-
BOEM	Marine Mineral Studies	Broader Resource	https://www.boem.gov/marine-mineral-studies	Website from BOEM on marine mineral studies and locally specific efforts.	-



Agency	Title	Type	Link	Summary	Year
BOEM	BOEM Marine Minerals Information Systems (MMIS)	Tool	https://mmis.doi.gov/BOEMMMIS/	Interactive tool from BOEM that provides public access to data and information relevant to offshore mineral resources throughout the United States, including sand/sediment resources for Coastal Resilience and Stewardship, Infrastructure Protection, Ecosystem Restoration, and Habitat Creation.	-
NPS	Beach Nourishment Guidance	Implementation Guidance	https://irma.nps.gov/D ataStore/DownloadFile /455109	Technical guidance by NPS for beach nourishment including tools for resource managers to interface with partners that are completing technical designs and outlines best management practices that can be utilized to avoid or minimize potential adverse impacts.	-
USACE/ BOEM	USACE Sand Availability and Needs Determination (SAND)	Tool	https://www.sad.usace.army.mil/Portals/60/siteimages/SACS/508%20SAND_FINAL_Report_15Sep_CC.pdf?ver=0m6wxMybXbFmX_UJdid1kg%3D%3D	Tool that quantifies sand needs and available sand resources for current Southeast beach nourishment projects for the next 50 years.	-



Agency	Title	Type	Link	Summary	Year
Nature-Based Coral and Oyster Reef Resources					
EPA/ NOAA	Green Infrastructure for Coral Conservation	Fact Sheet	https://www.coris.noaa.gov/activities/projects/watershed/private_green_infrastructure.pdf	Fact sheet outlining at a high level the importance of utilizing green infrastructure to protect corals, actions to be taken on individual properties and resources to learn more, produced by EPA and NOAA Coral Reef Conservation Program.	2021
NOAA	Oyster Habitat Restoration Monitoring and Assessment Handbook	Monitoring & Evaluation Guidance	http://www.oyster-restoration.org/wp-content/uploads/2014/01/Oyster-Habitat-Restoration-Monitoring-and-Assessment-Handbook.pdf	Handbook on oyster habitat restoration monitoring and assessment from NOAA, including universal monitoring metrics, variables, ancillary monitoring consideration, and metrics for success.	2014
NOAA	Coral Reef Restoration Monitoring Guide: Methods to Evaluate Restoration Success from Local to Ecosystem Scales	Monitoring Guidance	https://repository.library.noaa.gov/view/noaa/27135	Technical memo guidance for coral reef restoration and monitoring, including methodologies to measure success of restoration effort.	2020
USGS	A Geological Perspective on the Degradation and Conservation of Western Atlantic Coral Reefs	Implementation Guidance	https://pubmed.ncbi.nlm.nih.gov/27029403/	Peer reviewed USGS article on the geological degradation and conservation of coral reefs.	2016



Agency	Title	Type	Link	Summary	Year
USGS	A Framework for Identifying and Characterizing Coral Reef “Oases” against a Backdrop of Degradation	Monitoring Guidance	https://doi.org/10.1111/1365-2664.13179	Framework from USGS for coral reef managers to identify and manage coral "oases" among degraded corals.	2018
USGS	Rigorously Valuing the Potential Coastal Hazard Risk Reduction Provided by Coral Reef Restoration in Florida and Puerto Rico	Report	https://pubs.er.usgs.gov/publication/ofr20211054	Report from USGS that aims to value the Potential Coastal Hazard Risk Reduction Provided by Coral Reef Restoration in Florida and Puerto Rico.	2021
USGS	The Role of U.S. Coral Reefs in Coastal Protection	Training and Learning Resources	https://wim.usgs.gov/geonarrative/cch-reefprot/	Story map highlighting the protection coral reef systems give to coastal communities.	-

Nature-Based Living Shoreline and Dune Resources

NOAA	Guidance for Considering the Use of Living Shorelines	Implementation Guidance	https://www.habitatblueprint.noaa.gov/wp-content/uploads/2018/01/NOAA-Guidance-for-Considering-the-Use-of-Living-Shorelines_2015.pdf	Guidance for considering the use of living shorelines, including policy considerations and what types of support NOAA provides for living shorelines.	2015
NOAA	Working with Nature: A Guide to Native Plants for New York’s Great Lakes Shorelines	Implementation Guidance	https://seagrant.sunysb.edu/Images/Uploads/PDFs/GreatLakes-ShorelinePlantsGuide.pdf	Guide for utilizing native plants on NY's great lake shorelines, including integrating them into nature-based solution projects, produced by NY Sea Grant.	-



Agency	Title	Type	Link	Summary	Year
NOAA	NOAA Living Shorelines Project Map	Map	https://www.habitatblu.eprint.noaa.gov/storymap/ls/index.html	Story map outlining NOAA's Living shoreline projects across the US.	2020
USDA	Plant Materials Technical Note: Coastal Shoreline and Dune Restoration	Implementation Guidance	https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/stpmctn10670.pdf	Technical report on coastal shoreline and dune restoration, featuring technique guidance and vegetation guidance, produced by USDA NRCS.	2011
USDA	Native Plants for Coastal Dune Restoration: What When and How for Florida	Implementation Guidance	https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/flpmspu7474.pdf	Technical report on the utilization of native plants for coastal and dune restoration in Florida, produced by USDA NRCS.	2007
USDA	Plants for Coastal and Shoreline Protection and Restoration	Implementation Guidance	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/plantsanials/?cid=STELPRDB1044304	Website featuring multiple regional and locally specific technical resources and information on plants useful for coastal stabilization.	-

Nature-Based Solutions in Wetlands and Estuaries

NOAA	Planning for Sea Level Rise in the Northeast: Considerations for the Implementation of Tidal Wetlands Habitat Restoration Projects	Implementation Guidance	https://repository.library.noaa.gov/view/noaa/4016	Guide for understanding sea level rise impacts on tidal wetlands and for incorporating sea level rise into tidal wetland habitat restoration projects in the Northeast.	2011
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Agency	Title	Type	Link	Summary	Year
NOAA	Sea Level Rise Viewer Marsh Migration Data	Tool	https://coast.noaa.gov/digitalcoast/tools/slr.html	Interactive tool from NOAA that helps planners see where marshes may migrate due to sea level rise and where you can conserve inland areas to help facilitate migration.	-
NOAA/ USGS/ USFWS	Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes	Implementation Guidance	https://repository.library.noaa.gov/view/noaa/28919	Technical memo on Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes, produced by NOAA, USGS and USFWS.	2016
USDA	Climate Adaptation Tools for Wetland Conservation and Management	Implementation Guidance	https://www.climatehubs.usda.gov/hubs/northern-forests/topic/climate-adaptation-tools-wetland-conservation-and-management	Website featuring USDA Climate Adaptation Tools for Wetland Conservation and Management.	-
USFWS	Salt Marsh Sediment Augmentation to Combat Sea-Level Rise	Implementation Guidance	https://www.fws.gov/story/salt-marsh-sediment-augmentation-project	Website on a USFWS salt marsh sediment augmentation project in Seal Beach, CA, with resources on related trainings.	2019
USGCRP	Second State of the Carbon Cycle Report, Chapter 15 Tidal Wetlands and Estuaries	Whitepaper	https://carbon2018.globalchange.gov/chapter/15/	Coastal chapter within USGCRP report on the state-of-the-science assessment of the carbon cycle in North America and its connection to climate and society.	2018



Agency	Title	Type	Link	Summary	Year
USGS	Restoring Tides to Reduce Methane Emissions in Impounded Wetlands: A New and Potent Blue Carbon Climate Change Intervention	Report	https://doi.org/10.1038/s41598-017-12138-4	Paper on restoring tides to reduce methane emissions in impounded wetlands from USGS: A New and Potent Blue Carbon Climate Change Intervention.	2017
USGS	Evaluating Tidal Saline Wetland Migration along the U.S. Gulf of Mexico	Broader Resource	https://pubs.er.usgs.gov/publication/ds969	Study from USGS and USFWS that quantifies the potential for landward migration of tidal saline wetlands along the U.S. Gulf of Mexico coast under alternative future sea-level rise and urbanization scenarios.	2015

Select Nature-Based Solutions Resources from Non-Federal Entities

BBVA	Recipes for a Flourishing Arctic	Report	https://www.biophilia-fbbva.es/en/publicaciones/whither-the-arctic-ocean-research-knowledge-needs-and-development-en-route-to-the-new-arctic-2/	Publication from BBVA Foundation on natural-based solutions applied to the Arctic's governance, economy, legislation, and resource management.	2021
Cities of Service/ AmeriCorps	What Does Effective Engagement Look Like? Lessons from Resilience AmeriCorps	Report	https://citiesofservice.jhu.edu/resilience-ameri-corps-2/what-does-effective-engagement-look-like-lessons-from-resilience-ameri-corps/	Document with lessons learned about partnerships and strategies to build community resilience, produced by Cities of Service and AmeriCorps.	-



Agency	Title	Type	Link	Summary	Year
ELI	Nature-Based Mitigation Goals and Actions in Local Mitigation Plans	Study	https://www.eli.org/research-report/nature-based-mitigation-goals-and-actions-local-mitigation-plans	Study from ELI with results on a snapshot of nature-based practices that local governments may consider including in subsequent mitigation plan updates.	2021
ELI	Nature-Based Mitigation Goals and Actions in State and Tribal Hazard Mitigation Plans	Study	https://www.eli.org/research-report/nature-based-mitigation-goals-and-actions-state-and-tribal-hazard-mitigation-plans	Study from ELI with results on a suite of nature-based practices and model examples that can be used by states/tribes in mitigation plan updates.	2021
NRC	Using Nature to Address Flooding	Case Studies	http://nrcsolutions.org/	Guide of nature-based solutions and included case studies of successful projects from across the country to help communities learn more and identify which nature-based solutions might work for them.	-
NFWF	Coastal Resilience Evaluation and Siting Tool (CREST)	Tool	https://resilientcoasts.org/#Home	Tool and guidance for coastal siting with regionally specific guidance.	-
NFWF	Third-Party Evaluations of NFWF Conservation Programs	Case Studies & Evaluations	https://www.nfwf.org/strategies-results/evaluating-our-results/third-party-evaluations	This collection of third-party evaluations includes projects that utilize NBS and provides examples of assessment that capture broader socioeconomic and ecological benefits.	-



Agency	Title	Type	Link	Summary	Year
NWF and CSO	Softening Our Shorelines: Policy and Practice for Living Shorelines Along the Gulf and Atlantic Coasts	Implementation guidance	http://nwf.org/softeninourgourshorelines/	Guidance on policy and practice for implementing softened or natural shorelines across the US, produced by CSO and NWF.	-
NWF	Building Resilience through Natural Infrastructure	White Paper	https://www.nwf.org/-/media/Documents/PDFs/Press-Releases/2021/07-29-21_Building-Resilience-through-Natural-Infrastructure	An analysis of avenues and opportunities available to advance the use of nature-based solutions in FEMA and HUD programs.	2021
RAE	Coastal Restoration Toolkit	Toolkit	https://restoreyourcoast.org/	RAE Toolkit on coastal restoration to help start a restoration project guided by problem aiming to address like flooding, coastal erosion, water quality, invasive species, or wildlife habitat loss.	-
TNC	Promoting Nature-Based Hazard Mitigation Through FEMA Mitigation Grants	Funding Guidance	https://www.nature.org/content/dam/tnc/nature/en/documents/Promoting-Nature-Based-Hazard-Mitigation-Through-FEMA-Mitigation-Grants-05-10-2021-LR.pdf	Guidance document is intended for stakeholders pursuing FEMA HMA grants for nature-based solutions to mitigate risks associated with flooding (riverine and coastal) and wildfire.	2021



Federal Funding Programs for Nature-Based Solutions

The following federal programs are potential sources of support for coastal communities, States, Tribes, and Territories seeking to implement nature-based solutions. The programs encompass grant opportunities, loans, planning, design, construction and/or technical assistance.

Many existing programs now have an expanded opportunity to fund projects as a result of the Bipartisan Infrastructure Law's historic investment in the resiliency of our infrastructure to climate change, cybersecurity risks, and other hazards:

<https://www.whitehouse.gov/build/>



The EPA-led Green Infrastructure Federal Collaborative fosters engagement and cooperation between agencies that actively work to promote the implementation of green infrastructure. On November 2, 2021, members of the Green Infrastructure Federal Collaborative discussed funding and technical assistance opportunities that advance the implementation of green infrastructure and nature-based solutions. Attendees learned how federal programs are helping build vibrant and resilient communities with programs that support the design,

construction, and maintenance of green infrastructure. Breakout sessions hosted by Collaborative members provided attendees with the opportunity to pose questions and interact directly with relevant federal agencies. View the recording here: <https://youtu.be/nQCTK2jhckU>

Collaborative members developed the initial version of this funding list. They are working closely to align knowledge and resources to build capacity for green infrastructure implementation. To view more details, you can download the slides to the presentation:

https://www.epa.gov/system/files/documents/2021-11/navigating-federal-funding_green-infrastructure_508.pdf

Additional funding opportunities for green infrastructure projects may be accessed here:

<https://www.epa.gov/green-infrastructure/green-infrastructure-funding-opportunities>

These coordinated federal efforts provide a platform to publicize the multiple environmental, economic, and social benefits of green infrastructure. In addition, the Collaborative seeks to facilitate strategies that foster climate resilience and encourage the equitable implementation of green infrastructure in all communities.



Agency	Program	Link	Bipartisan Infrastructure Law Supplemental Funding
BIA	Tribal Climate Resilience Program	https://www.bia.gov/bia/ots/tribal-climate-resilience-program	\$216 million until expended
EDA	Public Works and Economic Adjustment Assistance Funds	https://www.eda.gov/funding-opportunities/	-
EDA	American Rescue Plan Program: Economic Adjustment Assistance Funds	https://eda.gov/arpa/economic-adjustment-assistance/	-
EPA	Overflow and Stormwater Grants (OSG)	http://www.epa.gov/cwsrf/sewer-overflow-and-stormwater-reuse-municipal-grants-program	-
EPA	Clean Water State Revolving Fund (CWSRF)	http://www.epa.gov/cwsrf	\$12.7 billion until expended
EPA	Water Infrastructure Finance and Innovation Act (WIFIA) ²	http://www.epa.gov/wifia	-
EPA	Section 319 Non-Point Source Grants	https://www.epa.gov/nps	-
EPA	Environmental Justice Small Grants	https://epa.maps.arcgis.com/apps/Cascade/index.html?appid=d426d553c4cc44a3af62bff7e175108e	-
EPA	Great Lakes Restoration Initiative (EPA)	https://glri.us/funding#grant-opps%C3%A2%E2%82%AC%E2%80%B9	\$1 billion until expended
EPA	Green Streets, Green Jobs, Green Towns (G3)	https://www.epa.gov/G3	-
EPA	Drinking Water State Revolving Fund	https://www.epa.gov/dwsrf	\$30.7 billion until expended



EPA	Brownfields Grant Program	https://www.epa.gov/brownfields/overview-epas-brownfields-program	\$1.5 billion until expended
EPA	Superfund Redevelopment Program	https://www.epa.gov/superfund-redevelopment	\$3.5 billion until expended
EPA	Five Star and Urban Waters Restoration Grant Program	https://www.epa.gov/urbanwaterspartners/five-star-and-urban-waters-restoration-grant-program	-
EPA	Urban Waters Small Grants Program	https://www.epa.gov/urbanwaters/urban-waters-small-grants	-
EPA	Office of Sustainable Communities Greening America's Communities Program – Technical Assistance	https://www.epa.gov/smartgrowth/greening-americas-communities	-
FEMA	Building Resilient Infrastructure & Communities (BRIC)	https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/resources	\$1 billion until expended
FEMA	Flood Mitigation Assistance (FMA) Grant Program	https://www.fema.gov/flood-mitigation-assistance-grant-program	\$3.5 billion until expended
FEMA	Hazard Mitigation Grant Program (HMGP)	https://www.fema.gov/grants/mitigation/hazard-mitigation	\$500 million until expended
HUD	Community Development Block Grant (CDBG)	https://www.hudexchange.info/programs/cdbg/	-
HUD	CDBG Section 108	https://www.hudexchange.info/programs/section-108/	-
HUD	CDBG-DR	https://www.hudexchange.info/programs/cdbg-dr/	-
NOAA	National Estuarine Research Reserve System	https://coast.noaa.gov/funding/archive.html	\$77 million / 5 years
NOAA	Community Based Restoration Program Grants	https://www.fisheries.noaa.gov/grant/coastal-and-marine-habitat-restoration-grants	\$491 million / 5 years



NOAA	National Coastal Zone Management Program	https://coast.noaa.gov/czm/about/	\$207 million / 5 years
NOAA	National Coastal Resilience Fund	https://www.nfwf.org/programs/national-coastal-resilience-fund?activeTab=tab-1	\$492 million / 5 years
USACE	Floodplain Management Services Program - Technical Assistance	https://www.nab.usace.army.mil/technical-services/	-
USACE	Planning Assistance to States (PAS)	https://www.usace.army.mil/Missions/Civil-Works/Project-Partnership-Agreements/templates_pas/	\$30 million until expended
USACE	Project Partnership Agreements (PPA)	https://www.usace.army.mil/Missions/Civil-Works/Project-Partnership-Agreements/templates_pas/	-
USACE	Individually Authorized Feasibility Studies and Projects	https://planning.ercd.dren.mil/toolbox/project.cfm?Step=2	-
USACE	Continuing Authorities Program (CAP) – including Small Flood Risk Management Projects, Beneficial Use of Dredged Material, Modification of Projects for the Environment	https://planning.ercd.dren.mil/toolbox/processes.cfm?Id=229&Option=Continuing Authorities Program (CAP).	\$465 million until expended
USACE	Tribal Partnership Program (TPP)	http://www.usace.army.mil/Missions/Civil-Works/Tribal-Nations/tribal_otherpolicies/	-
USACE	Watershed Studies (Sec 729)	http://www.usace.army.mil/Missions/Civil-Works/Project-Planning/WRRDA-7001-Proposals/	-
USDA	Regional Conservation Partnership Program	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/	-
USDA	Conservation Innovation Grants	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/	-



USDA	Environmental Quality Incentives Program	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/	-
USDA	Agricultural Conservation Easement Program (inc. Wetland Reserve Easements)	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/	-
USDA	Conservation Stewardship Program	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/	-
USDA	National Water Quality Initiative	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/initiatives/?cid=stelprdb1047761	-
USDA	Conservation Reserve Program	https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index	-
USDA	Farmable Wetland Program	https://www.fsa.usda.gov/programs-and-services/conservation-programs/farmable-wetlands/index	-
USDA	NRCS Health Forests Reserve Program	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/	-
USDA NRCS	Watershed and Flood Prevention Operations Program	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/	\$500 million until expended
USDA NRCS	Watershed Rehabilitation Program	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wr/	\$118 million until expended
DOD	Readiness and Environmental Protection Integration (REPI) Program	https://www.repi.mil/	-
DOT	FHWA Surface Transportation Block Grants	https://www.fhwa.dot.gov/specialfunding/stp/	\$72 billion / 4 years



DOT	Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Grants and Formula Funding	https://www.transportation.gov/grants	\$8.7 billion / 4 years
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