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The Role of Natural and Nature-Based Features (NBF) in Water Resources Projects: Challenges in Moving Forward.

Chairman Carper, Ranking Member Capito, members of the Committee. It is a distinct privilege to participate in this important and timely hearing on the role of natural and nature-based features in water resources projects. I want to thank the Committee for the opportunity.

I am Gerald E. Galloway, a just retired Glenn L. Martin Institute Professor of Engineering, University of Maryland, where I taught and did research in water resources and natural disaster management. I came to that position following a 38-year career in the US Army and eight years service in the federal government, most of which was associated with water resources management. I served for three years as District Engineer for the Corps of Engineers in Vicksburg, MS and later, for seven years as a member of the Mississippi River Commission. From 2009-2018 I served as a member of the Governor of Louisiana's Advisory Commission on Coastal Protection, Restoration and Conservation and from 2016 to this year as a member of the Maryland Coast Smart Council. I am currently a member of the Advisory Board of the Center of Climate and Security, and Vice Chair of the CNA Military Advisory Board dealing with climate change and national security. In1993 and 1994, I was privileged to be assigned to the White House to lead an interagency study, *Sharing the Challenge*, that examined the causes of the Great Mississippi River Flood of 1993 and made recommendations to the President concerning the nation's floodplain management program. More recently, I have had the opportunity, as a member of the National Academy of Engineering, to participate in two studies defining and discussing the importance of building resilience in our nation as a means of reducing the impacts of natural and anthropogenic disasters.

The use of natural systems and nature like features (NBF) in the development and wise use of our nation's water resources dates to the earliest inhabitants of this great land, Today they are still important parts of our efforts to ensure the sustainable use our water resources and to prevent disasters and should be seen as significant elements of the nation's portfolio to deal with these challenges. Unfortunately use of natural

systems and nature-based systems in project development is not proceeding as rapidly as it should and creates challenges for those charged with carrying out water resource development and disaster risk reduction, especially the U.S. Army Corps of Engineers (USACE) although, for the most part, these same challenges also must be faced by other Federal agencies in the water resources business. I would like to provide a little background and then discuss why we are not making adequate progress in employing these natural systems and nature like features in water resources development.

Development of Federal Guidance

Over the last 55 years the nation has grown in its recognition of the importance of the natural environment and its role in ensuring sustainability of our society. Here in Washington, in a stream of legislation, the Congress established policies and goals for the treatment of our natural resources.

in the 1965 Water Resource Planning Act, Congress stated that:

> *It is the policy of the United States that all water resources projects should reflect national priorities, encourage economic development, and protect the environment by—*
> *(1) seeking to maximize sustainable economic development;*
> *(2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and*
> *(3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems*

This was followed in 1969 by the passage of the National Environmental Policy Act which further emphasized the importance of the natural environment in gaining a better understanding of the role played by natural resources in water resources development.

> *The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation.*

Since 1970 several additional federal documents highlighted the attention that should be given to the natural environment (Clean Water Act, 1972; Unified National Program, 1976, 1979, 1994).

In 1973, the Water Resources Council, in response to the 1965 Water Resources Planning Act, issued *Principles and Standards for Planning Water and Related Land Resources.*

> *The overall purpose of water and land resource planning is to promote the quality of life, by reflecting society's preferences for attainment of the objectives defined below:*
>
> *A. To enhance national economic development by increasing the value of the Nation's output of goods and services and improving national economic efficiency.*
>
> *B. To enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecologic systems.*

The Principles also included the guidance that:

> *… there are beneficial and adverse effects for national economic development and environmental quality. These are measured in quantitative units or qualitative terms appropriate to a particular effect. The accounts are not mutually exclusive with respect to beneficial or adverse effects, and final decisions as to the selection of the recommended plan will be made by considering the differences among alternative plans as to all their effects.*

Provisions were also made for inclusion of displays of beneficial and adverse effects of a proposed project on regional development and social well-being.

In 1983, the Reagan Administration issued *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies,* which in effect created economic development as the sole objective of federal water resources planning, effectively reducing environmental and social consequences to afterthoughts.

> *Section ll—The Federal Objective (a) The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.*

In 2007, a Water Resources Development Act (WRDA) included provision that overrode the 1983 Principles and Guidelines and brought social and environmental benefits back into the picture.

> *SEC. 2031. WATER RESOURCES PRINCIPLES AND GUIDELINES.*
> *(a) NATIONAL WATER RESOURCES PLANNING POLICY.--It is the policy of the United States that all water resources projects should reflect national priorities, encourage economic development, and protect the environment by--*
> *(1) seeking to maximize sustainable economic development.*
> *(2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and*
> *(3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems…*
> *(2) IN GENERAL.--Not later than 2 years after the date of enactment of this Act, the Secretary shall issue revisions, consistent with paragraph (3), to the principles and guidelines for use by the Secretary in the formulation, evaluation, and implementation of water resources projects.*
> *(3) CONSIDERATIONS.--In developing revisions to the principles and guidelines under paragraph (2), the Secretary shall evaluate the consistency of the principles and guidelines with, and ensure that the principles and guidelines address, the following:*
> *(A) The use of best available economic principles and analytical techniques, including techniques in risk and uncertainty analysis.*
> *(B) The assessment and incorporation of public safety in the formulation of alternatives and recommended plans.*
> *(C) Assessment methods that reflect the value of projects for low-income communities and projects that use nonstructural approaches to water resources development and management.*
> *(D) The assessment and evaluation of the interaction of a project with other water resources projects and programs within a region or watershed.*
> *(E) The use of contemporary water resources paradigms, including integrated water resources management and adaptive management.*

(F) Evaluation methods that ensure that water resources projects are justified by public benefits.

In 2013, in response to the requirements of WRDA 2007, the Administration forwarded to Congress and federal agencies updated *Principles and Requirements for Water and Land Related Resources Implementation Studies (P&R)*, mirroring the federal objectives found in WRDA 2007. In 2014, it added interagency guidelines. Congressional action, however, limited through funding constraints, any participation by USACE in the implementation of the PR&G.

The 2020 WRDA directed the USACE to take steps to implement the PR&G.

DEVELOPMENT OF FUTURE WATER RESOURCES DEVELOPMENT PROJECTS.—The procedures required by subsection (a) shall ensure that the Secretary, in the formulation of future water resources development projects—
(1) develops such projects in accordance with—
(A) the guiding principles established by the principles and requirements; and
(B) the national water resources planning policy established by section 2031(a) of the Water Resources Development Act of 2007 (42 U.S.C. 1962–3(a)); and
(2) fully identifies and analyzes national economic development benefits, regional economic development benefits, environmental quality benefits, and other societal effects

Response to Disasters

Following major disasters, studies have been conducted to identify lessons learned and chart paths forward. These highlighted the necessity for protection of the environment and full use of the environment as part of the recovery process and future development.

In a 1994 White House Report on Great Mississippi Flood, *Sharing the Challenge*, an interagency committee found that:

The principal federal water resources planning document, Principles and Guidelines, is outdated and does not reflect a balance among the economic, social, and environmental goals of the nation. This lack of balance is exacerbated by a present inability to quantify, in monetary terms, some environmental and social impacts. As result, these impacts are frequently understated or omitted. Many critics of Principles and Guidelines see it as biased against nonstructural approaches… To focus attention on comprehensive evaluation of all federal water project and program effects, the President should immediately establish environmental quality and national economic development as co-equal objectives of planning conducted under the Principles and Guidelines. Principles and Guidelines should be revised to accommodate the new objectives and to ensure full consideration of nonstructural alternatives.

Following the 2005 Hurricane Katrina, a Department of the Army led Interagency Performance Evaluation Taskforce (IPET) noted that:

SUSTAINABILITY: Man-made measures alone cannot sufficiently reduce risk for vulnerable areas such as New Orleans. Natural processes and attributes such as marshes, mangroves, and barrier islands need to be integral to a systems strategy for risk reduction. In combination with traditional structures and aggressive emergency management planning and execution, an enhanced natural environment would be a major component to a sustainable and effective long-term strategy to deal with the dynamics of climate, demographics, and social and economic wellbeing.

After 2012 Super Storm Sandy, in 2015 a USACE led *North Atlantic Coast Comprehensive Study* found that:

- *Communities should adopt combinations of solutions, including nonstructural, structural, natural and nature-based, and programmatic measures to manage risk, where avoidance is not possible.*
- *Working together in a collaborative manner across multiple levels of governance (including Federal, Tribal, State, and local) and with relevant entities outside of the government to develop long-term strategies that promote public safety, protect and restore natural resources and functions of the coast, and enhance coastal resilience.*
- *Improving coastal resilience by pursuing a systems approach that incorporates natural, social, and built systems as a whole.*

In reaction to the 2017 Hurricane Harvey disaster, the State of Texas, conducted an internal review of the Hurricane's impacts, *EYE OF THE STORM. Report of the Governor's Commission to Rebuild Texas*, which noted the need to:

> *Enhance natural storm water drainage and storage across flood-prone landscapes. Natural landscape features such as wetlands, river areas and forests collect, store and slowly release storm water. They can significantly reduce losses during small to moderate flood events caused by rainfall… Multiple studies in Texas have shown the value of naturally occurring wetlands in reducing property loss during flooding…The Gulf-Houston Regional Conservation Plan, a collaborative effort of environmental, business and governmental entities, is working to preserve and protect undeveloped land in the eight-county Houston-Galveston area. Its primary focus is on nature-based infrastructure, including wetlands and river areas that can reduce runoff and slow floodwaters, and marshes and dunes that can reduce storm surge and resist sea-level rise. The plan's goal is to preserve nearly 1.2 million acres of nature-based infrastructure in the area.*

Use of NBF in Projects

Congresses and Administrations have not always been willing to embark on new environmental and social approaches, focusing instead on ensuring economic development and use of economic return to establish priorities for water resource projects. However, through innovative efforts over the years on the part of government agencies and non-governmental organizations, many NBF projects have been initiated and many highlighted in the *Engineering with Nature Atlas, Vol 2* prepared by the USACE and discussed by the first witness this morning, Dr. Todd Bridges. Across the globe, there are a large number of projects underway that demonstrate the efficiency and effectiveness of these approaches.

I must note that many of the more significant projects underway are outside of the United States where nations facing difficult water resources challenges have already begun to greatly increase their use of NBF in major projects. Colleagues in the United Kingdom, the Netherlands and other countries have embarked on many important projects. The largest natural project is taking place is occurring in China, where President Xi Jinping directed Chinese mega cities to use natural systems to capture stormwaters to prevent flooding, store water for repurposing, reduce the impacts of the urban heat island, and create water storage. He established a target of capturing

70% of stormwater within these cities, labeled *Sponge Cities*. The Chinese plan to make 80% of its urban areas sponge cities. This initiative, begun in 2014, has been very successful. In 2018 I visited four Chinese cities where I saw the effort in progress. This sponge city concept is also being followed in Singapore and in Berlin on a lesser scale. A US parallel, certainly not at the China scale, has been initiated in several major cities including Philadelphia, Chicago and New York under the rubric of low impact development using green roofs, bioswales, local flood storage, urban parks and other NBF. Given the significant impact of urban flooding on low-income and minority neighborhoods in US cities and in smaller rural communities. Such efforts are a step in the right direction.

I should also note that while NBF can play a major role role in water resource development, this is not to say that grey infrastructure, which has supported the construction of dams, levees, navigation systems etc., has not been an indispensable part of our approach to wisely using our natural resources and protecting our citizens from the challenges of natural disasters, preventing billions of dollars in flood losses, and supporting national economic development. The fiscal, environmental and social benefits of this construction over the last century have been well chronicled and indicate that such grey infrastructure may continue to be the only appropriate response under certain conditions that require human intervention to ensure the availability and use of our water resources.

Limits to Progress

If NBF do provide effective and efficient approaches to dealing with water resources, why are they not playing a larger role in execution of the nation's water resource development activities? Let me discuss some of the barriers and impediments to full utilization of the NBF in water resource development.

1. **Why do many planners not seem excited about pursuing projects that include NBF?** Forty years ago, during last years of the Carter Administration, as a consultant to the US Water Resources Council, I was asked to examine why nonstructural measures were not being widely employed by the principal Federal agencies involved in flood risk reduction. This included USACE, the Bureau of Reclamation and the Natural Resources Conservation Service. My first and most important conclusion was that nonstructural projects, including those with NBF were not being identified or moved forward because of a belief among planners and their colleagues that the projects would encounter many hurdles in review and would go nowhere once they reached Washington, if they even got there. Experience indicated to planners in the field that decision makers, reviewers at various levels, and the analysts in the Office of Management and Budget did not see the utility of non-structural approaches including NBF and could not identify economic benefits sufficient to outweigh the costs of such projects, even though there were significant environmental

and social benefits presented. Today, much of the same skepticism exists because the list of successful environmental projects is limited, especially when the principal purpose of a project is not environmental enhancement.

2. **The process and procedures used to justify water resources projects in general and environmental and social benefits are complex, unwieldy and not transparent.** This is closely linked with the concern over lack of support for such projects at higher levels. Almost since the 1936 initiation of benefit-cost, analysis, those responsible for budgeting both in Administrations and Congresses have sought to increase the preciseness of the analyses of benefits and costs being conducted. As a result, a tangle of instructions, procedures, and directions has been developed and has overwhelmed the planning process and created delay in reasonable execution of the planning. Each decade, additions have been made to the analyses that must be accomplished in the ever-sought-after goal of increased accuracy and quantitative justification. An examination of aa list of USACE publications in the field of planning for the past three decades indicates a continuous rise in their numbers. As was learned following Katrina, an increasing number of guidance documents creates a slowdown in the ability of the agency to maintaining the currency of the documents that have been published.

3. **Efforts to broaden the benefit base for projects to include environmental and social benefits, in many cases, are hampered by the lack of local interest in carrying out such "uneconomic, not-main purpose" approaches.** This has occurred **s**ince the 1986 introduction of cost sharing in USACE projects and increased local participation, In part this occurs because the non-Federal sponsors typically represent the principal users of the proposed projects and those who are seeking future development from these projects vs. others who have environmental and social stakes and interests in taking a broader approach.

4. **There is a lack of understanding within government agencies at both the Federal and local level concerning the purposes and benefits of NBF** and**,** as a result, it is difficult to build support for inclusion of NBF in a project design, especially if the inclusion will cause will increase the costs of the project, especially to the local sponsors. Part of this lack of understanding can be expected since the effectiveness of NBF has not been widely demonstrated. As was discovered in a justification for elements of the rehabilitation of the Everglades, it takes years, if not decades, for the full benefits of NBF to be fully realized.

5. **Much of the work in water resource development is conducted within inefficient and ineffective stovepipes** that exist within agencies, committees of the Congress, and academic disciplines. Creation of NBF in projects requires

considerable cross-discipline and cross turf coordination and understanding. The late Congressman Jim Oberstar, former Chair of the House T& I committee once noted, “the diverse water resources challenges throughout the United States are often studied, planned, and managed in individual "silos," independently of other water areas and projects. Generally, this has resulted in local and narrowly focused project objectives with little consideration of the broader watersheds that surround these projects.” Effective NBF development requires a paradigm shift to collaborative efforts.[i]

6. **Congressional actions have limited full consideration of NBF**. It is difficult for local officials and USACE planners to understand why the Congress in 2007, as indicated above, directed the Administration to develop planning procedures that would fully consider environmental and social benefits and then, when in 2013 the Administration sent new procedures forward, the Congress took action to limit the use of these new procedures by USACE (and by inference within other agencies). This action created much of the skepticism as to use of NBF and consideration of social benefits that exists today. The direct result of this was a delay in the development of a 21st century benefit-cost analysis process that would fully consider all the costs and benefits involved in such projects and that would bring NBF, social and environmental justice, and social welfare into the tally. The direction in WRDA 2020 for USACE to revise its planning guidance to accommodate the new approach may make a difference if no adverse action is allowed to take place when revisions reach the Congress.

7. **NBF are new on the block and there are many unknowns and existing biases that must be overcome**. Some NBF offer a potential to reduce water pollution, sequester carbon, lower temperatures in heat islands, improve quality of the local environment, and add to social ambiance, benefits that are not easily quantified. Although environmental groups and some government agencies have been working with NBF for nearly a half century, there are still open questions that to many must be fully resolved before commitments are made to move in this new direction. Engineers and their clients, for the most part, understand the performance metrics of the grey infrastructure they support, and a considerable body of knowledge exists to consider modifications and changes required under changing local conditions. The same cannot be said for NBF as most projects are unique to their geographic location and performance information is not readily transferable to other locations. NBF frequently require more land than does grey infrastructure leading to concern over potential loss of tax base.

8. **There is an obvious lack of will to move ahead with NBF** (and social approaches) **in the face of the unknowns** mentioned in the previous paragraph, and growing constituent concerns over budgetary pressures. I would note that

in moving forward with the Sponge City concept in China, the government and the professional community faced many questions concerning how such a massive effort might fully be carried out, however the leadership of the country recognized the necessity address the issue and to act and it did so. The same can be said of the government of the Netherlands' response to the potential impacts of climate change and sea level rise. While there were still uncertainties in understanding the impacts that would take place over time, the government determined that action was needed and moved ahead with major strengthening of levees and dikes and NBF in the form of "Room for the River" and other similar projects.

What to Do?

What can the Congress to do to increase the use of NBF in water resources development. I would recommend that:

1. The Congress, through the relevant congressional committees**, recognize and accept the benefits of NBF and the unknowns that still accompany their use**, **and support, in authorization and appropriation, the full use of NBF** where the USACE identifies a favorable benefit-cost analysis employing both quantitative and qualitative analyses.

2. The Congress **support the rapid approval of changes to planning documents required under WRDA 2020,** section 113.

3. The Congress, if action has not been taken under section 113 of WRDA 2020, **direct**, in the next WRDA, **USACE and other Federal agencies and the Administration to simplify procedures for approval of NBF.**

4. The Congress **identify the use of NBF and social elements of projects as integral elements of these water resource development project**s and not require separate authorizations just as the decision on use of flood wall vs, a levee is an engineering decision within the purview of the construction agency. Decisions on use of NBF or social focused project elements should be left to USACE and other construction agencies.

In Conclusion

Policies that create fences between agencies hinder cooperative efforts and deprive those in need of the assistance they need. They make little sense.

The use of NBF is not the sole answer to meeting the challenges of 21st Century water resource development, but a failure to promote their use where it makes sense is

passing up opportunities that offer long term rewards. Continuing reliance primarily on economic justification of projects makes it difficult for those in rural and low-income areas to justify projects that would give them considerable environmental, social and conceivably health benefits. The recent NASEM studies of affordability of flood insurance gives a very clear picture of the differential level of flood protection under various economic situations and strong reason to consider all factors in project justification.

References

American Society of Civil Engineers. 2021. Hazard-Resilient Infrastructure: Analysis and Design Bilal M. Ayyub, Ed. Infrastructure Resilience Division.2021, Reston: ASCE

Bridges, T. S., E. M. Bourne, B. C. Suedel, E. B. Moynihan, and J. K. King. 2021. Engineering With Nature: An Atlas, Volume 2. ERDC SR-21-2. Vicksburg, MS: U.S. Army Engineer Research and Development Center. http://dx.doi.org/10.21079/11681/40124.

Cole, Richard. Sustainability and Ecosystem Restoration in the U. S. Army Corps of Engineers. Richard 2010. US Government Institute for Water Resources, USACE. Power Point Presentation. Alexandria., VA: IWR

Congressional Research Service. Flood Risk Reduction from Natural and Nature-Based Features: Army Corps of Engineers Authorities. CRS R46328 April 27, 2020.

Federal Interagency Floodplain Management Task Force (FIFMTF). 1994. Unified National Program for Floodplain Management. Washington: FEMA

Flood Risk Management Call for a National Strategy Edited by Robert Traver, Ph.D., P.E. Task Committee on Flood Safety Policies and Practices 2014

Galloway, G. E,. 1980. Nonstructural Measures in Flood Damage Reduction Activities." Consultant Report for US Water Resources Council, Washington D.C.

Galloway, G. E,. 1981. Impediments In the Process for Development of Federal Water Resource Projects:. Why All The Delay And What Can We Do About It? Consultant Report for US Water Resources Council, Washington D.C.

Governor's Commission to Rebuild Texas. EYE OF THE STORM Report of the Governor's Commission. Office of the Governor; Austin TX .

Interagency Floodplain Management Review Committee, Executive Office of the President. 1994. Sharing the Challenge: Floodplain Management into the 21st Century. Washington, GPO. (available at http://www.floods.org/Publications/free.asp)

Interagency Performance Evaluation Taskforce (IPET). 2009. US Army Corps of Engineers, Vicksburg. https://biotech.law.lsu.edu/katrina/ipet/ipet.html

National Committee on Levee Safety (NCLS). 2009. Draft Report to Congress on Recommendations for a National Levee Safety Program. Washington: US Army Corps of Engineers. Available at http://www.iwr.usace.army.mil/ncls/docs/NCLS-Recommendation-Report_012009_DRAFT.pdf

National Research Council. 2012. Disaster Resilience: A National Imperative. Washington: National Academy Press.

0berstar, Honorable James L.2009.Remarks before the USACE Conference, "Collaborating for a Sustainable Water Resources Future" August 27, 2009

Opperman, Jeffrey J, Gerald E Galloway, Joseph Fargione, Jeffrey F Mount, Brian D Richter, and Silvia Secchi. "Sustainable Floodplains through Large-Scale Reconnection to Rivers." Science 326, no. 5959 (2009): 1487–88

Opperman, Jeffrey J, Gerald E Galloway, and Stephanie Duvail. "Encyclopedia of Biodiversity." Essay. 2013. In The Multiple Benefits of River-Floodplain Connectivity for People and Biodiversity, 144–60. Elsevier Inc, 2013. https://doi.org/10.1016/B978-0-12-384719-5.00325-7.
Resilient Design Institute. 2021. The Resilient Design Principles https://www.resilientdesign.org/the-resilient-design-principles/

Smith, M.P., Galloway, G., van Wesenbeeck, B.K., Heynert, K., Brideau, J., Joseph, T., The Path to a Safe and Sustainable Future: Mainstreaming Nature-based Approaches in Comprehensive Flood Risk Management., The Nature Conservancy, 2017.

US. Pub. L. 89–80, §1, July 22, 1965, 79 Stat. 244, Water Resources Planning Act

US. Pub L 110-114 (HR 1495). 2007.WATER RESOURCES DEVELOPMENT ACT OF 2007

US Army Corps of Engineers, Institute for Water Resources, 2018. The Development of Water Resources Planning in the United States from the Reclamation Act of 1902 to the Principles and Standards of 1973. Alexandria, VA: IWR

US Army Corps of Engineers. 2015. North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk. U.S. Army Corps of Engineers. Washington DC
http://www.nad.usace.army.mil/CompStudy

U.S. Army Engineer Research & Dev. Ctr., ERDC. 2015_ Use_of_Natural_and_Nature-Based_Features_NNBF_for_Coastal_Resilience.
https://www.researchgate.net/publication/271763884

US Water Resources Council. 1973. Water and Related Land Resources: Establishment of Principles and Standards for Planning. Washington: WRC

US Water Resources Council. 1976. A unified national program for flood plain management. Washington: WRC

WWAP (United Nations World Water Assessment Programme/UN-Water. 2018. The United Nations World Water Development Report 2018: Nature-Based Solutions for Water. Paris, UNESCO.