2021

TMAC

TECHNICAL MAPPING ADVISORY COUNCIL

ANNUAL REPORT

May 3, 2022

Deanne Criswell
Administrator
Federal Emergency Management Agency
500 C Street SW
Washington, DC 20472

Administrator Criswell,

As Chair of the Technical Mapping Advisory Council (TMAC), I am pleased to forward to you the TMAC *2021 Annual Report* for your consideration. This Annual Report includes three recommendations for FEMA to consider.

Typically, the TMAC would conduct a mix of in-person and virtual meetings; however, due to the Coronavirus pandemic, the TMAC was forced to hold all meetings virtually. Even without any in-person meetings, the TMAC was able to effectively conduct its business to deliver the *2021 Annual Report*. The TMAC conducted three virtual public meetings and eight virtual administrative meetings between March 2021 and February 2022. Subcommittees were established and met regularly with invited subject matter experts, who presented information relevant in the construction of the proposed recommendations contained in the 2021 Annual Report. Through much effort, discussion, and deliberation, the work of the TMAC culminated in voting to finalize the report in February 2022.

TMAC's efforts in 2021 involved continued stakeholder engagement and focused in two areas: 1) review of our 2015 recommendations regarding the development of future conditions flood hazard and risk information; and 2) an exploration of risk management frameworks with a focus on enterprise risk management approaches. In summary, the TMAC continues to promote the development, deployment, and continued enhancement of the Future of Flood Risk Data (FFRD) initiative including supporting existing partnerships to leverage best available climate science and efforts to develop standard approaches in the probabilistic modeling suite and resultant nonregulatory products. Moreover, the TMAC has recommended FIMA use enterprise risk management to accomplish its strategic objectives including its efforts to further promote the use of graduated flood hazard and risk data.

The TMAC is excited to continue providing thoughtful recommendations to you and is working with FEMA staff to help guide our 2022 efforts.

Respectfully,

Doug Bellomo, P.E., PMP
Chair
Technical Mapping Advisory Council

Acknowledgments

2021

The TMAC would like to acknowledge the efforts of several subject matter experts who provided important insights through briefings, presentations, and dialogue in the development of the TMAC's response to FEMA: Alex McElroy, Brian Caufield, Camille Crain, Casey Zuzak, Christina Lindemer, Dave Canaan, David Bascom, David Herring, David Reidmiller, Doug Marcy, Emily Pindilli, Gayle Bowness, Kerry Bodgan, Lauren Schmeid, Leonard Shabman, Matthew Meyer, Patrick Barnard, Peter Claggett, Peter Slovinsky, Salomon Miranda, Stacey Archfield, Stephen Aichele, and Tim Trautman. Additional thanks and gratitude for extraordinary work that was instrumental to the development of key elements of this report goes to Robert Mason, Extreme Hydrologic Events Coordinator and Senior Science Advisor for Surface Water with the U.S. Geological Survey (USGS), and William Lehman an economist and risk management expert with the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center.

The Production and Technical Services (PTS) support staff also provided exceptional support throughout the year. Efforts included the coordination and support of committee leadership, members, and subcommittees; stakeholder engagement and outreach; and the development and production of the report. This team includes Ann Terranova, Jen Marcy, Milani Chatterji-Len, Molly Tuttle, and Phetmano Phannavong. Additional gratitude to the editing and graphic design teams led by Susan Patton and Lee-Ann Lyons, respectively. The TMAC would also like to extend its thanks to Henry Cauley, Sarah Vining, Alexis Richmond, and the rest of TMAC Project Management Team for their efforts in coordinating the many logistical requirements of the Council.

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EXECUTIVE SUMMARY

In 2021, there were 20 weather and climate-related disasters in the United States that caused over $1 billion in damages (with total estimated damages at over $145 billion), and many of them had a flooding component (NOAA https://www.ncdc.noaa.gov/billions/). There were two land-falling hurricanes and two tropical storms as well as severe weather events in the central part of the Nation. Floods have always been and remain the most prevalent natural disaster in the Nation, and the impacts of flooding continue to disrupt lives and communities, damage infrastructure, and cause loss of life. As a Nation, we must continue to improve our understanding of flood risk and subsequently take steps to reduce losses and human suffering.

The Federal Emergency Management Agency (FEMA) aims to provide comprehensive flood risk data to inform people's flood insurance and risk mitigation investment decisions and foster a culture of preparedness across the Nation through administration of the National Flood Mapping Program. The Technical Mapping Advisory Council (TMAC), a Federal Advisory Committee, has provided recommendations to FEMA since 2014 related to the National Flood Insurance Program (NFIP) and the National Flood Mapping Program, as authorized and directed by the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12) and the Homeowner Flood Insurance Affordability Act of 2014. Since its establishment in 2014, TMAC has delivered nine final reports, as shown in summary Figure ES-1. The reports include 37 recommendations (with additional subrecommendations) and 13 implementation actions. Many of these formal recommendations and implementation actions (accompanying suggestions on how to implement the formal recommendations) are being considered and implemented as FEMA continues to improve program delivery.

In 2021, FEMA tasked the TMAC to improve understanding regarding the development and application of graduated flood hazard and risk information through continued stakeholder engagement, to review prior recommendations from the TMAC *Future Conditions Risk Assessment and Modeling* report (hereafter referred to as the 2015 Future Conditions report [TMAC, 2015a]) and identify new ones, and to explore how risk management frameworks, such as Enterprise Risk Management (ERM), might be applied in sectors such as flood risk management (FRM).

To accomplish FEMA's request, the 2021 TMAC was assembled as mandated in BW-12 as a group of professionals with demonstrated knowledge and competence regarding surveying, cartography, remote sensing, geographic information systems, or the technical aspects of preparing and using Flood Insurance Rate Maps (FIRMs). The stakeholder engagement process, as well as investigations into prior Future Conditions

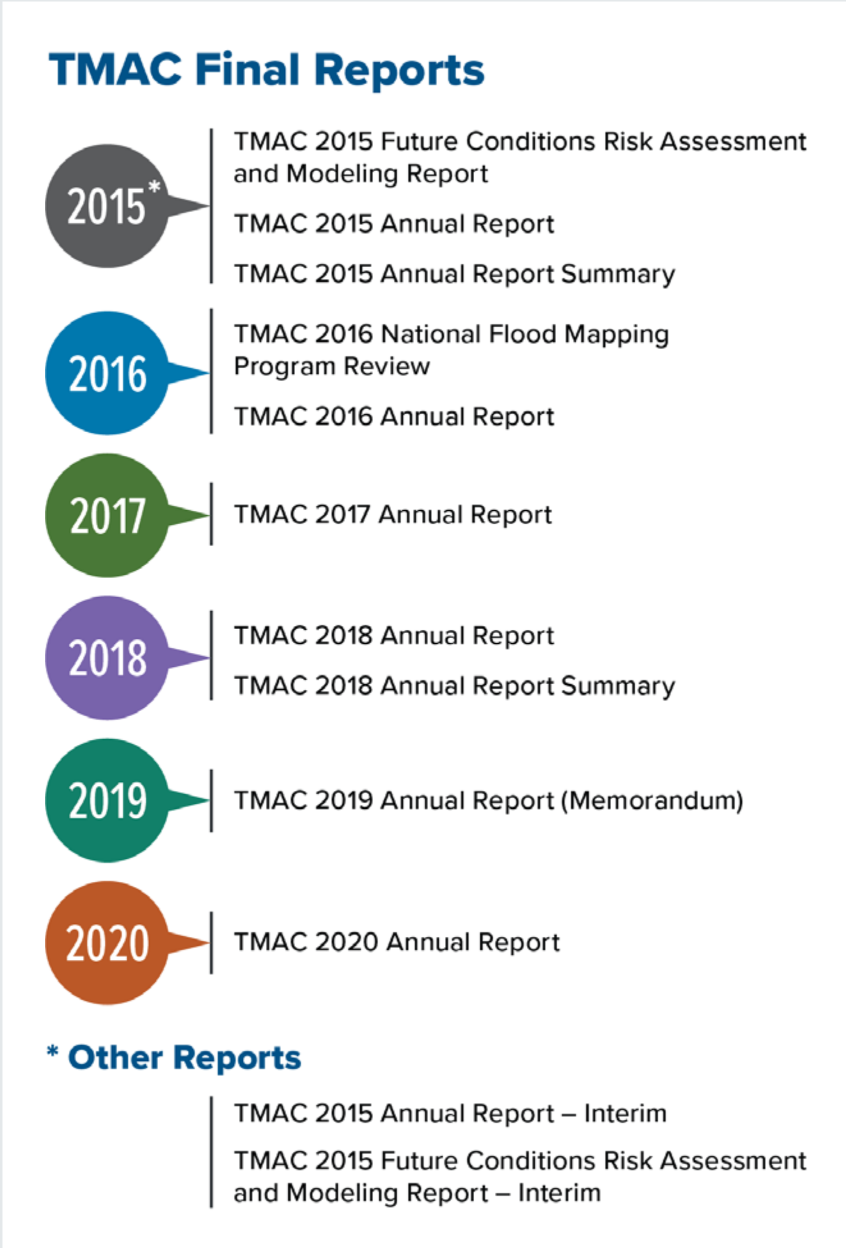

Figure ES-1: Summary of past TMAC publications

Source: Annual Reports and Recommendations | FEMA.gov

recommendations and exploration of risk management frameworks, resulted in modification of 27 prior recommendations (including subrecommendations) and the development of 3 new recommendations as part of this 2021 TMAC report. New recommendations are presented in Table ES-1, and modified recommendations are presented in Table 3-2.

Table ES-1: 2021 New TMAC Recommendations

Number	Recommendation
Future Conditions Recommendation No. 1	FEMA should incorporate the Future Conditions recommendations outlined in this report into the development, deployment, and continued enhancement of the Future of Flood Risk Data (FFRD) initiative. This includes supporting existing partnerships to leverage best available climate science and datasets that will support future conditions analyses through the lens of the FFRD initiative. Future conditions flood hazard and risk analyses should be standard approaches within the probabilistic modeling suite and resultant nonregulatory products that the FFRD initiative will employ.
Enterprise Risk Management Recommendation No. 1	The Technical Mapping Advisory Council (TMAC) recommends that the Federal Insurance and Mitigation Administration (FIMA) use Enterprise Risk Management (ERM) to accomplish its strategic objectives. ERM can guide FIMA's efforts to prioritize and then mitigate or take prudent risks that increase the likelihood that FIMA can achieve its organizational objectives.
Enterprise Risk Management Recommendation No. 2	The FIMA is building an analytical foundation of graduated risk data, concepts, and products, as recommended by the TMAC in 2017. FIMA should leverage ERM processes and concepts to prudently take opportunity risks to promote widespread use of graduated risk in flood risk management decision making by governments, businesses, and individuals.

The 2021 TMAC engagement survey responses demonstrated agreement in opinions on adopting graduated flood hazard and risk data and a probabilistic modeling approach to support a more comprehensive understanding of flood risk, including respondents' understanding of new approaches and behavior change, their perception of the benefits of new approaches, and their perception of the challenges of new approaches. Respondents were generally hopeful about the shift to graduated view of flood hazard and risk data, but also had a limited understanding of graduated risk analysis. Given the uncertainty of future climatic changes, many respondents felt that there is a need for a more dynamic, graduated product that can communicate varied levels of flooding across a community was needed. The stakeholders acknowledged the obstacles to optimal use of graduated risk information, such as regulatory consistency, public buy-in, and equity concerns.

The main outcome of reviewing prior recommendations from the 2015 Future Conditions report (TMAC, 2015a) was to revise 27 of the 44 recommendations, taking into consideration FEMA's shift from a binary to graduated view of flood hazard and risk data. The TMAC adjusted these prior recommendations to incorporate new science and information and to better align them with current-day FEMA programs and initiatives, including its Future of Flood Risk Data (FFRD) initiative. Broadly speaking, these adjustments add clarity, given what is known today about the state of technology, broaden recommendations to address newly identified needs, and recognize science or programmatic advances that have been made since 2015. Only one new Future Conditions recommendation has been added for consideration, and it addresses the need to incorporate future conditions into the development, deployment, and continued enhancement of FFRD.

The main result of exploring how risk management frameworks might be applied in sectors such as FRM was to demonstrate how the Federal Insurance and Mitigation Agency (FIMA) can successfully implement ERM. Since little evidence was uncovered to suggest that state and local FRM authorities have successfully implemented ERM, the TMAC developed an example ERM plan for FIMA. FEMA, in general, and FIMA, in particular, have excellent potential to benefit substantially from the implementation of ERM. The TMAC applauds FIMA for its ongoing ERM efforts and encourages its continued effort to complete the work.

The TMAC urges FEMA to use the findings of this report to better inform program delivery so that communities throughout the United States can be afforded the best possible protection against flood-related disasters. Given that the negative impacts of flooding are exacerbated by climate change, it is essential that communities be prepared for future disasters. The TMAC is committed to continuing to advise FEMA on how to effectively administer the NFIP and the National Flood Mapping Program to support its critical work.

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ACRONYMS

1% AEP	1 percent Annual Exceedance Probability
ADFO	Alternative DFO
ALE	Annualized Loss Estimate
APCIA	American Property and Casualty Insurance Association
AR5	Fifth Assessment Report
ASFPM	Association of State Floodplain Managers
BCA	benefit-cost analysis
BFE	base flood elevation
BRIC	Building Resilient Infrastructure and Communities
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012
CCAMP	*California Coastal Analysis and Mapping Project*
CFO/IT	Chief Financial Officers/Intelligence Community
CFOC	Chief Financial Officers Council
CMIP	Coupled Model Intercomparison Project
CMSWS	Charlotte-Mecklenburg Storm Water Services
COSO	Committee of Sponsoring Organizations
CRAB	Climate Ready Action Boundary
CRS	Community Rating System
CRT	Climate Resilience Toolkit
CS-CRAB	State Coast Smart Councils – Climate Ready Action Boundary
DFO	designated federal officer
EPA	U.S. Environmental Protection Agency
ERM	Enterprise Risk Management
FAIR	Findability, Accessibility, Interoperability, and Reusability
FC	Future Conditions Recommendation
FEMA	Federal Emergency Management Agency
FFRD	Future of Flood Risk Data
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FIMA	Federal Insurance and Mitigation Administration
FINS	Flood Information and Notification System
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FIT	Flood Information Tool
FRD	Flood Risk Database
FRM	flood risk management
FY	Fiscal Year
GDP	gross domestic product
GHG	greenhouse gases
GIA	glacial isostatic adjustment
GIS	geographic information system
HMA	Hazard Mitigation Assistance
HUC	hydrologic unit code
IDF	Intensity-duration-frequency (data)
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
IWG-SLR	Inter-agency Working Group on Sea Level Rise and Coastal Flood Hazard Scenarios and Tools
IWRSS	Interagency Water Resources Science and Services
LMI	low- to moderate-income
LRSL	local relative sea level
LTCE	long-term coastal erosion
MPR	Mandatory Purchase Requirement
NASA	National Aeronautics and Space Administration
NCA	National Climate Assessment
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NRDC	Natural Resources Defense Council
OMB	Office of Management and Budget
OPC	Open Pacific Coast
PIC	Performance Improvement Council
PII	Personal Identifiable Information
Program	National Flood Mapping Program
PTS	Production and Technical Services
RIDM	risk-informed decision-making
Risk MAP	Risk Mapping, Assessment and Planning
RL	repetitive loss
RR	Risk Rating 2.0
SALT	Strategy, Action, Learning Tools
SFHA	Special Flood Hazard Area
SLR	sea level rise
SLTT	state, local, tribal, and territorial
SME	Subject Matter Expert
SOST	Subcommittee on Ocean Science and Technology
SRL	severe repetitive loss
TMAC	Technical Mapping Advisory Council
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USGS	U.S. Geological Survey
VLM	vertical land motion

KEY CONCEPTS

Binary flood hazard and risk versus graduated flood hazard and risk. In 1973, the National Flood Insurance Act of 1968 was amended to establish the mandatory purchase requirement, which requires all homeowners within a floodplain to purchase flood insurance. This has resulted in a binary view of flood hazards and risks, including an oversimplified approach to floodplain management. Today, risk is understood to be more graduated than the "in/out" dichotomy of the statute, and therefore, a graduated depiction of hazards and risks is important to communicate the true nature of flooding. The shift from a binary view of flood hazards and risks to a more graduated depiction and communication of risk involves using data and tools to leverage additional analysis and information beyond current practices to enhance our understanding of the probability of flood scenarios.

Enterprise Risk Management. Enterprise Risk Management (ERM) is a type of risk management approach that focuses on the ability of an enterprise to meet its strategic objectives. Within ERM, risk is defined as the effect of uncertainty on meeting strategic objectives (ISO, 2018). The goal of ERM is to increase the certainty of achieving strategic objectives across the entity by monitoring entity-level risks that affect multiple objectives yet are not the responsibility of any given program or project. By managing these risks at a higher level, decision-makers can direct the risk appetite of the organization to appropriately take, mitigate, or avoid risks to improve the certainty of success. Office of Management and Budget (OMB) Circular A-123 requires federal agencies to prepare and utilize ERM plans. For the Federal Insurance and Mitigation Administration (FIMA), a migration to the use of graduated flood hazard and risk data presents both opportunity and loss risks across multiple strategic objectives. Without ERM, internal and external forces will have an outsized impact on FIMA's ability to meet its objectives in this area. Through ERM, FIMA can use disciplined risk management activities to leverage opportunity risks against loss risks to achieve greater reductions in disaster suffering for the Nation.

Future conditions. For the purposes of this report, and in alignment with the FEMA definition, "future conditions" encompasses both natural and human changes and impacts (e.g., sea level rise, ground subsidence, erosion, rainfall patterns, population changes, land use policies, development). Work by the Future Conditions Subcommittee to address the 2021 FEMA tasking, documented in Chapter 3 of this report, assumed the broader definition of future conditions, including both natural and human (manmade).

National Flood Mapping Program. The term "National Flood Mapping Program," as used in Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12), has been defined as the national program dedicated to flood mapping. FEMA carries out flood mapping through the Risk Mapping, Assessment, and Planning (Risk MAP) program and the National Flood Insurance Program (NFIP). The National Flood Mapping Program includes both regulatory products, such as Flood Insurance Rate Maps (FIRMs) and flood profiles, and non-regulatory elements, such as Flood Risk Databases (FRDs).

Probabilistic approach versus deterministic approach. In this report, the term "probabilistic approach" refers to the practice of taking a variety of input parameters to yield a variety of potential outcomes. These many outcomes are compiled together and represented through probabilities. On the other hand, a deterministic approach uses one set of input parameters to yield a single given outcome, an example of which is the current 100-year floodplain, or the Special Flood Hazard Area (SFHA).

Recommendations, Subrecommendations, and Implementation Actions. As in past iterations of the Technical Mapping and Advisory Council (TMAC) Report, the TMAC's formal recommendations and subrecommendations to FEMA are numbered and included in tables of recommendations. To avoid confusion, informal recommendations do not have numbers associated with them, are solely embedded in the text, and will not be referred to as "recommendations" but rather may be preceded by words such as "should" or "could." Implementation Actions are further suggestions to FEMA on how to implement the formal recommendations but are not recommendations themselves.

Uncertainty. Estimating flood risks requires a series of linked and sequenced models. Each model—indeed, each input to each model—contributes some level of uncertainty around the final estimate of the probability of flooding at each pixel location in the geospatial domain. For example, estimating the flood flow requires one or more hydrologic or statistical models, each contributing uncertainty. Subsequently distributing the selected flows across the floodplain requires one or more hydraulic models, each also contributing uncertainty. The concept also applies to other geophysical and meteorological processes. Among those sources of uncertainty are the estimation of flows and hydraulic inputs and their uncertainty. For example, assuming we know how much rainfall might land in a watershed, the resulting flow in a river can be influenced by various antecedent conditions in the watershed, which change the flood flow and have a cascading influence on the resulting flood stages in a floodplain. Uncertainty is generally measured as the variability around an estimate. It can be pictured as a bell curve of repeated measurements or simulated results. Although managing with uncertainty may be challenging, it is not impossible. In fact, quantifying the uncertainties allows analysts to place confidence limits around their point estimates. These confidence intervals can help decision-makers align their objectives so that they can be more certain in meeting them.

Unmapped areas. Some areas in the United States have no or only limited flood hazard data, particularly in undeveloped or underdeveloped areas. However, there are significant benefits of providing flood hazard and risk information in areas with little development and in areas where future development is possible. These benefits go beyond informing flood insurance decisions to include bringing equity to the availability of data, avoiding development in risky areas, and informing and improving emergency action plans. Unmapped urban areas, often labeled as Zone X (unshaded) on the FIRM, have different concerns. Flooding in these areas from intense rainfall can overwhelm urban stormwater systems or the infiltration capacity of the ground. Urban and pluvial flooding can form sheet flows or pooling of water in areas that are beyond the reach of larger flooding sources. The modeling techniques required to estimate the extent and probability of pluvial flooding are more data intensive and complex, and thus generally more uncertain and expensive to develop than the models used for riverine flood hazards.

Future of Flood Risk Data Initiative. FEMA's Future of Flood Risk Data (FFRD) initiative provides a comprehensive picture of flood hazards and risk by leveraging new technologies to include more efficient, accurate, and consistent flood risk information across the Nation. FFRD includes four major elements:

1. Shift from binary to graduated risk analysis
2. Ensure a significant and appropriate role for the private sector and state, local, tribal, and territorial (SLTT) entities
3. Increase access to flood hazard data to improve resulting mitigation and insurance action
4. Modernize the management and delivery of flood hazard mapping

01 INTRODUCTION

Helping Americans before, during, and after disasters is the Federal Emergency Management Agency's (FEMA's) mission. Through the National Flood Insurance Program (NFIP) and the National Flood Mapping Program, FEMA aims to provide comprehensive flood hazard and risk data to inform flood insurance pricing and flood risk mitigation activities, including floodplain management. The Technical Mapping Advisory Council (TMAC), a federal advisory committee, supports FEMA in its efforts by reviewing and making recommendations on matters related to flood hazard and risk mapping as authorized and directed by the Biggert-Waters Flood Insurance Reform Act of 2012 (42 United States Code [U.S.C.] Sections 4001–4130) (BW-12), the Homeowner Flood Insurance Affordability Act of 2014, and Agency tasking.

Background on the TMAC is provided in Section 1.1 and details on the 2021 TMAC members and focus are provided in Section 1.2.

1.1 TMAC BACKGROUND

Since the BW-12 mandate establishing the TMAC in 2013, the TMAC has continued to successfully implement its mandate. Figure 1-1 presents a timeline of the 12 reports that TMAC has published since 2015, not including this 2021 annual report. In addition to five final annual reports, the TMAC has produced two interim reports, two summary reports, and three other reports. These reports include a combined total of 132 subrecommendations, implementation actions, and formal recommendations to FEMA.

TMAC's reports were provided under the authorities and responsibilities described in Sections 1.1.1 and 1.1.2.

1.1.1 TMAC AUTHORIZATION

BW-12 mandated that FEMA establish a federal advisory committee to provide advice and recommendations to improve the preparation of Flood Insurance Rate Maps (FIRMs) created under the National Flood Insurance Program (NFIP) and on future risks from climate change, rising sea levels, and FIRM development. Pursuant to BW-12, FEMA filed the charter with Congress on July 29, 2013, that formally established the Council.[1]

The TMAC views elements of today's NFIP as a significant part of a new, much stronger foundation for an improved national flood risk management (FRM) framework that

NATIONAL FLOOD INSURANCE PROGRAM

FEMA administers the NFIP through the Federal Insurance and Mitigation Administration (FIMA). Created with the passage of the National Flood Insurance Act of 1968, the NFIP is an insurance, mapping, and floodplain management program that makes federally backed flood insurance available to home and business owners and renters in communities that participate in the program. By participating in the NFIP, communities agree to adopt ordinances and enforce minimum building requirements that reduce the risk of flooding.

1 Microsoft Word - 2021 TMAC Bylaws_Updated_8-6-2021.docx (fema.gov)

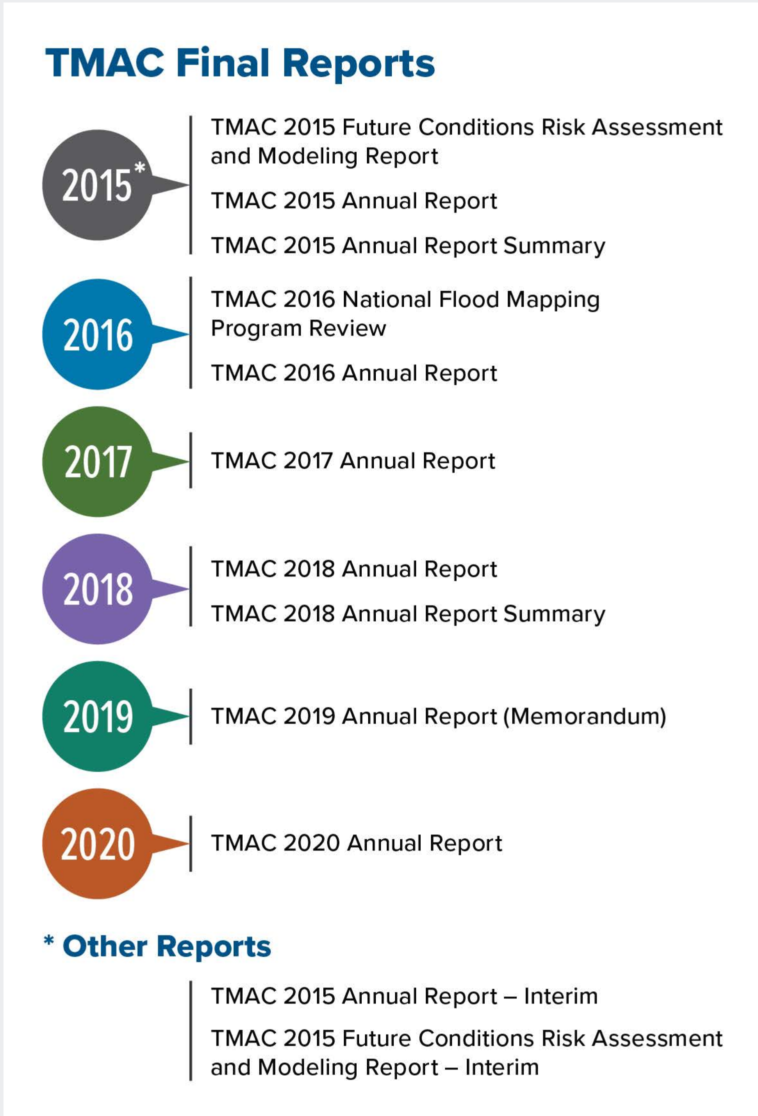


Figure 1-1: Timeline of past TMAC reports

Source: Annual Reports and Recommendations | fema.gov

recognizes the complex nature of flood risk and the diverse ways in which it is managed.

1.1.2 TMAC RESPONSIBILITIES

The TMAC's Charter outlines the principles and functions of the TMAC, including the objectives and scope of TMAC activities, description of duties, member composition, frequency of meetings, and other pertinent items related to the TMAC's establishment and operation. The TMAC's bylaws establish and describe rules of conduct, regulations, and procedures regarding its membership and operation.

One of the TMAC's primary responsibilities is the submittal of an annual report to the FEMA Administrator. The report must include a description of the TMAC's activities, its evaluation of the "status and performance of FIRMs and mapping activities to revise and update FIRMs," and its recommendations. Past efforts since the TMAC's establishment are summarized in Section 1.1. Past annual reports are available on FEMA's TMAC website.

1.2 2021 TMAC

The 2021 TMAC convened in March 2021 with the members shown in Section 1.2.1. FEMA tasked the TMAC through a letter dated February 23, 2021, from Michael Grimm, Assistant Administrator for Risk Management for FIMA. The TMAC held four public-facing meetings and eight administrative meetings, as noted in Table 1-3, as well as numerous internal working meetings throughout 2021 to develop this TMAC 2021 Annual Report (see Section 1.2.3).

1.2.1 TMAC MEMBERS AND DESIGNATED FEDERAL OFFICERS

The 2021 TMAC members and subcommittee members are listed in Table 1-1 and designated federal officers (DFOs) are listed in Table 1-2.

Members of the TMAC include designated members and additional members appointed by the FEMA Administrator, as set forth in the bylaws. The designated members of the Council are:

- The FEMA Administrator or the designee thereof;
- The Secretary of the Interior or the designee thereof;
- The Secretary of Agriculture or the designee thereof; and
- The Under Secretary of Commerce for Oceans and Atmosphere or the designee thereof.

The FEMA Administrator or designee appoints the 16 additional members of the Council. These members are appointed based on their demonstrated knowledge and competence regarding surveying, cartography, remote sensing, geographic information systems (GISs), or the technical aspects of preparing and using FIRMs.

To the maximum extent practicable, the Council membership will have a balance of federal, state, local, tribal, and private members, and include geographic diversity consisting of representation from areas with a coastline on the Gulf of Mexico and other states containing areas identified by the FEMA Administrator as at high risk for flooding or as Special Flood Hazard Areas (SFHAs).

Table 1-1: TMAC Member List

Member Name	BW-12 Membership Title	Job Title, Company/Agency	Future Conditions Subcommittee	Enterprise Risk Management Subcommittee	Stakeholder Engagement Working Group
Doug Bellomo (TMAC Chair)	Engineering Member	AECOM	✓	✓	
Nancy Blyler	USACE Representative	US Army Corps of Engineers (USACE)		✓	
Edward Clark	NOAA/Commerce for Oceans and Atmosphere Designee	Deputy Director, Office for Water Prediction, National Oceanic and Atmospheric Administration (NOAA)	✓		
Maria Cox Lamm	NFIP Coordination Offices Representative	State NFIP Coordinator, South Carolina Department of Natural Resources		✓	
Joshua Davies	State Hazard Mitigation Officer	State Hazard Mitigation Officer, Texas Division of Emergency Management	✓		
Vincent DiCamillo	Mapping Member	Senior Principal, Stantec Consulting	✓		
Scott Giberson	Flood Hazards Determination Firm Member	Compliance Principle, CoreLogic Flood Services		✓	✓
David Guignet (Enterprise Risk Management Subcommittee Co-Chair)	State Cooperating Technical Partner Representative	State National Flood Insurance (NFIP) Coordinator, Maryland Department of the Environment		✓	
Carey Johnson (Future Conditions Subcommittee Co-Chair)	State Cooperating Technical Partner Representative	Environmental Scientist Consultant, Director's Office, Kentucky Division of Water	✓		
David Love (Enterprise Risk Management Subcommittee Co-Chair)	Local Cooperating Technical Partner Representative	Project Manager, Mecklenburg County Storm Water Services		✓	
Robert Mason	US Department of the Interior Designee	Extreme Hydrologic Events Coordinator, U.S. Geological Survey (USGS)	✓		
James Nadeau	Surveying Member	Owner, Nadeau Land Surveys	✓		✓
Jon Paoli	State Geographic Information System Representative	Iowa Homeland Security & Emergency Management		✓	
Luis Rodriguez	FEMA Designee	Director, Engineering and Modeling Division, Federal Insurance and Mitigation Administration (FIMA), Federal Emergency Management Agency (FEMA)	✓		

Table 1-1: TMAC Member List (continued)

Member Name	BW-12 Membership Title	Job Title, Company/Agency	Future Conditions Subcommittee	Enterprise Risk Management Subcommittee	Stakeholder Engagement Working Group
Jonathan Smith (Future Conditions Subcommittee Co-Chair)	US Department of Agriculture Designee	Director, Resource Inventory Division, Natural Resources Conservation Service	✓		
Jeff Sparrow	Floodplain Management Member	Vice President, Moffatt & Nichol		✓	
Joshua Stuckey	Regional Flood and Stormwater Management Member	Chief Administrative Officer, Harris County, Texas Public Infrastructure	✓		
Michael Tischler	USGS Representative	Director, National Geospatial Program, USGS	✓		
Liang Xu	Local Cooperating Technical Partner Representative	Engineering Manager, Santa Clara Valley Water District	✓		

Table 1-2: Designated Federal Officers

Name	FEMA Title	Designated Federal Officer (DFO) / Alternate DFO (ADFO)
Brian Koper	Emergency Management Specialist, FIMA	DFO
Sarah Abdelrahim	Emergency Management Specialist, FIMA	ADFO
John Ebersole	Attorney, FIMA Legal Division	TMAC Legal Counsel/ADFO

1.2.2 **2021 TMAC FOCUS**

Each year, FEMA asks the TMAC to focus its efforts in specific areas to complement efforts FEMA is undertaking to adapt and improve delivery of the National Flood Mapping Program. With this opportunity in mind, in 2020 the TMAC adopted, by vote, the following vision for a future state of FEMA's current mapping programs: a more flood-resilient Nation. The TMAC adopted this vision to guide its efforts and to provoke thought on what execution of FEMA's current authorities might look like in the future.

In 2021, FEMA tasked the TMAC with the three tasks shown below. The TMAC responded specifically to this tasking in developing this report (excerpt from the 2021 Tasking Letter is shown in Figure 1-2).

FEMA tasks the TMAC with the following:

1. Continue engaging with external stakeholders, to include local officials/Floodplain Managers, State NFIP coordinators, Community Rating System (CRS) communities, emergency managers, and professional organizations, to understand the potential applications of graduated flood hazard and risk data for a broad range of users. Specifically, the TMAC should work with stakeholders to consider the following questions:
   - What opportunities does graduated flood hazard and risk data offer in developing policies and driving behavioral change to enhance flood resilience?
   - What are the challenges in applying graduated flood hazard and risk data, including regulatory barriers for floodplain management and challenges to data access by internal and external stakeholders and the public?
   - To enhance the use of graduated flood hazard and risk data, what changes (if any) do you recommend to FEMA's floodplain management strategies?
   - What kind of products will assist our stakeholders in understanding and communicating graduated flood risk and incentivizing mitigation actions?
   - How can graduated flood hazard and risk data help stakeholders prepare for climate change and other future conditions that the current binary approach (i.e., mapping the 1%-annual-chance flood) does not offer?
   - What is the role of SLTTs in developing a more localized understanding of flood hazard and flood risk, leveraging FEMA's graduated data?

2. Review recommendations from the TMAC's 2015 Future Conditions report to:
   - Determine which of the recommendations still apply, in light of FEMA's transition from a binary to graduated approach to flood hazard and flood risk identification; and
   - Identify additional recommendations for addressing future conditions with the graduated approach to flood hazard and flood risk identification

3. Explore risk management frameworks, such as Enterprise Risk Management (ERM), in the context of flood risk management (FRM) and explore how FEMA could apply ERM for FRM. ERM is typically applied in sectors other than FRM so the collective knowledge at the intersection between ERM and FRM is small. Risk management approaches, such as ERM, can allow federal, state, and local agencies to reduce variance and improve the ability to meet their objectives. Exploring ERM in the context of FRM can support FEMA meeting the objectives of OMB Circular A-123, which requires agencies to implement ERM. The TMAC should consider the following activities to guide its exploration:
   - Conduct a review of community, state, and federal agencies that have applied ERM in the context of FRM;
   - Use the strategic visions across FIMA (e.g., FY2021-2023 FIMA Strategy) to inform how ERM could be applied to the National Flood Insurance Program (NFIP). Evaluate whether the current FIMA strategic objectives support an ERM framework for the NFIP. This may require experimenting with risk appetites, tolerances, and capacity thresholds on metrics that support tracking progress to reach strategic objectives;
   - Illustrate an example of how a community ERM application can feed metrics for a state ERM application and support the Federal ERM application; and,
   - Based on the explorations above, suggest next steps for how FEMA could implement ERM for FRM.

Figure 1-2: 2021 Tasking Letter

1.2.3 OVERVIEW OF 2021 TMAC ACTIVITIES AND REPORT

The TMAC began its 2021 efforts with a public meeting on March 1 and March 2 in which FEMA introduced the 2021 Tasking Letter. Shortly thereafter, the TMAC organized itself into two subcommittees—one focused on the “Future Conditions” elements of the tasking and another focused on the “Enterprise Risk Management” elements of the tasking. Instead of establishing a separate stakeholder subcommittee, the TMAC asked one member of each of the two subcommittees to form a small working group focused on continuing stakeholder engagement.

Throughout the year, TMAC held four public-facing meetings and eight administrative meetings as summarized in Table 1-3. Leading up to and during the public meetings, stakeholders were encouraged to share their thoughts in the comment sections of the surveys. Moreover, the TMAC collected information from 498 individual survey respondents through three surveys available online from May through September.

Table 1-3: TMAC Meetings

Date	Type	Purpose
January 19-20, 2021	Public	• Finalize the writing of the TMAC 2020 Annual Report • Vote on each section and recommendations
March 1-2, 2021	Public	• Review the TMAC 2020 Annual Report • Vote to approve and submit the 2020 report • Review the 2021 Tasking Letter • Begin to organize approach to address the letter • Vote in the new chair
March 16, 2021	Administrative	• Hear SME briefings on the FIMA Strategic Plan, Behavioral Sciences, and Enterprise Risk Management • Organize into subcommittees
March 30, 2021	Administrative	• Discuss subcommittee organization and duties further • Identify stakeholder engagement group members • Identify SME briefs and short-term stakeholder engagement needs
April 8, 2021	Administrative	• Identify future SME briefings • Discuss potential survey questions and long-term stakeholder engagement needs • Create a draft report structure and outline, with subsections, for the TMAC 2021 Annual Report
April 28, 2021	Administrative	• Provide an update on each subcommittee's progress towards the draft outline for the TMAC 2021 Annual Report • Discuss survey questions for upcoming conferences
July 19, 2021	Administrative	• Hear a presentation from FEMA on Future of Flood Risk Data (FFRD) Stakeholder efforts and FFRD prototype visualizations relevant to TMAC's stakeholder engagement efforts • Provide each subcommittee time to present progress made towards compiling the draft TMAC 2021 Annual Report content
September 3, 2021	Administrative	• Hear feedback received on the stakeholder engagement survey • Listen to a briefing from FEMA on the status of previously published TMAC Recommendations • Discuss progress made by the subcommittees towards the draft TMAC 2021 Annual Report content
October 19-20, 2021	Public	• Hear an update on stakeholder engagement findings • Discuss the content of the draft TMAC 2021 Annual Report • Discuss potential recommendations • Receive pertinent Federal Advisory Committee Act (FACA) training
November 18, 2021	Administrative	• Hear an update on the Stakeholder Engagement, Enterprise Risk Management, and Future Conditions chapters of the draft TMAC 2021 Annual Report
December 15-16, 2021	Administrative	• Prepare the Draft TMAC 2021 Annual Report for review
February 23-24, 2022	Public	• Present the TMAC 2021 Annual Report to the public for review and vote on its passage

02

STAKEHOLDER ENGAGEMENT

FEMA TASKING LETTER

Continue engaging with external stakeholders ... to understand the potential applications of graduated flood hazard and risk data for a broad range of users. Specifically, the TMAC should work with stakeholders to consider the following questions:

- What opportunities do graduated flood hazard and risk data offer in developing policies and driving behavioral change to enhance flood resilience?
- What are the challenges in applying graduated flood hazard and risk data, including regulatory barriers for floodplain management and challenges to data access by internal and external stakeholders and the public?
- To enhance the use of graduated flood hazard and risk data, what changes (if any) do you recommend to FEMA's floodplain management strategies?
- What kind of products will assist our stakeholders in understanding and communicating graduated flood risk and incentivizing mitigation actions?
- How can graduated flood hazard and risk data help stakeholders prepare for climate change and other future conditions that the current binary approach does not offer?
- What is the role of SLTTs in developing a more localized understanding of flood hazard and flood risk, leveraging FEMA's graduated data?

The TMAC has been engaging stakeholders since the inception of its charter through public meetings, focus groups, and public comment periods. For the first time, in the 2020 Tasking Letter from FEMA, the TMAC was asked to increase its stakeholder outreach to include surveys. In 2021, for the second consecutive year, FEMA requested that the TMAC build upon its stakeholder outreach to gather input, understanding, and perspective on issues currently facing FEMA's flood hazard and risk identification.

Overall, the 2021 stakeholder engagement surveys found that while there are challenges and barriers when applying graduated flood hazard and risk concepts, respondents were positive about adopting new tools and methods to understand flood hazard and risk, flood mitigation and preparing for the future. Figure 2-1 shows the key highlights from the 2021 surveys.

2.1 PURPOSE

In the 2021 Tasking Letter, FEMA asked the TMAC to build upon its work from 2020 (see textbox for 2020 tasking) by reaching stakeholders who could provide insight on adopting graduated flood hazard and risk data and a probabilistic modeling approach to support a more comprehensive understanding of flood risk. Specifically, the TMAC was asked to continue engaging stakeholders including local officials/floodplain managers, state NFIP coordinators, Community Rating System (CRS) communities, state and local emergency managers, and professional organizations to understand the potential applications of graduated flood hazard and risk data for a broad range of users. The TMAC's stakeholder engagement efforts involved gathering feedback on opportunities, challenges, and barriers when applying graduated flood hazard and risk data, as well as how to enhance the use of graduated flood hazard and risk data. This chapter describes the TMAC surveys that were conducted, the key findings, and ideas for future TMAC stakeholder engagement efforts.

2020 TMAC STAKEHOLDER ENGAGEMENT TASKING

In 2020, FEMA tasked TMAC to work with stakeholders to provide insight into FEMA's Future Flood Risk Data (FFRD) and to receive feedback to inform the transition path to a future program by identifying useful elements of the current program and exploring the obstacles, opportunities, and the key roles for communities and partners of the future program. These findings can be found in the *TMAC 2020 Annual Report*. (https://www.fema.gov/sites/default/files/documents/fema_2020-tmac-annual-report.pdf).

2021 Stakeholder Engagement

2021 GOAL

The goal of the stakeholder engagement plan was to continue gather feed back to inform and provide advice on adopting graduated approaches to support a more comprehensive understanding of flood hazard and risk

- To understand challenges and barriers when applying graduated flood hazard and risk data
- How to enhance the use of graduated flood hazard and risk data

2021 KEY THEMES

- Hopeful about the shift to graduated risk and see the adopt ion as a benefit to improve clarity, flood mitigation and ability to prepare for climate change.
- Limited understanding of graduated risk analysis and related approaches
- Considering the uncertainty of a future with climate change, many respondents expressed the need for a more dynamic and graduated product able to communicate and display different levels of flooding across a community
- Stakeholders acknowledge the obstacles to properly use flood hazard and risk information

MAJOR OBSTACLES to adopting graduated flood hazard and risk data:

- Statutory/regulatory consistency
- Buy-in from the public, local community, and other stakeholders
- Equity issues

DEMOGRAPHIC: Top job functions of respondents:

- Floodplain Administrators (20%)
- Engineer (16%)
- State Agency Staff (12%)
- Land-Use Planner (10%)
- Building Official (8%)

OUTREACH TACTICS: Online surveys

TOTAL RESPONSES RECORDED – 498

Figure 2-1: 2021 Stakeholder engagement survey highlights

2.2 DESCRIPTION OF SURVEYS

The goal of the stakeholder engagement plan was to continue gathering feedback to inform and provide advice on whether stakeholders are adopting graduated flood hazard and risk data and a probabilistic modeling approach to support a more comprehensive understanding of flood hazard and risk. Using surveys, the TMAC engaged stakeholders who are highly aware of flood risk (i.e., local officials/floodplain managers, state NFIP coordinators), but also engaged those in the community who may not be as aware yet but will play a key role in communicating flood hazard and risk to their clients (i.e., insurance, real estate, and lenders).

The TMAC conducted three different surveys. The first two surveys, the “first-tier” surveys, were the initial outreach with questions aligned to meet the objectives of the Tasking Letter. The third survey, a “second-tier” survey, was a follow-up to the first two surveys to obtain additional information, specifically, on applying ERM methods to flood risk management programs. The surveys are described briefly below, and the distribution and responses are shown in Figure 2-2.

- **First-Tier Survey.** The initial first-tier survey was kicked off during the Association of State Floodplain Managers (ASFPM) national conference in May 2021, and a separate survey began during the National Flood Conference by American Property Casualty Insurance Association (APCIA FC) in June 2021. The first-tier surveys consisted of 26 questions in various formats—multiple choice, matrix, and free response—that assessed the respondents’ backgrounds, experience, and attitudes toward the potential applications of graduated flood hazard and risk data. The first-tier surveys had two versions to accommodate different stakeholders. While largely the same, some changes were made in wording tailored to those specific audiences. Personal Identifiable Information (PII) was redacted from results and thus not accessible during any data analysis.
- **Second-Tier Survey.** The TMAC conducted the second-tier survey to focus on first-tier respondents who were familiar with the ERM concept and applications to solicit more detailed information and feedback. The TMAC asked 13 questions focused on information related to the respondent’s familiarity with using ERM.

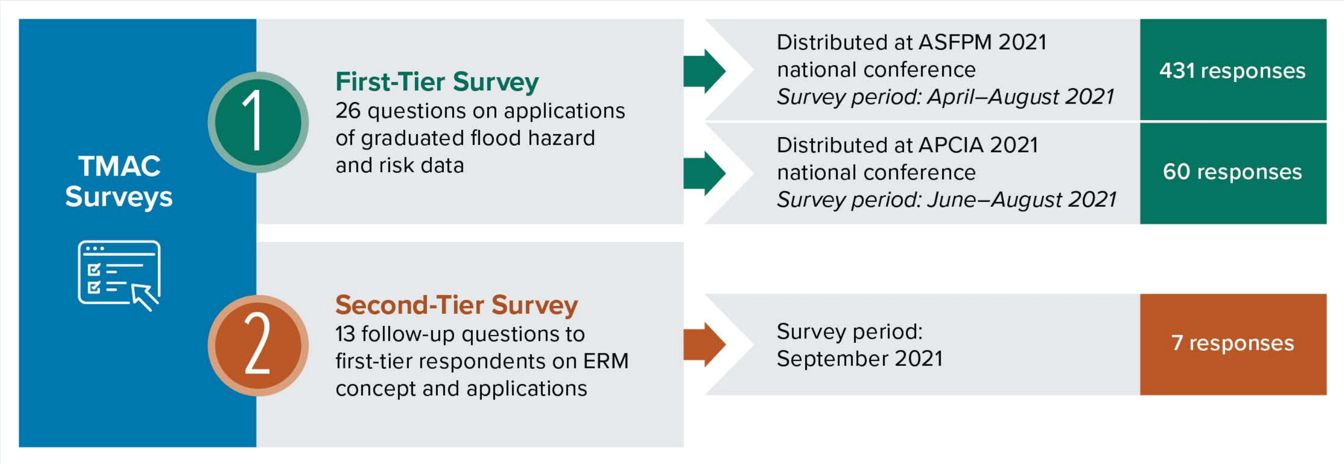


Figure 2-2: Distribution of the stakeholder engagement surveys and responses

2.3 DEMOGRAPHICS OF RESPONDENTS

The 2021 surveys included several questions to better understand respondents' professional background. The demographic section of the surveys included questions that shed light on the most frequent job functions and respondents' geographic profiles. The top five job functions of 2021 respondents are floodplain manager, professional engineer, state agency, land use planner, and building official (see Figure 2-3). These state, local, and private sector job functions combined represent 66% of the total responses to the 2021 surveys. Far fewer respondents were from federal government, and only 6% identified as elected government officials.

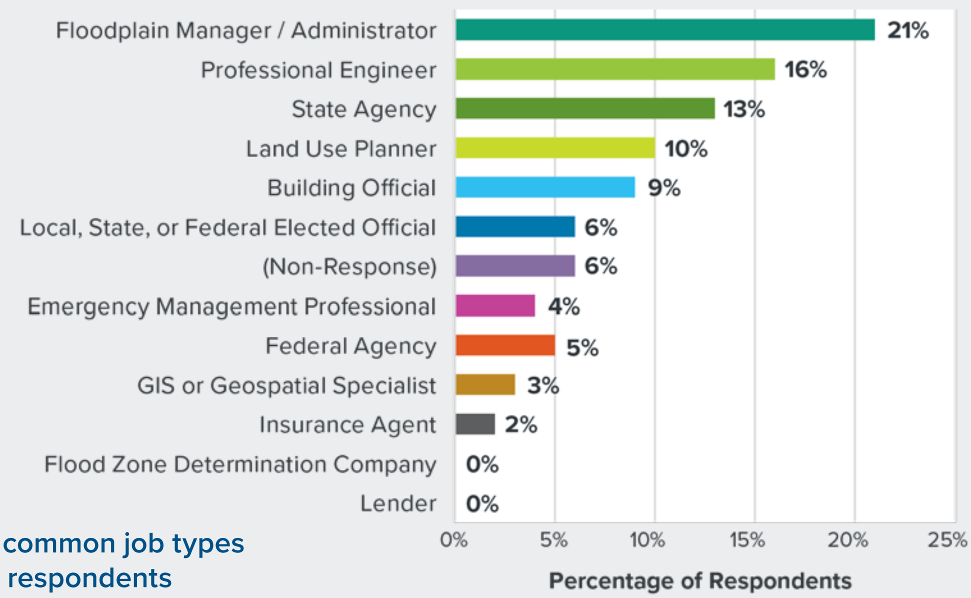


Figure 2-3: Most common job types for TMAC survey respondents

Geographically, although there were respondents from the entire country, the respondents were heavily clustered in certain areas, which is likely a result of the locations of the conferences where the survey was distributed. See Figure 2-4 for survey participation by FEMA Region.

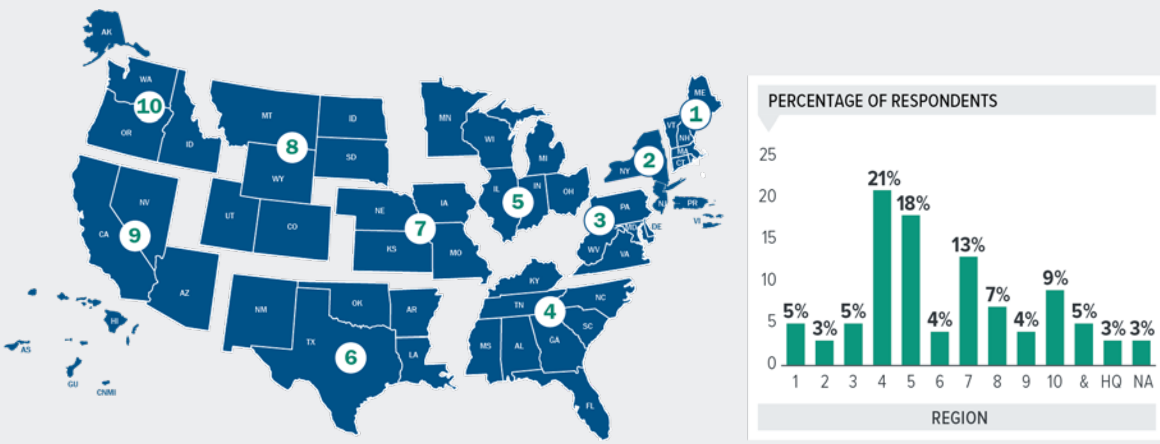


Figure 2-4: Percent participation by FEMA Region

2.4 SUMMARY OF SURVEY FINDINGS

The 2021 TMAC engagement survey responses from the first-tier surveys demonstrated three clear patterns across respondents.

- **Understanding New Approaches and Behavior Changes.** While respondents had heard of initiatives like the graduated flood hazard and risk data, a probabilistic modeling approach, or Risk Rating 2.0, understanding was limited. The responses conveyed a consistent theme that understanding of these approaches was limited. This theme was reinforced by responses reflecting a desire for more information about the logistics and implementation.

RISK RATING 2.0

Under Risk Rating 2.0, flood insurance rates will reflect each building's individual flood risk using structure-specific data that are easier to understand. With access to the latest industry technology and NFIP mapping data, policyholders will be able to better understand how their flood risk is reflected in the cost of their insurance.

- **Benefits of New Approaches.** While most respondents were uncertain about the specifics of graduated flood hazard and risk data and a probabilistic modeling approach, most were nevertheless strongly optimistic about the potential opportunities these approaches could provide. Respondents saw major opportunities for graduated flood hazard and risk data and the probabilistic approach to help when dealing with climate changes and flood mitigation.

- **Challenges of New Approaches.** The main challenges perceived by most respondents were in the areas of statutory and regulatory consistency.

2.4.1 UNDERSTANDING NEW APPROACHES AND BEHAVIOR CHANGES

The survey data provided insight into respondents understanding of concepts related to a probabilistic modeling approach to graduated flood hazard and risk data, and about whether they believed a better understanding of these new approaches to graduated flood hazard and risk identification would drive behavioral change.

SURVEY RESULTS: UNDERSTANDING OF GRADUATED FLOOD HAZARD AND RISK DATA

One of the clear themes that emerged from the 2021 survey pertains to how well respondents understand graduated flood hazard and risk data. Although respondents were aware of some of the new graduated types of flood hazard and risk and approaches to address them, they were not comfortable with these concepts. Here are three noteworthy examples pulled from the survey responses:

Example 1 (Risk Rating 2.0): When asked about their understanding of Risk Rating 2.0, respondents could choose from five options, ranging from "Extremely familiar" to "What is Risk Rating 2.0?" Approximately half selected the middle option ("not so familiar"), and another 22% of respondents had not heard of or were "not at all" familiar with the Risk Rating 2.0. This meant that only approximately one-quarter were "very comfortable" with Risk Rating 2.0. Similarly, when asked how they would feel integrating modeled future flood conditions, 45% of respondents selected "comfortable but cautious."

KEY TAKEAWAY

Those surveyed in professional industries (lenders, land use planners, real estate) have become comfortable with these graduated approaches to support their clients and communities in the work that they do.

The APCIA FC respondents were much more comfortable with these approaches overall: 46% reported they were very or extremely familiar with the Risk Rating 2.0, while just 26% of the ASFPM respondents reported they were very or extremely familiar with Risk Rating 2.0.

Example 2 (Definition of graduated risk): When asked to define what graduated risk meant to them, respondents grappled with a common definition. The automated text analysis produced three categories of response—Flood, Risk, and Other. The "Other" category consisted primarily of respondents answering, "Don't know."

- Approximately 33% of respondents focused on risk and risk-related concepts. Some responses demonstrated clear understanding of the concept (e.g., "a scale based on percent chance of occurrence," "an incremental level of risk assessment based on varying levels of risk of properties located in and out of designated floodplains"). Others did not (e.g., "calculated risk with correlated insurance fee," "areas of hazard by priority").

KEY TAKEAWAY

Terms like graduated risk are not widely used nor commonly understood by the public; this lack of common use should be considered when communicating flood hazards and risk to stakeholders.

- Approximately 50% of respondents emphasized flood-related aspects of graduated risk. In this category, responses included "a fuller spectrum of risk, no in/out of flood zone," and "a more nuanced, less black-and-white approach to assessing flood risk." This category of responses also reflected a mixed level of understanding. For example, responses included comments such as "actual risk of flooding and depth of flooding (amount of flood damage)," "a visual method of showing the degree of possible flood risk," "the more intense the flood event, the more risk will have to be managed," and "using a longer time period or storm events to make better assessment of flood hazard potential."

Example 3 (Barriers to understanding): Significant barriers to understanding were identified by most respondents, as follows:

- The vast majority (81%) of respondents reported that technical literacy is a barrier to graduated flood hazard and risk information, and 19% consider it a significant issue.
- Approximately 81% of respondents also reported community desire as a barrier.

KEY TAKEAWAY

Close to 100% of respondents see "critical or significant" barriers and thus indicate that there are significant opportunities for helping stakeholders better understand the probabilistic modeling approach and graduated flood hazard and risk data.

- Lastly, 83% of respondents indicated that dissemination of information is a critical barrier to graduated flood hazard and risk information, and 17% saw dissemination of information as a significant barrier.

SURVEY RESULTS: **DRIVING BEHAVIORAL CHANGE**

FEMA requested that the TMAC survey stakeholders to get a better understand of their perspectives as to whether graduated hazard and risk information can drive behavioral change, particularly as the Nation prepares for an uncertain future that includes climate change.

> Graduated flood hazard and risk data can increase understanding of flood risk and can facilitate better decision-making at a local community and individual level, including taking steps to mitigate flood risk and preparing for climate change.

Many respondents view the potential application of graduated flood hazard and risk data as a positive development in terms of moving toward a more resilient Nation. In comparison to the 2020 survey results, the positive outlook on the use of graduated data increased by 10%, going from 70% with a positive view to 80%.

Several respondents view graduated hazard and risk data as being important to communicating the variable and changing reality of flooding. Flooding can occur in areas at various levels based upon numerous factors. Mapping one primary level—the 1-percent-annual-chance flood level—does not inform the public of the extent of risk within a community. By identifying the risk beyond the SFHA, some respondents see a greater opportunity for mitigating and managing flood risk more holistically within a community. Some respondents noted that homeowners whose homes are just outside of the SFHA or are just above the Base Flood Elevation (BFE) will likely not take mitigative actions because these homeowners believe there is no flood risk to them.

Considering the uncertain future with climate change, many respondents expressed the need for a more dynamic and graduated product that would be able to communicate and display different levels of flooding across a community. Some respondents pointed out that this need also includes showing levels of flooding—and increasing flood risk.

2.4.2 BENEFITS OF GRADUATED FLOOD HAZARD AND RISK DATA

Respondents of the 2021 survey identified several positives regarding graduated flood hazard and risk data. Major benefits noted by respondents included improved clarity, better flood mitigation, and a greater ability to prepare for climate change.

Almost universally, respondents saw the adoption of the new approach as an improvement to how they previously dealt with flood mitigation and climate change. These results are also generally consistent with results from the 2020 survey: approximately 70% of

> **KEY TAKEAWAY**
>
> Respondents have remained steady with a slight increase in the number acknowledging benefits to graduated flood hazard and risk data in 2021 compared to 2020.

respondents from the 2020 survey indicated that the proposed shift to a graduated view of flood hazard and risk data would be useful, compared to 71% indicating the same response in 2021.

When asked whether graduated flood hazard and risk data presented opportunities to help communities prepare for climate change, 60% of respondents indicated that it would help with both mitigation and clarity among floodplain managers. This acknowledgment was also demonstrated in respondents' attitudes about graduated versus binary materials. Respondents were asked whether a binary, semi-graduated, or graduated map would most help them communicate flood hazards or risk. They overwhelmingly (73%) selected the graduated map, with another 9% picking a semi-graduated map. Figure 2-5 shows Question 13, which asked respondents to select the map they would use to help them communicate flood hazards or risk.

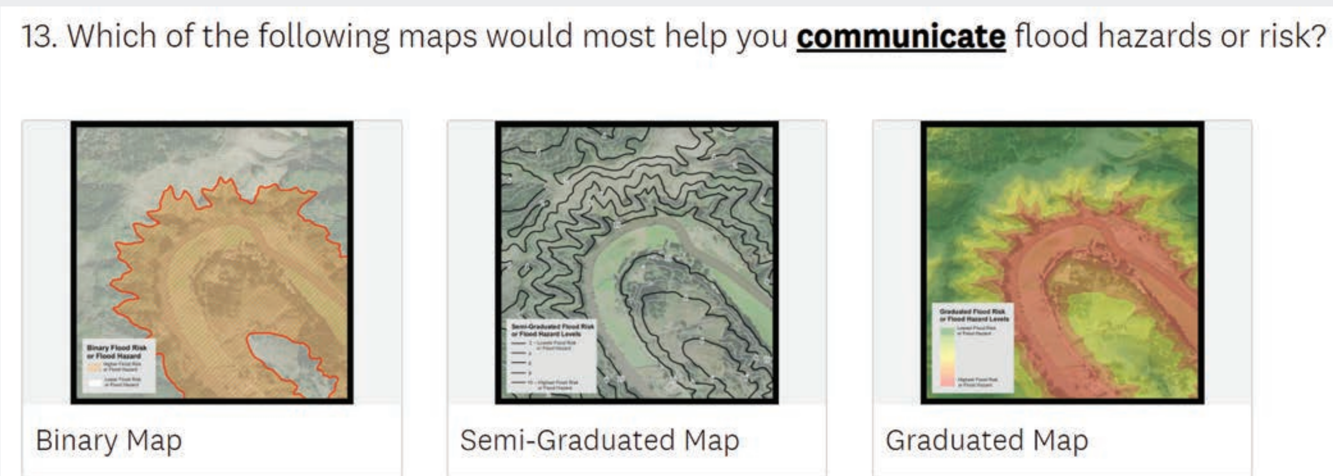


Figure 2-5: Examples of maps to communicate flood hazards or risks

Respondents were also given the opportunity to respond to free text questions throughout the 2021 survey, including questions about the benefits of the new approaches (see Figure 2-6). Respondents stated that FEMA benefits from communities developing a more localized understanding flood hazard and flood risk and that communities can help close the knowledge gap between what their day-to-day processes are currently and how they might improve using new approaches.

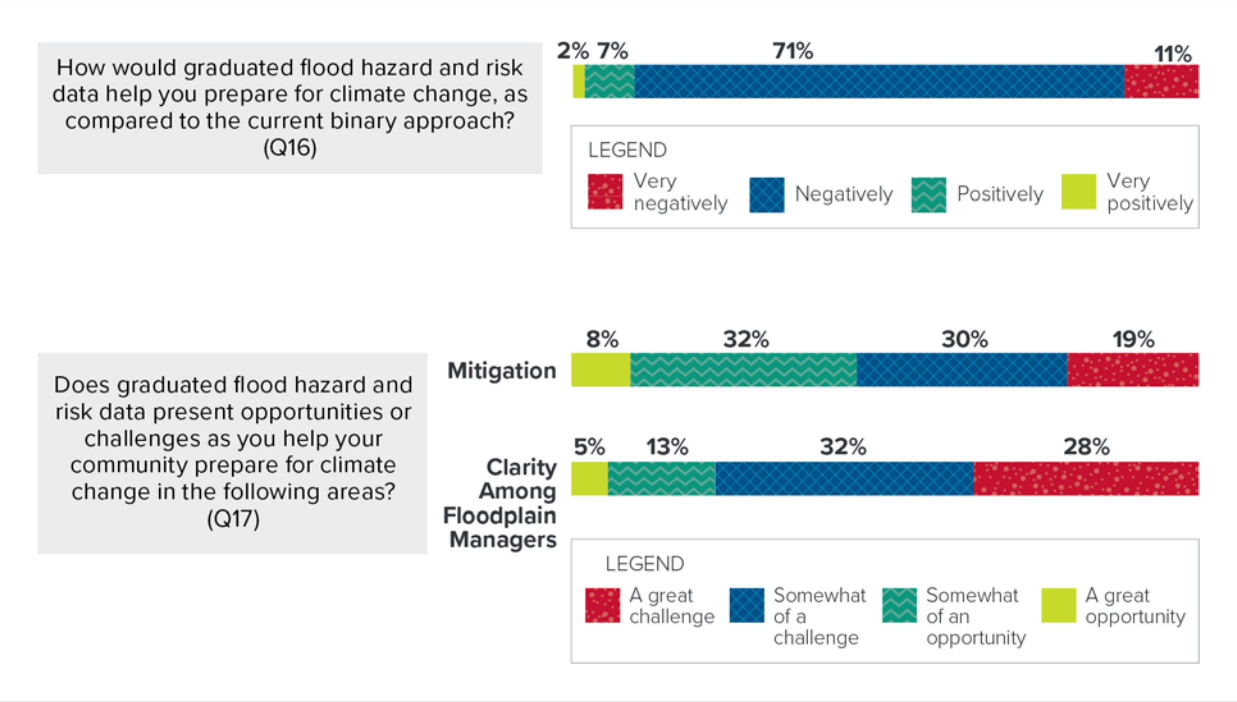


Figure 2-6: Survey results – benefits to graduated approach

2.4.3 CHALLENGES OF GRADUATED FLOOD HAZARD AND RISK DATA

Throughout the survey, respondents highlighted obstacles to their ability to properly use graduated flood hazard and risk information.

Major areas of concern include statutory and regulatory consistency, local community buy-in (both in terms of interest and understanding), and equity. These patterns emerged most clearly in responses to the questions:

MAJOR AREAS OF CONCERN

- Statutory and regulatory consistency
- Local community buy-in
- Equity

- "Select the kinds of obstacles that exist as barriers to using graduated flood hazard and risk information by identifying the magnitude of the barrier"[2]
- "Does graduated flood hazard and risk data present opportunities or challenges as you help your community prepare for climate change in the following areas?"[3]

For example, less than 6% of respondents said that regulatory issues do not pose any obstacles; in fact, 22% of respondents said regulatory issues pose significant

2 Answer choices included "significant barriers", "many barriers", "some barriers", and "no barriers"
3 Answer choices included "A great opportunity", "somewhat of an opportunity", "somewhat of a challenge", and "A great challenge."

barriers, and 29% said regulatory issues pose “many” barriers. Another 32% of respondents stated there were “some” barriers.

BARRIERS

Barriers to a successful transition to use of graduated hazard and risk data include the lack of understanding of the science behind it, the skepticism about the ability to move beyond the current regulatory scheme, and a resistance to change due to the inertia created by years of reliance upon existing hazard data.

Respondents were also worried about how graduated flood hazard and risk data would affect and be received by their local communities. Approximately, 81% identified community buy-in or desire to learn new tools as an obstacle. Most were also concerned about the equity implications: 86% stated equity was an obstacle.

Obstacles and barriers identified by NFIP stakeholders with only minimal involvement in the 2020 and 2021 surveys may offer valuable input for improvements to the NFIP. Figure 2-7 illustrates the perceived barriers of graduated flood hazard and risk information.

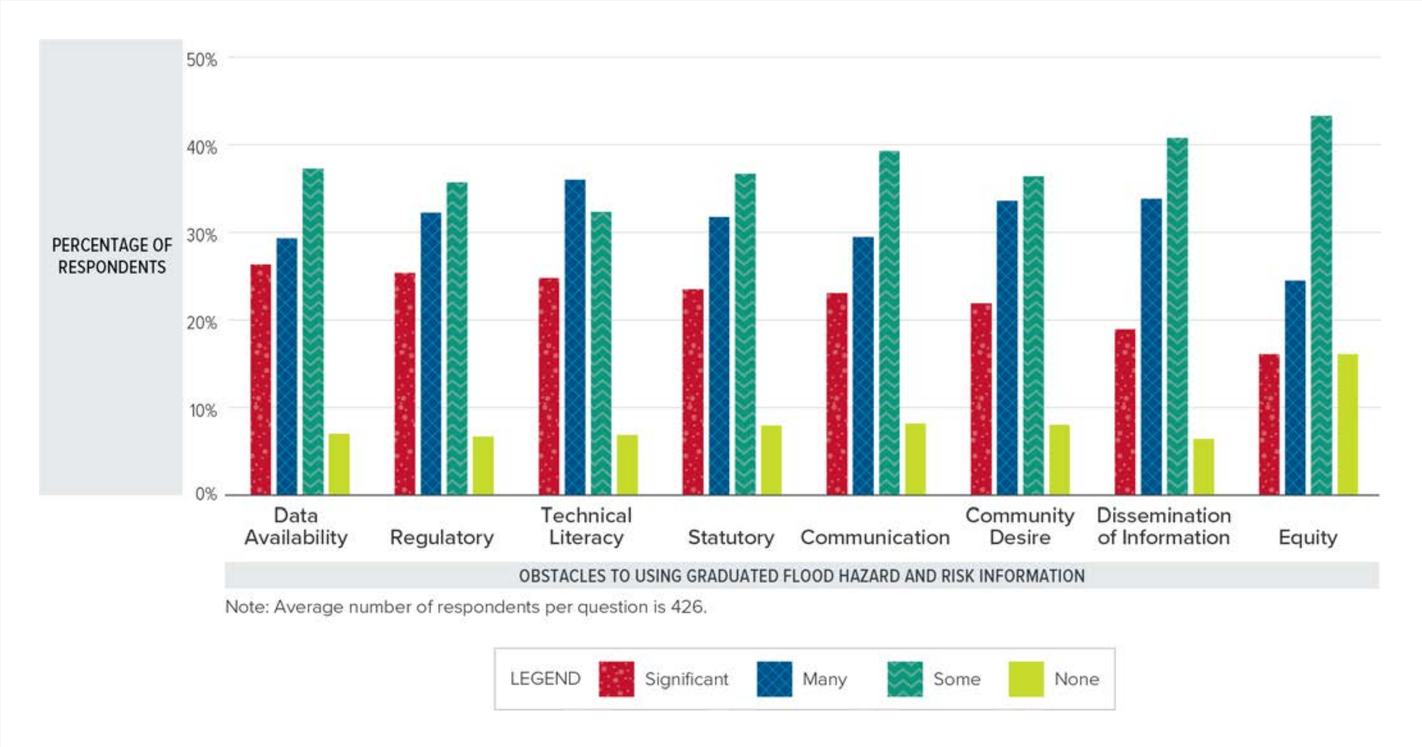


Figure 2-7: Perceived barriers to use of graduated flood hazard and risk information

2.4.4 SIMPLIFY THE MESSAGE

Many respondents consider the need to begin working with graduated flood hazard and risk products as urgent. In other words, the stakeholders view products that can withstand appeal and criticism as less important than working in product development. As with the 2020 survey, many respondents have difficulty fully comprehending the "what" and "how" of graduated flood hazard and risk products; therefore, they want to see them and work with them to increase that understanding.

OVERCOMING BARRIERS

Tools and products, such as graduated hazard maps and graduated hazard risk scores, can help FIMA to overcome the barriers to acceptance and adoption within communities and the public at large.

2.4.5 FINDINGS OF THE SECOND-TIER SURVEY

A second-tier ERM survey was sent to the 57 respondents who indicated in one of the first-tier surveys that they always, usually, or somewhat employed ERM concepts in managing flood risk. The survey, which was adapted from the Federal Enterprise Risk Management 2020 survey (Guidehouse and AFERM, 2020) of federal agencies on ERM use, consisted of 11 questions about the extent of the organization's ERM use, one question about whether respondents would share their ERM plans with the TMAC, and one question about whether respondents would provide contact information to the TMAC for a follow-up interview. The questions and responses are provided in Appendix B (all identifying information for respondents has been removed.)

The results of the outreach effort in this TMAC survey suggest that few if any public agencies are robustly employing ERM for FRM. Some of our specific findings from this survey include the following:

- Seven people responded to the second-tier survey.
  - Of those that responded, two represented a public agency,
  - Four reported having ERM programs (greater than 5 years old),
  - Two reported having ERM programs 1 to 5 years old, and
  - One reported having a program less than 1 year old.
- All respondents with programs 1 or more years old reported that a chief-executive-level employee was responsible for the ERM program.
- Cybersecurity/privacy risks, followed by reputational risk, were reported most often as concerns of the organization.
- The reporting of climate/flood risk equaled the reporting of strategic, financial, and compliance risks. See Figure 2-8.

Of the standard ERM methods and procedures in use (see Section 3.1), five respondents reported having identified strategic objectives, four identified specific risks to the strategic objectives, and four reported developing risk profiles. Three reported identifying risk tolerances and the development of risk appetites, controls, and metrics was reported by two respondents. Four respondents replied that they used risk reports and other risk communication measures. See Figure 2-9.

Figure 2-8: Reported perception of risk by type

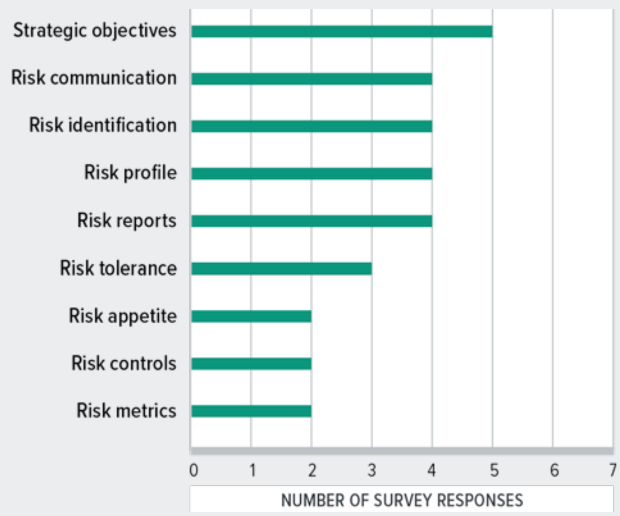


Figure 2-9: Reported ERM methods and procedures in use

2.5 2020 VERSUS 2021 STAKEHOLDER ENGAGEMENT SURVEYS

The TMAC has been engaging stakeholders since the inception of its charter through public meetings, focus groups, and public comment periods. But FEMA has only tasked the TMAC with a more formal and deliberate stakeholder engagement in the last 2 years. For the first time, in the 2020 Tasking Letter from FEMA, the TMAC was asked to increase its stakeholder outreach to include surveys. In 2021, and for the second consecutive year, FEMA requested that the TMAC build upon its stakeholder outreach to gather input, understanding, and perspective on issues currently facing FEMA and its approaches to identifying flood hazard and flood risk. Specifically, FEMA can use this information to refine the future of its flood hazard and flood risk identification program in a way that is forward-thinking and supports the needs of a wide range of stakeholders. Table 2-1 shows a side-by-side comparison of the 2020 stakeholder engagement results with the 2021 stakeholder engagements results.

Table 2-1: Side-by-Side Comparison of 2020 and 2021 Stakeholder Engagement Efforts

2020 Stakeholder Engagement	2021 Stakeholder Engagement	Key Takeaways
2020 Goal • To identify best practices to equip stakeholders for understanding graduated flood hazards and flood risks; • To promote increased investments in flood mitigation; and • To identify obstacles, opportunities, and roles for stakeholders across all elements of the program.	**2021 Goal** • To continue gathering feedback to inform and provide advice on adopting approaches to support a more comprehensive understanding of graduated flood hazard and risk; • To understand challenges and barriers when applying graduated flood hazard and risk data; and • To enhance the use of graduated flood hazard and risk data.	The goals of the 2020 and 2021 stakeholder engagement were similar; however, the 2021 survey was intended to dig deeper in gathering data about the stakeholder understanding and adoption of graduated flood hazard data.
2020 Key Themes • Stakeholders are hopeful about the shift to graduated risk, but apprehensive about how it impacts current activities. • Stakeholders prefer flexibility across all areas of the program. • Stakeholders acknowledged that graduated risk information is beneficial for all program elements, but they are unclear on how it fits in the program. • Risk communication will be an important part of the shift; there is a need for clear messaging for non-technical audiences.	**2021 Key Themes** • Stakeholders are hopeful about the shift to graduated risk and see the adoption as a benefit to improve clarity, flood mitigation, and the ability to prepare for climate change. • Stakeholders have a limited understanding of graduated risk analysis and related approaches. • Considering the uncertainty of a future with climate change, many stakeholders expressed the need for a more dynamic and graduated product able to communicate and display different levels of flooding across a community. • Stakeholders acknowledge the obstacles to properly using flood hazard and risk information.	The surveys were generally aligned in the themes that emerged: • Stakeholders were hopeful about graduated approaches but had limited understanding of the specifics of them. • Stakeholders requested more simplified communication and tools to better understand the products; and • Stakeholders acknowledged similar obstacles to adoption both years.
Major Obstacles in the shift to graduated risk: • Buy-in from the public, elected officials, or other stakeholders • Statutory/regulatory consistency • Confusion about data/products and how to use them	**Major Obstacles** to adopting graduated flood hazard and risk data • Statutory/regulatory consistency • Buy-in from the public, local community, and other stakeholders • Equity issues	The feedback reveals that the obstacles have not changed from 2020 to 2021, with the exception that in 2021, the equity issues was considered one of the top three obstacles to adopting graduated flood hazard and risk products. This is an area where more outreach could be helpful to FEMA.
Demographics (Top job functions of respondents) • Engineer (28%) • Floodplain Administrators (19%) • Land-Use Planning/Zoning Official (8%) • Other State Agency (7%) • NFIP Program Consultant (6%)	**Demographic** (Top job functions of respondents) • Floodplain Administrators (20%) • Engineer (16%) • State Agency Staff (12%) • Land-Use Planner (10%) • Building Official (8%)	Stakeholder demographics were similar. However, in 2021, the participation of engineers declined, while participation of the land use / planner professions was greater. Moving forward, outreach to land use planners, lenders, insurance, and real estate professionals will be critical to understanding their use of flood mitigation tools.
Outreach Tactics • Online Surveys • Webinars • Focus Groups	**Outreach Tactics** • Online surveys	The outreach tactics in 2020 were multi-faceted compared to 2021. The TMAC expects to return to a more expansive outreach moving forward.
Total Responses Recorded 781	**Total Responses Recorded** 498	With outreach extending beyond surveys in 2020, more responses were captured.

2.6 FUTURE TMAC STAKEHOLDER ENGAGEMENT EFFORTS

Lessons learned from 2 years of surveys and stakeholder engagement will inform similar efforts going forward. These efforts should include:

- Expanding reach to include a wide range of stakeholders
- Using webinars to solicit feedback on specific topics
- Engaging stakeholders in small focus groups

2.6.1 ENGAGE OTHER STAKEHOLDER GROUPS

Targeting a greater diversity of the professional groups and associations that provide products and services within our Nation's communities will help identify the gaps in terms of how professional groups and associations understand FEMA's programs and what actions can be taken to enhance the services they provide. Increasing the representation of these groups in TMAC stakeholder surveys will provide valuable insight on how to improve the growth and stability of FEMA's flood hazard and risk mapping efforts.

Stakeholder groups to consider for future surveys include realtors, land surveyors, engineers, insurance agents, architects, planners, mortgage professionals, and appraisers. Professional organizations to consider for inclusion in future stakeholder engagement survey efforts include:

- National Association of Realtors
- National Society of Professional Land Surveyors
- National Society of Professional Engineers
- American Property Casualty Insurance Association
- American Institute of Architects
- American Planning Association
- National Association of Mortgage Professionals
- National Association of Real Estate Appraisers

To engage other important stakeholder groups not adequately represented within the TMAC's previous stakeholder engagement survey efforts, the TMAC suggests the following actions:

- Develop stakeholder engagement surveys specifically for each group.
- Prepare and distribute brochures, articles, newsletters, or other written means of communication to each stakeholder group.
- Offer continuing education courses for licensing credit for participation.
- Include outreach to national, regional, and state conferences.
- Offer online webinars and focus groups for interaction and input on key subject matter.

2.6.2 IMPORTANCE OF WEBINARS

As we learned in 2020, when executed well, a webinar provides an interesting and informative platform for the TMAC to educate and inform stakeholders on important issue it faces. This learning is reciprocal, it is not just for the stakeholders. The TMAC learns from stakeholders on critical issues or obstacles when adopting and understanding flood hazard and risk data.

With an increase of flood hazards and risk program knowledge and education, stakeholders, communities, and the public will make more sound decisions in terms of safer development, mitigation strategies to reduce risk and financial burden, and to best prepare for climate change and anticipated sea level projections.

2.6.3 IMPORTANCE OF FOCUS GROUPS

Using focus groups was a tool used in the TMAC 2020 report to reach specific stakeholders in a qualitative way to gain an in-depth understanding of elements of flood hazard and risk, using new approaches and to be aware of the obstacles for adoption. Looking ahead, the TMAC will continue to engage a variety of key stakeholders in focus groups for this specific, real-time feedback and discussion.

03 FUTURE CONDITIONS

FEMA TASKING LETTER

FUTURE CONDITIONS RECOMMENDATIONS DIRECTIVE

Review recommendations from the TMAC's 2015 Future Conditions report to:

- Determine which of the recommendations still apply, in light of FEMA's transition from a binary to graduated approach to flood hazard and flood risk identification; and
- Identify additional recommendations for addressing future conditions with the graduated approach to flood hazard and flood risk identification.

In its February 23, 2021, Tasking Letter, FEMA requested that the TMAC review the recommendations established by the 2015 TMAC Future Conditions Risk Assessment and Modeling (2015 Future Conditions) report (TMAC 2015a). Specifically, FEMA asked the TMAC to assess the 2015 recommendations and determine which ones still apply "in light of FEMA's transition from a binary to graduated approach to flood hazard and flood risk identification," which will ultimately result in a national-scale flood hazard and flood-risk data set. FEMA also requested that the TMAC identify additional recommendations to address future conditions based on advances in science and technology, and data availability, among other things.

3.1 INTRODUCTION AND BACKGROUND

This chapter presents the results of TMAC's review of future conditions in response to FEMA's 2021 Tasking Letter. The chapter is organized in parallel with the Tasking Letter, as follows:

- Section 3.1 provides background information that informs the rest of the chapter.
- Section 3.2 describes the process used by the TMAC to conduct its review and presents the results of that review, including proposed specific content changes to 27 of the 2015 recommendations. The TMAC also demonstrates how each changed recommendation aligns with three primary themes or categories, developed based on FEMA programs and initiatives, which justify the need for change.
- Section 3.3 presents the TMAC's 2021 future condition's recommendation. This new recommendation further establishes the importance of including future conditions in the implementation of FEMA's Future of Flood Risk Data (FFRD) initiative, aimed at reducing our Nation's hazard and flood risk.
- Section 3.4 briefly describes what the TMAC believes FEMA may wish to consider when establishing its course of action for implementing the Future Conditions recommendations described in this 2021 Annual Report.

Appendix C provides additional detailed and supporting information developed by the TMAC throughout its deliberation and discussion. The information in Appendix C provides important context for the TMAC's determination of the relevance of existing future conditions (defined in the TMAC 2015 Annual Report), needed changes to the 2015 recommendations, and the TMAC's new recommendation.

3.1.1 DEFINING FUTURE CONDITIONS

To understand the work conducted by the TMAC in 2021 and documented in this chapter, it is important to understand the background for FEMA's request in its 2021 Tasking Letter. In 2015, in accordance with BW-12, FEMA directed the TMAC to develop recommendations for incorporating the best available climate science in flood insurance studies and maps and for using the best available methodology to evaluate the impacts of sea level rise (SLR) and future development on flood risk. This was the focus of the 2015 Future Conditions report (TMAC 2015a), which establishes the framework for the TMAC's current work to address future conditions as tasked in the 2021 Tasking Letter.

Historically and currently, the NFIP does not routinely consider future conditions as part of the assessment and identification of SFHAs on the regulatory FIRMs or in the standard Risk Mapping Assessment and Planning (Risk MAP) non-regulatory suite of flood hazard and flood risk products. However, FEMA, Congress, and other stakeholders have recognized the need for incorporating future conditions information into the NFIP and the Risk MAP Program.

3.1.2 TRANSITION IN APPROACH FROM BINARY TO GRADUATED HAZARD AND RISK IDENTIFICATION

From a regulatory perspective, the purchase of flood insurance as well as other floodplain management considerations (e.g., requirements to build at or above the regulatory, mapped BFEs shown on FIRMs) were determined with respect to where a structure was located relative to the 1 percent-annual-chance contour line on the map. FEMA recognized that flood risk does not stop at the line, and there are degrees or gradations of flood risk not necessarily reflected on the current FIRMs. This shift from a binary (e.g., on one side of the line or the other) to a graduated view more precisely characterizes flood hazard and flood risk.

Over the past decade, FEMA has recognized the need to include future conditions in its mapping products, primarily for non-regulatory purposes, to more effectively and accurately communicate to stakeholders about flood hazard and flood risk. With this in mind, the TMAC was directed in 2021 to look at the 2015 Future Conditions recommendations through the lens of the shift in approach from binary to graduated hazard and risk identification, described above, and assess whether the 2015 recommendations still apply. In addition, the TMAC was also asked to identify additional recommendations that address future conditions, given this shift.

On this last point, the shift from binary to graduated risk is only one element of FEMA's FFRD initiative, which aims to provide a more comprehensive understanding of the Nation's flood risk. The FFRD initiative's elements, shown in Figure 3-1, are as follows:

- Shift from binary to graduated risk analysis;
- Ensure a significant and appropriate role for the private sector and state, local, tribal, and territorial entities;
- Increase access to flood hazard data to improve resulting mitigation and insurance actions; and
- Modernize the management and delivery of flood hazard mapping.

The FFRD initiative is germane to the 2021 tasking because the TMAC has recognized the need to address not only the shift from binary to graduated flood risk relative to future conditions, but also how future conditions impact or are impacted by the remaining three FFRD elements (see Figure 3-1). As FEMA transforms the NFIP into a risk-informed program through FFRD, an important outcome will be a framework for probabilistic flood hazard and flood risk analysis to help better understand the Nation's current and future flood risk. This transformation can only be accomplished in

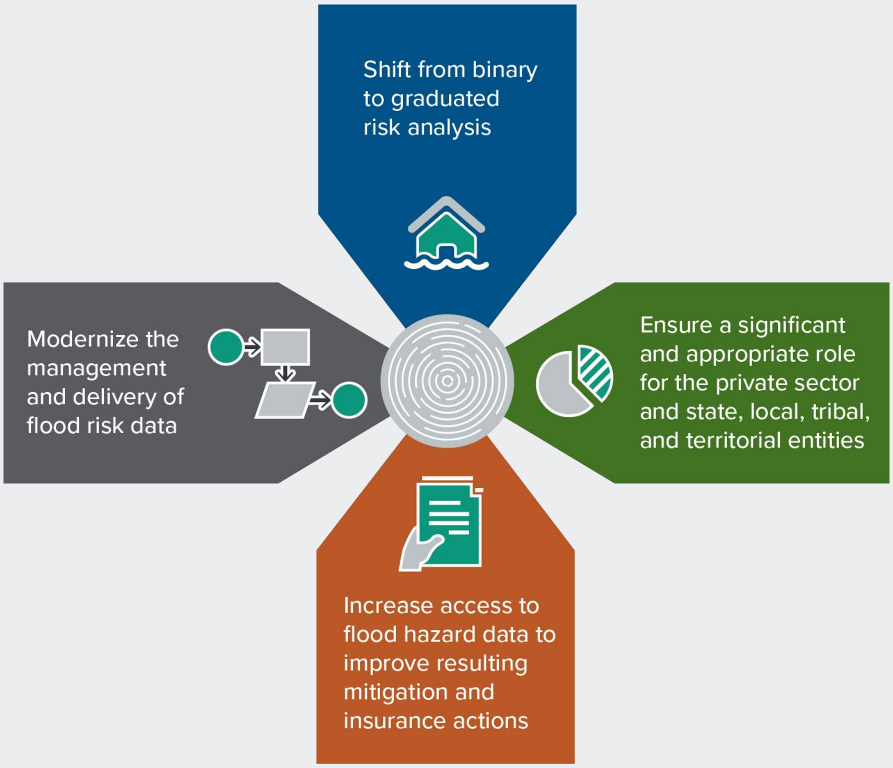
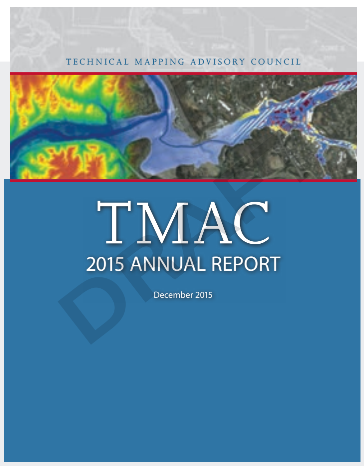


Figure 3-1: FEMA FFRD major elements

Source: https://www.fema.gov/fact-sheet/future-flood-risk-data-ffrd a comprehensive manner by incorporating future conditions. The TMAC 2020 Annual Report (TMAC, 2021) provides a more detailed discussion of the importance of FFRD in addressing the Nation's flood hazard and flood risk.

3.1.3 INTRODUCTION TO THE 2015 FUTURE CONDITIONS RECOMMENDATIONS

The TMAC provided 7 primary recommendations and 37 subrecommendations focused on future conditions in the TMAC *2015 Annual Report* (TMAC, 2015b) and the companion *2015 Future Conditions Risk Assessment and Modeling* report (TMAC, 2015a). The intent of these recommendations was to help FEMA incorporate the best available climate science to assess future flood risks and advise FEMA in the use of available data and methods in assessing the impacts of SLR, long-term erosion (coastal and riverine), climate-impacted hydrology, and future land development on flood risk.



TMAC RECOMMENDATION NUMBERING

In 2017, the recommendations and subrecommendations as numbered in 2015 were renumbered in the 2017 TMAC Annual Report (TMAC, 2018). The recommendation content was not changed. The numbering used in ths report reflects the 2017 renumbering.

3.2 TMAC REVIEW OF 2015 FUTURE CONDITIONS RECOMMENDATIONS

The TMAC reviewed in detail the Future Conditions recommendations in the 2015 Future Conditions report (TMAC, 2015a) in light of FEMA's transition from a binary to a graduated view of flood hazard and flood risk data. These included seven primary recommendations and 37 subrecommendations, for a total of 44 recommendations that were the focus of the TMAC's work. Deliberation and discussion within the TMAC's Future Conditions Subcommittee regarding its tasking began in early March 2021, and the subcommittee met thereafter on a bi-weekly basis. Its discussions were informed by a series of SME briefings conducted throughout 2021 (see text box). The briefings were intended to fill any data and information gaps needed for the TMAC to conduct its work.

SME Briefings

- **SEA LEVEL RISE SME BRIEFING** (May 18, 2021): Mr. Peter Slovinsky, Marine Geologist, Maine Geological Survey; Maine Climate Council
- **CLIMATE CHANGE SME BRIEFING** (May 20, 2021): Dr. David Reidmiller and Ms. Gayle Bowness, Gulf of Maine Research Institute
- **BUILDING RESILIENT INFRASTRUCTURE AND COMMUNITIES BRIEFING** (May 26, 2021): Camille Crain, FEMA
- **NOAA CLIMATE RESILIENCE TOOLKIT** (June 7, 2021): Mr. David Herring, Communication, Education, & Engagement Division Chief, NOAA
- **FUTURE CONDITIONS RECOMMENDATIONS STATUS BRIEFING** (September 3, 2021): David Bascom, FEMA
- **LANDUSE AND FUTURE CONDITIONS SME BRIEFING** (September 29, 2021): Peter Claggett, Research Geographer, USGS
- **COASTAL ANALYTICAL METHODOLOGIES STATUS BRIEFING** (October 1, 2021): Lauren Schmied and Christina Lindemer, FEMA

3.2.1 RESULTS OF TMAC ANALYSIS OF 2015 RECOMMENDATIONS

FEMA TASKING LETTER

FUTURE CONDITIONS RECOMMENDATIONS DIRECTIVE

Review recommendations from the TMAC's 2015 Future Conditions report to:

- Determine which of the recommendations still apply, in light of FEMA's transition from a binary to graduated approach to flood hazard and flood risk identification

The TMAC believes no substantive changes have occurred since 2015 that render any of the seven primary recommendations and 37 subrecommendations invalid. As part of its review, the TMAC identified 27 recommendations that it modified to better address FEMA's stated intention to shift from binary to graduated flood hazard and risk identification. To increase the relevancy of the 27 recommendations tagged for change or updating, the TMAC added content and/or modified content taking into account the following:

- Considerations resulting from FEMA's FFRD initiative;
- Increased knowledge as research has evolved in the areas of climate change and SLR, and is documented in the fourth National Climate Assessment (NCA4);
- Additional research in an expanded coastal area footprint (e.g., Alaska, the Pacific Islands, Caribbean Territories) to address how climate change impacts wave conditions in these areas;
- Considerations for the development of national standards to ensure greater consistency in how flood risk is addressed across the United States;

- Physical changes to the earth's landscape as a result of human "intervention," including changes in land use that affect hydrologic conditions, leading to increased flood risk and flood hazard;
- The availability of more data, which facilitates more precise characterization of variables that impact flood hazard and flood risk; and
- Considerations for improvements in dynamic modeling of geomorphic (land forming) processes that impact future flood risk.

Table 3-1 summarizes the results of the TMAC analysis of the 2015 Future Conditions recommendations and includes the following information for each:

- Future Conditions recommendation identification number (as established in the TMAC 2017 Annual Report [TMAC, 2017])
- Existing 2015 Future Conditions recommendation language
- Updated language based on the TMAC's review and analysis
- Brief justification for the suggested changes
- The recommendation's relevancy to binary versus graduated flood hazard and risk identification
- Timeliness (e.g., short term or long term) associated with implementation

Section C.1 in Appendix C, Review of TMAC Future Conditions Recommendations, includes a detailed summary of the TMAC's analysis of each Future Condition recommendation. Information in Section C.1 reflects the culmination of extensive work by the TMAC to ensure it fully addresses FEMA's tasking.

Table 3-1: Revised Future Conditions to Reflect 2021 Deliberations by TMAC

Designated Recommendation Number	2015 Recommendation	Updated Recommendation Based on 2021 Future Conditions Subcommittee Deliberations	Justification/Description	Relevance Low / Mod Low / Mod High / High (L / ML / MH / H)	Timeliness (Near-Term / Long-Term)
FC-1	Provide future conditions flood risk products, tools, and information for coastal, Great Lakes, and riverine areas. The projected future conditions should use standardized timeframes and methodologies wherever possible to encourage consistency and should be adapted as actionable science evolves.	Provide future conditions flood risk products, tools, and information for coastal, Great Lakes, and riverine areas. The projected future conditions should use standardized timeframes and methodologies, wherever possible, to encourage consistency **and enable efficient analysis of varying expert-recommended, climate change adaptation timeframes and scenarios, which** should be **adapted** as actionable science evolves.	These changes emphasize that FEMA's methods and procedures for developing and delivering future flood conditions products must include the capability to flexibly adapt to new greenhouse and climate-change scenarios and data as climate science involves.	**High.** This is the 2015 Future Condition's primary recommendation.	**Long-term.** As implied, the science behind climate change projections is expected to evolve.
FC-1.1	FEMA should define a future population metric that uses a standard future population database along with various budget scenarios for keeping the data current to predict the percent of the population covered at various points in the future.		If implemented wisely, these unchanged recommendations will ensure the systematic development of National and locally relevant climate, land use, and geomorphological change and flood-control scenarios and related data that is essential for the creation and effective utilization of a probabilistic-modeling framework while ensuring that modeling and mapping efforts serve areas experiencing population-driven increases in flood risk.	**Moderately Low.** This recommendation was intended to permit programmatic measurement of future mapping coverage.	**Near-term.** These databases exist.
FC-1.2	FEMA should take into account future development (excluding proposed flood control structures for the base condition/scenario) for future conditions mapping. An additional scenario can be generated that does include future flood control structures.		This unchanged subrecommendation addresses the ongoing need for FEMA's future flood conditions products to include the impacts of expected flood-control structures and land use policies in order to supply information relevant to community-level flood-risk decision-making.	**High.** As potentially dire as climate change may be, urbanization and development are likely to account for the greater share of future flood damages.	**Near-term.** Methods exists for projecting future development including assumed build-out.
FC-1.3	FEMA should use population growth as an indicator of areas with increased potential flood risk.		If implemented wisely, these unchanged recommendations will ensure the systematic development of National and locally relevant climate, land use, and geomorphological change and flood-control scenarios and related data that is essential for the creation and effective utilization of a probabilistic-modeling framework while ensuring that modeling and mapping efforts serve areas experiencing population-driven increases in flood risk.	**High.** Population growth is a necessary and reasonable proxy for urban development.	**Near-term**
FC-1.4	FEMA should develop guidance for how local zoning and land use planning can be used to identify where and how land use will change in the future, and incorporate that into local hazard and risk modeling.		If implemented wisely, these unchanged recommendations will ensure the systematic development of National and locally relevant climate, land use, and geomorphological change and flood-control scenarios and related data that is essential for the creation and effective utilization of a probabilistic-modeling framework while ensuring that modeling and mapping efforts serve areas experiencing population-driven increases in flood risk.	**High [confirm].** A suggestion was made to rank this Low (e.g., does FEMA want to influence local zoning and land use planning more than the SFHA?)	**Long-term.** A question was asked whether this ranking is still applicable with a comment made regarding the need to further discuss with the Subcommittee members to agree on ranking.
FC-1.5	FEMA should develop a policy and standards on how to consider and determine erosion zones that are outside of the Special Flood Hazard Area (SFHA), as they ultimately affect flooding and environmental conditions within the SFHA.		If implemented wisely, these unchanged recommendations will ensure the systematic development of National and locally relevant climate, land use, and geomorphological change and flood-control scenarios and related data that is essential for the creation and effective utilization of a probabilistic-modeling framework while ensuring that modeling and mapping efforts serve areas experiencing population-driven increases in flood risk.	**Moderately High.** Discussed in coastal modeling update	**Long-term**
FC-1.6	FEMA should use a scenario approach for future conditions flood hazards calculation and mapping that will allow users to evaluate the robustness of proposed solutions to a range of plausible future conditions, including uncertain land use and climate change impacts.		This unchanged subrecommendation addresses the ongoing need for FEMA's future flood conditions products to include the impacts of expected flood-control structures and land use policies in order to supply information relevant to community-level flood-risk decision-making.	**High.** This recommendation is consistent with use of probabilistic modeling and mapping.	**Near-term**

Table 3-1: Revised Future Conditions to Reflect 2021 Deliberations by TMAC (continued)

Designated Recommendation Number	2015 Recommendation	Updated Recommendation Based on 2021 Future Conditions Subcommittee Deliberations	Justification/Description	Relevance Low / Mod Low / Mod High / High (L / ML / MH / H)	Timeliness (Near-Term / Long-Term)
FC-2	Identify and quantify accuracy and uncertainty of data and analyses used to produce future conditions flood risk products, tools, and information.		This simple, direct, and unchanged recommendation requiring the quantification/qualification of data and modeling accuracy and uncertainty represents a fundamental prerequisite for widespread acceptance of FEMA's future flood conditions products.	**High.** This recommendation is consistent with use of probabilistic modeling and mapping.	**Near-term**
FC-2.1	FEMA should use future risk assessments to take into account the likelihood of events occurring and their impacts, as well as the associated uncertainties surrounding these estimates.		FEMA should use future risk assessments to take into account the likelihood of events occurring and their impacts, as well as the associated uncertainties surrounding these estimates.	**High.** This recommendation is consistent with use of probabilistic modeling and mapping.	**Near-term**
FC-2.2	FEMA should publish multiple future conditions flood elevation layers that incorporate uncertainty so as to provide a basis for building designs that lower flood risk.		FEMA should publish multiple future conditions flood elevation layers that incorporate uncertainty so as to provide a basis for building designs that lower flood risk.	**High.** This recommendation is consistent with use of probabilistic modeling and mapping.	**Near-term**
FC-3	Provide flood hazard products and information for coastal and Great Lakes areas that include the future effects of long-term erosion and sea/lake level rise. Major elements are: • Provide guidance and standards for the development of future conditions coastal flood risk products. • Incorporate local relative sea/lake level rise scenarios and long-term coastal erosion into coastal flood hazard analyses. • Consider the range of potential future natural and man-made coastal changes, such as inundation and coastal erosion.	Provide flood hazard products and information for coastal and Great Lakes areas that include the future effects of long-term erosion and sea/lake level rise. Major elements are: • Provide guidance and standards for the development of future conditions coastal flood risk products. • Incorporate local relative sea/lake level rise scenarios and long-term coastal erosion into coastal flood hazard analyses. • Consider the range of potential future natural and man-made coastal changes, such as ~~inundation and coastal erosion~~ **flooding, coastal erosion, and land use**.	Recommendation FC-3 remains valid, but changes were required to include land use in the considerations of future coastal flood conditions.	**Moderately High.** Progress outlined during FEMA's Coastal Update.	**Near-term**
FC-3.1	FEMA should use a scenario approach when considering shoreline location for the estimation of future conditions flood hazards. At least two scenarios should be evaluated, one in which the shoreline is held at its present location, and another in which the shoreline is eroded according to the best available shoreline erosion data.	FEMA should ~~use a scenario approach when considering~~ **ensure FFRD methods incorporate multiple scenarios for future shoreline position and long-term erosion for the estimation of future conditions flood hazards. Different process-based methods should be evaluated for different shoreline geology/morphology, erosion mechanisms, and vertical land motion, including data-driven approaches that leverage the satellite record.** At least two scenarios should be evaluated, one in which the shoreline **is restricted from eroding past existing infrastructure (e.g., revetments, sea walls, roads),** and another in which the shoreline is eroded **assuming no infrastructure restrictions,** both according to the best available shoreline erosion data **and models**.	This subrecommendation was revised to reflect the current FFRD methods that will more easily incorporate multiple scenarios for shoreline position and long-term erosion.	**Low.** Accounted for in FFRD.	**Long-term**
FC-3.2	FEMA should develop guidance for incorporating future conditions into coastal inundation and wave analyses.	FEMA should develop guidance for incorporating future conditions into coastal flooding and wave analyses, **including Great Lakes water levels, vertical land motion, and Arctic sea ice conditions for Alaska. Wave analysis should include future scenarios derived from latest Coupled Model Intercomparison Project (CMIP) models.**	This subrecommendation was revised to consider changing Great Lakes Lake levels, vertical land motion, and Artic Sea ice conditions for Alaska.	**Low.** Accounted for in FFRD.	**Long-term**
FC-3.3	FEMA should develop consistent methods and models for long-term coastal erosion hazard mapping.	FEMA should develop consistent methods and models for long-term coastal erosion hazard mapping **to inform current and future erosion hazard zones for planning purposes in parallel to the flood hazard zones. The latest federal and academic shoreline modeling approaches should be leveraged.**	This subrecommendation was extended for clarify its purpose and advise FEMA to use newer shoreline models.	**Low.** Accounted for in FFRD.	**Long-term**

Table 3-1: Revised Future Conditions to Reflect 2021 Deliberations by TMAC (continued)

Designated Recommendation Number	2015 Recommendation	Updated Recommendation Based on 2021 Future Conditions Subcommittee Deliberations	Justification/Description	Relevance Low / Mod Low / Mod High / High (L / ML / MH / H)	Timeliness (Near-Term / Long-Term)
FC-3.4	FEMA should use Parris, et. al., 2012, or similar global mean sea level scenarios, adjusted to reflect local conditions, including any regional effects (Local Relative Sea Level) to determine future coastal flood hazard estimates. Communities should be consulted to determine which scenarios and time horizons to map based on risk tolerance and criticality.	FEMA should use ~~Parris, et. al., 2012, or similar global mean sea level scenarios, adjusted to reflect local conditions, including any regional effects (Local Relative Sea Level) to determine future coastal flood hazard estimates. Communities should be consulted to determine which scenarios and time horizons to map based on risk tolerance and criticality.~~ **the latest federal guidance for regionally based sea level scenarios (from the latest National Climate Assessment). Scenarios and time horizons should use a consistent natural approach based on risk tolerance and criticality.**	Recognizing that national sea-level rise scenarios have been and will continue to be developed, this subrecommendation has been enhanced to remove reference to specific scenarios while suggesting the adoption of consistent national scenarios.	**Moderately High.** Use best available data in modeling efforts.	**Near-term**
FC-3.5	FEMA should work with other Federal agencies (ex. NOAA, USACE, USGS), the U.S. Global Change Research Program (USGCRP), and the National Ocean Council to provide a set of regional sea-level rise scenarios, based on the Parris, et al., 2012 scenarios, for the coastal regions of the U.S. out to the year 2100 that can be used for future coastal flood hazard estimation.	FEMA should work with ~~other Federal agencies (ex. NOAA, USACE, USGS), the U.S. Global Change Research Program (USGCRP), and the National Ocean Council to provide a set of regional sea-level rise scenarios, based on the Parris, et al., 2012 scenarios, for the coastal regions of the U.S. out to the year 2100 that can be used for future coastal flood hazard estimation~~ **the Interagency Working Group on Sea Level Rise and Coastal Flood Hazard Scenarios and Tools (IWG-SLR) to provide a set of regional sea-level rise scenarios That feed into the latest National Climate Assessment, including using updated historical trends and extrapolations to inform the most likely scenarios for shorter time horizons. Time horizons beyond 2100 should be considered.**	This subrecommendation was revised to be less prescriptive and more generally recommend use of the latest National Climate Assessment scenarios.	**Moderately High.** Ongoing partnering efforts should continue.	**Near-term**
FC-3.6	FEMA should prepare map layers displaying the location and extent of areas subject to long-term erosion and make the information publicly available. Elements include: • Establishing the minimum standards for long-term erosion mapping that will be used by FEMA that must be met by partners/communities if it is to be incorporated into the FEMA products • Working with Federal, State, and local stakeholders to develop these minimum standards via pilot studies • Securing funding that can support sustained long-term erosion monitoring and mapping by allowing for periodic updates	FEMA should prepare map **and data** layers displaying the location and extent of areas subject to long-term erosion and make the information publicly available. Elements include: • Establishing the minimum national standards for long-term erosion **hazard zone** mapping **that** ~~will be used by FEMA that must be met by partners/communities if it is to be incorporated into the FEMA products~~ **incorporate both a median shoreline projection and a 95% confidence band, and should be produced for both storm conditions (extreme shoreline excursions) and daily conditions.** • Working with Federal, State, and local stakeholders to develop these minimum standards via pilot studies **• Exploring use of non-traditional datasets such as satellite shoreline measurements that can be used at national scale to establish historical rates and to inform models for future projections** • Securing funding that can support sustained long-term erosion monitoring and mapping by allowing for periodic updates	This subrecommendation was enhanced to emphasize national consistency, provide specific guidance related to future shoreline projections, and encourage consideration of non-traditional datasets.	**Moderately High.** FFRD depictions of graduated risk based on flooding and erosion hazard analyses.	**Near-term**

Table 3-1: Revised Future Conditions to Reflect 2021 Deliberations by TMAC (continued)

Designated Recommendation Number	2015 Recommendation	Updated Recommendation Based on 2021 Future Conditions Subcommittee Deliberations	Justification/Description	Relevance Low / Mod Low / Mod High / High (L / ML / MH / H)	Timeliness (Near-Term / Long-Term)
FC-3.7	FEMA should support additional research to characterize how a changing climate will result in changes in Great Lakes and ocean wave conditions, especially along the Pacific Coast. The relative importance of waves on this coast makes this an important consideration.	FEMA should support additional research to characterize how a changing climate will result in changes in Great Lakes and ocean wave conditions, **especially in Alaska,** Pacific Coast**, Pacific Islands and Caribbean Islands, and how changing storm and sea/lake ice patterns may impact future wave conditions. CMIP6 driven wave models that represent the state-of-the-science for projecting future wave conditions should be leveraged.** ~~The relative importance of waves on this coast makes this an important consideration.~~	This subrecommendation was updated to include specific mention of other coasts, including Alaska, Great Lakes sea/lake ice impacts, Pacific Islands and Caribbean Islands, where waves are the dominant component of extreme water levels, and how changing storm patterns may impact future wave conditions.	**Moderately Low.** Confirm if FEMA is the appropriate agency.	**Long-term**
FC-3.8	For the Great Lakes, the addition or subtraction of future lake level elevations associated with a changing climate is not recommended at this time due to current uncertainty in projections of future lake levels.	For the Great Lakes, **FEMA should use a scenario approach for high and low water level modeling and engage in future research efforts to more clearly characterize changing Great Lakes water levels and work on standards for Great Lakes water level projections.** ~~the addition or subtraction of future lake level elevations associated with a changing climate is not recommended at this time due to current uncertainty in projections of future lake levels.~~	The subrecommendation was revised to include future research needed for development a scenario approach for high and low water level modeling to more clearly characterize changing Great Lakes water levels.	**Moderately High**	**Near-term**
FC-3.9	FEMA should build upon the existing current conditions flood hazard analyses prepared by FEMA for the NFIP to determine future coastal flood hazards.	FEMA should build upon **the latest FFRD methods for determining current graduated flood risk to determine future flood risk.** ~~the existing current conditions flood hazard analyses prepared by FEMA for the NFIP to determine future coastal flood hazards.~~	This recommendation was changed to reference the latest FFRD methods.	**Moderately High.** Accounted for in FFRD.	**Near-term**
FC-3.10	FEMA should incorporate Local Relative Sea Level Rise scenarios into the existing FEMA coastal flood insurance study process in one of the following ways:• Direct Analysis – Incorporate sea level rise directly into process modeling (i.e., surge, wave setup, wave runup, overtopping, and erosion) for regions where additional sea level is determined to impact the Base Flood Elevation non-linearly (for example, where a 1-foot sea level rise equals a two-foot or more increase in the base flood).• Linear Superposition – Add sea level to the final calculated total water level and redefine the Base Flood Elevation for regions where additional sea level is determined to impact the base flood linearly (for example,1 foot of sea level rise equals a 1-foot increase in the base flood).• Wave effects should be calculated based on the higher Stillwater, including sea level rise.	FEMA should incorporate regionally based Sea Level Rise scenarios into the existing FEMA **FFRD** coastal ~~flood insurance~~ study process **using dynamic modeling (Direct Analysis):** ~~in one of the following ways:~~ • *Direct Analysis* – Incorporate sea level rise directly into process modeling (i.e., surge, **tide**, wave setup, wave runup, overtopping, and erosion). ~~for regions where additional sea level is determined to impact the Base Flood Elevation non-linearly (for example, where a 1-foot sea level rise equals a two-foot or more increase in the base flood).~~ • ~~Linear Superposition – Add sea level to the final calculated total water level and redefine the Base Flood Elevation for regions where additional sea level is determined to impact the base flood linearly (for example,~~ • ~~1 foot of sea level rise equals a 1-foot increase in the base flood).~~ • ~~Wave effects should be calculated based on the higher Stillwater, including sea level rise.~~	This subrecommendation was updated to remove reference to the current FEMA coastal study process and reference emerging plans for FFRD.	**Moderately High.** Accounted for in FFRD.	**Near-term**
FC-3.11	Maps displaying the location and extent of areas subject to long-term coastal erosion and future sea level rise scenarios should be advisory (non-regulatory) for Federal purposes. Individuals and jurisdictions can use the information for decision-making and regulatory purposes if they deem appropriate.	Maps **and data** displaying the location and extent of areas subject to long-term coastal erosion and future sea level rise scenarios should be advisory (non-regulatory) for Federal purposes. Individuals and jurisdictions can use the information for decision-making and regulatory purposes if they deem appropriate.	This recommendation was extended to recognize that data from which future conditions maps will be developed may also be used in other ways to facilitate consideration of coastal erosion risks.	**Moderately High.** Accounted for in FFRD.	**Near-term**

Table 3-1: Revised Future Conditions to Reflect 2021 Deliberations by TMAC (continued)

Designated Recommendation Number	2015 Recommendation	Updated Recommendation Based on 2021 Future Conditions Subcommittee Deliberations	Justification/Description	Relevance Low / Mod Low / Mod High / High (L / ML / MH / H)	Timeliness (Near-Term / Long-Term)
FC-4	Provide future conditions flood risk products and information for riverine areas that include the impacts of future development, land use change, erosion, and climate change, as actionable science becomes available. Major elements are: • Provide guidance and standards for the development of future conditions riverine flood risk products. • Future land use change impacts on hydrology and hydraulics can and should be modeled with land use plans and projections, using current science and build upon existing model study methods where data are available and possible. • Future land use should assume built-out floodplain fringe and take into account the decrease of storage and increase in discharge. • No actionable science exists at the current time to address climate change impacts to watershed hydrology and hydraulics. If undertaken, interim efforts to incorporate climate change impacts in flood risk products and information should be based on existing methods, informed by historical trends, and incorporate uncertainty based upon sensitivity analyses. • Where sufficient data and knowledge exist, incorporate future riverine erosion (channel migration) into flood risk products and information.	Provide future conditions flood risk products and information for riverine areas that include the impacts of future development, land use change, erosion, and climate change, as actionable science becomes available. Major elements are: • Provide guidance and standards for the development of future conditions riverine flood risk products. • Future land use change impacts on hydrology and hydraulics can and should be modeled with land use plans and projections, using current science and build upon existing model study methods where data are available and possible. • Future land use should assume built-out floodplain fringe and take into account the decrease of storage and increase in discharge. ~~No actionable science exists at the current time to address climate change impacts to watershed hydrology and hydraulics. If undertaken, interim e~~ **E**fforts to incorporate climate change impacts in flood risk products and information should be based on **standardized scenarios** ~~existing methods~~, informed by historical trends, and incorporate uncertainty based upon sensitivity analyses. • Where sufficient data and knowledge exist, incorporate future riverine erosion (channel migration) into flood risk products and information.	The recommendation is revised to reflect that actionable science is now available and could be explored further.	**High.** This is the 2021 Future Conditions recommendation.	**Near-term.** As implied, the science behind climate change projections is available.
FC-4.1	FEMA should evaluate previously issued guidance for future conditions land use and hydrology to incorporate best practices and lessons learned from communities that have implemented the guidance since 2001.	FEMA should evaluate previously issued guidance for future conditions land use and hydrology to incorporate best practices and lessons learned from communities that have implemented the guidance since **2015**.	Minor changes to this recommendation merely recognize the ongoing need to examine and build on efforts of communities across the country to account for expected land use and hydrology change in flood mitigation planning.	**Moderately High.**	**Near-term**
FC-4.2	FEMA should determine long-term riverine erosion hazard areas for areas subject to high erosion and provided to the public in a digital layer.	FEMA should **support research to identify important mechanisms and factors to help** determine long-term riverine erosion hazard areas for areas subject to high erosion and provided to the public in a digital layer.	Changes to this recommendation recognize that current methodologies for predicting important aspects of riverine erosion are not ready for National implementation and that additional research is needed to understand and account for bank instabilities.	**Moderately High.** (Accounted for in) FFRD and residual risk areas.	**Near-term**
FC-4.3	FEMA should utilize a national standard for riverine erosion zone delineations that reflects geographic variability.	FEMA should ~~utilize~~ **develop** a national standard for riverine erosion zone delineations that reflects ~~geographic variability~~ **important mechanisms and factors**.	Changes to this recommendation clarify that standards for predicting river erosion need to recognize and account for the many important factors which affect riverine erosion.	**Moderately Low.** Regional variability should be priority.	**Long-term**
FC-4.4	FEMA should take the impacts of future development and land use change on future conditions hydrology into account when computing future conditions for riverine areas.		This unchanged recommendation remains a relevant and central recommendation requiring implementation as actionable science becomes available.	**High**	**Long-term.** Suggest near-term with FFRD
FC-4.5	FEMA should implement riverine erosion hazard mapping (channel migration zones), leveraging existing data, models, and approaches that reflect site-specific processes and conditions.	FEMA should ~~implement~~ **support research to develop best practices for** riverine erosion hazard mapping **(E-Zones that define** channel migration zones), leveraging existing data, models, and approaches that reflect site-specific processes and conditions.	Changes to this recommendation recognize that current methodologies for predicting important aspects of riverine erosion are not ready for National implementation and that additional research is needed to understand and account for bank instabilities.	**Moderately Low.** FFRD with regional variability considerations.	**Long-term**

Table 3-1: Revised Future Conditions to Reflect 2021 Deliberations by TMAC (continued)

Designated Recommendation Number	2015 Recommendation	Updated Recommendation Based on 2021 Future Conditions Subcommittee Deliberations	Justification/Description	Relevance Low / Mod Low / Mod High / High (L / ML / MH / H)	Timeliness (Near-Term / Long-Term)
FC-4.6	FEMA should use observed riverine trends to help estimate what future conditions might look like. In watersheds where floods of interest may decrease in magnitude and frequency, then use existing riverine study results as the basis for flood hazard mapping. In watersheds where floods exhibit an increase in magnitude and (or) frequency, then use best available science to determine future hydrology and flood hazards.	FEMA should **develop best practices and standards to leverage updated techniques to detect nonstationarities; identify statistically significant changes, patterns, and trends; and attribute and model these nonstationarities continually to re-evaluate flood flow frequencies (whether increased or decreased flows).** ~~use observed riverine trends to help estimate what future conditions might look like. In watersheds where floods of interest may decrease in magnitude and frequency, then use existing riverine study results as the basis for flood hazard mapping. In watersheds where floods exhibit an increase in magnitude and (or) frequency, then use best available science to determine future hydrology and flood hazards.~~	Changes to this recommendation recognize that FEMA can take advantage of new techniques for detecting nonstationarities, attributing, and in some cases, incorporating, them into flood-frequency estimates and should develop guidance for doing so.	**High**	**Near-term**
FC-4.7	FEMA should work with other Federal agencies via the Advisory Committee on Water Information's Subcommittee on Hydrology to produce a new method to estimate future riverine flood flow frequencies. This method should contain ways to consistently estimate future climate-impacted riverine floods and address the appropriate range of flood frequencies needed by the NFIP.	FEMA should work with other Federal agencies ~~via the Advisory Committee on Water Information's Subcommittee on Hydrology~~ to produce a new method to estimate future riverine flood flow frequencies. This method should contain ways to consistently estimate future climate-impacted riverine floods and address the appropriate range of flood frequencies needed by the NFIP.	Changes to this recommendation remove reference to the Advisory Committee for Water Information and its subcommittees and workgroups which were dissolved and substitutes more a general reference to federal agencies.	**High**	**Long-term**
FC-4.8	FEMA should produce, and should encourage communities to adopt, future conditions products to reduce flood risk.		This unchanged recommendation remains relevant.	**High**	**Near-term**
FC-5	Generate future conditions data and information such that it may frame and communicate flood risk messages to more accurately reflect the future hazard in ways that are meaningful to and understandable by stakeholders. This should enable users to make better-informed decisions about reducing future flood-related losses.	~~Generate~~ **Assess and evaluate** future conditions data and information such that it may frame and communicate flood risk messages to more accurately reflect the future hazard in ways that are meaningful to and understandable by stakeholders. This should enable users to make better-informed decisions about reducing future flood-related losses.	Changes to this recommendation recognize FEMA's dependence on many other federal agencies to develop future flood conditions data and inputs, while asserting FEMA's responsibility for assessing future flood conditions.	**High**	**Long-term**
FC-5.1	FEMA should frame future risk messages for future conditions data and information such that individuals will pay attention to the future flood risk. Messages may be tailored to different stakeholders as a function of their needs and concerns.		This unchanged recommendation remains relevant and pivotal.	**High**	**Near-term**
FC-6	Perform demonstration projects to develop future conditions data for representative coastal and riverine areas across the Nation to evaluate the costs and benefits of different methodologies or identify/ address methodological gaps that affect the creation of future conditions data.	**FEMA should perform additional demonstration projects to further develop and refine future conditions data for additional representative coastal, riverine, and pluvial areas across the Nation.** ~~Perform demonstration projects to develop future conditions data for representative coastal and riverine areas across the Nation to evaluate the costs and benefits of different methodologies or identify/ address methodological gaps that affect the creation of future conditions data.~~	Extensive changes to this recommendation express TMACs concern that FEMA briefings imply that FEMA believes that it has completed the necessary pilot projects and demonstration efforts, while the TMAC believes that significant additional projects are needed.	**High**	**Near-term**
FC-6.1	FEMA should perform a study to quantify the accuracies, degree of precision and uncertainties associated with respect to flood studies and mapping products for existing and future conditions. This should include the costs and benefits associated with any recommendation leading to additional requirements for creating flood related products.	FEMA should ~~perform a study to quantify~~ **assess and report how FFRD** will quantify the accuracies, degree of precision, and uncertainties with respect to flood studies and mapping products for existing and future conditions. ~~This should include the costs and benefits associated with any recommendation leading to additional requirements for creating flood related products.~~	FEMA indicated FC-6.1 was completed through the probabilistic methodology exploration, and the methodology could be used to quantify accuracies, degrees of precision, and uncertainties. Context needs to be provided on how FFRD impacts future flood hazards assessments and product creation. FFRD was not a viable concept when this recommendation was made in 2015, and as a result, FEMA should assess and document accuracy, precision, and uncertainties related to future conditions flood studies.	**High**	**Near-term**

Table 3-1: Revised Future Conditions to Reflect 2021 Deliberations by TMAC (concluded)

Designated Recommendation Number	2015 Recommendation	Updated Recommendation Based on 2021 Future Conditions Subcommittee Deliberations	Justification/Description	Relevance Low / Mod Low / Mod High / High (L / ML / MH / H)	Timeliness (Near-Term / Long-Term)
FC-6.2	FEMA should conduct future conditions mapping pilots to continue to refine a process and methods for mapping and calculating future flood hazards and capture and document best practices and lessons learned for each.	FEMA should conduct ~~future conditions~~ mapping pilots to continue to refine processes and methods for mapping and calculating future flood hazards **under FFRD** and capture and document best practices and lessons learned for each.	The original text from 2015 remains mostly relevant and aligns closely with the TMAC's overall recommendation FC 6. However, slight updates were made to Recommendation FC-6.2 to align with FFRD efforts.	**High**	**Near-term**
FC-6.3	FEMA should support research for future conditions coastal hazard mapping pilots and case studies using the latest published methods to determine the best means to balance the costs and benefits of increasing accuracy and decreasing uncertainty.	FEMA should support research for future conditions coastal**, riverine, and pluvial flood** hazard mapping pilots and case studies using the ~~latest~~ **most current** published methods to determine the best means to balance the costs and benefits of increasing accuracy **and precision** and decreasing uncertainty.	The original text from 2015 remains mostly relevant and aligns closely with the TMAC's overall recommendation FC 6. However, slight updates were made to the recommendation relative to precision and to add riverine and pluvial future flood hazards to align with FFRD efforts.	**High**	**Near-term**
FC-7	Data and analysis used for future conditions flood risk information and products should build on standardized data and analysis used to determine existing conditions flood risks and additional future conditions data, such as climate data, sea level rise information, long-term erosion data; and develop scenarios that consider land use plans, planned restoration projects, and planned civil works projects, as appropriate, that would impact future flood risk.	Data and analysis used for future conditions flood risk information and **nonregulatory** products should build on standardized data and analysis used to determine existing conditions flood risks and additional future conditions data, such as climate data, sea level rise information, long-term erosion data; and development scenarios that consider land use plans, planned restoration projects, and planned civil works projects, as appropriate, that would impact future flood risk.	Minor edits to this recommendation clarify that TMAC expects the focus of future flood conditions products to be offered as nonregulatory projects and that future flood conditions scenarios should include watershed and hydrology development.	**High**	**Near-term**
FC-7.1	FEMA should support expanded research innovation for water data collection, for example using Doppler radar.	FEMA should support expanded research innovation for ~~water data collection, for example using Doppler radar.~~ **understanding the frequency and intensity of flood causing events and antecedent conditions and how those factors may change through time and affect future flood conditions.**	Substantial edits reframe this recommendation to more suggest that FEMA support research to understand and predict changes in frequency and intensity of flood causing events and antecedent conditions.	**Low**	**Long-term**
FC-7.2	FEMA should use a scenario approach to evaluate the impacts of future flood control projects on future conditions flood hazards.		This unchanged subrecommendation remains relevant.	**Moderately High.** This is a component of FFRD effort.	**Near-term**
FC-7.3	FEMA should support research on future conditions land use effects on future conditions hydrology and hydraulics.		This unchanged subrecommendation remains relevant.	**High**	**Near-term**
FC-7.4	FEMA should develop guidance for evaluating locally developed data from States and communities to determine if it is an improvement over similarly available National data sets and could be used for future condition flood hazard analyses.		This unchanged subrecommendation remains relevant.	**High**	**Near-term**
FC-7.5	FEMA should develop better flood risk assessment tools to evaluate future risk, both population-driven and climate-driven. Improve integration of hazard and loss estimation models (such as Hazus) with land use planning software designed to analyze and visualize development alternatives, scenarios, and potential impacts to increase use in local land use planning.		This unchanged subrecommendation remains relevant.	**High**	**Near-term**
FC-7.6	Future flood hazard calculation and mapping methods and standards should be updated periodically as we learn more through observations and modeling of land surface and climate change, and as actionable science evolves.		This unchanged subrecommendation remains relevant.	**High**	**Near-term**
2021 Recommendation (NEW)		FEMA should incorporate the Future Conditions Recommendations outlined in this report into the development, deployment, and continued enhancement of FFRD. This includes supporting existing partnerships to leverage best available climate science and datasets that will support future conditions analyses with an FFRD lens. Future conditions flood hazard and risk analyses should be standard approaches within the probabilistic modeling suite and resultant nonregulatory products that FFRD will employ.	This new recommendation recognizes that the 2015 Future Conditions recommendations and 2021 enhancements to them are well aligned with FEMA's FFRD initiative including the use probabilistic modeling and development of depictions of flood risk in a graduated manner.	**High**	**Near-term**

3.2.2 ALIGNMENT OF RECOMMENDATION TO FEMA PROGRAMS AND INITIATIVES (THEMES)

As part of its analysis, the TMAC reviewed the primary justification for changes to 27 of the 44 recommendations. The TMAC recognized three primary areas or themes that allowed a grouping of the recommendations into three categories. These categories demonstrate a broad alignment with FEMA programs and initiatives, including FFRD, in order to inform potential implementation actions for FEMA consideration. Additionally, by categorizing the recommendations into themes, the TMAC was able to assess relative priority and timeliness for implementation. Broadly speaking, the recommendations are aligned with the following three themes:

- **Theme 1.** Recommendation adds clarity on what is known about the state of technology. Additionally, the updated recommendation adds specificity and/or recognizes that climate science is evolving and will continue to do so.
- **Theme 2.** Recommendation broadens existing recommendations and addresses the need to recognize newly identified needs or additional research.
- **Theme 3.** Recommendation recognizes scientific or programmatic advances made since 2015 Future Conditions report (TMAC, 2015a).

The TMAC thematically assessed the recommendations (and their proposed updates) to formulate a potential implementation strategy for future conditions considerations that inform FEMA's FFRD initiative. Figure 3-2 indicates the Future Conditions recommendations assigned to each theme. The 27 recommendations that were proposed to be updated (17 recommendations remained unchanged) can be broken down as follows:

- 7 were revised to clarify what is known currently about the state of technology
- 2 were revised to recognize new needs
- 6 recommendations were revised to recognize program advances
- 12 were revised in alignment with more than one theme

Specifically, language in both Future Conditions Recommendations FC-1 and FC-3 was clarified to recognize the need for adaptive approaches and include land use in the considerations of future coastal flood conditions. Additionally, language in Subrecommendations FC-3.4 and FC-3.5 was broadened to be less prescriptive while removing outdated references, and adjustments were made in recognition of technical advances and FEMA's role in incorporating these advances

In some instances, the recommendations encompassed more than one theme; in these instances, the TMAC thought it relevant to review the recommendation, so that future implementation considerations may be discussed. After thorough assessment, the TMAC recommends that nearly half (49%) of the 2015 Future Conditions recommendations remain "as-is." This is significant because FEMA is currently implementing of a number of the recommendations, and because the TMAC is not suggesting changes to these recommendations, implementation will not be disrupted. Also noteworthy is that FEMA's FFRD initiative was not part of the TMAC's consideration for the 2015 report and it is the TMAC's belief that FFRD, as envisioned, intends to provide a robust platform for future conditions considerations.

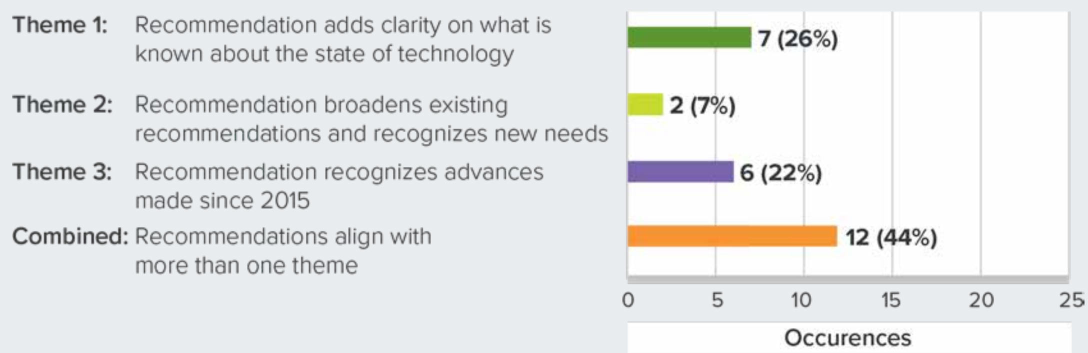


Figure 3-2: Number of Future Conditions recommendations assigned to themes

Data sources: *TMAC 2015 Annual Report* and *TMAC 2015 Future Conditions Risk Assessment and Modeling Report*

Table 3-2 is provides a crosswalk detailing which of the recommendations the TMAC proposes to update to align with each of the three general themes outlined above. The TMAC applied this approach in order to quantitatively and qualitatively justify the proposed updates to previous Future Conditions recommendations. A key takeaway of this assessment led to the TMAC's new recommendation in this year's report, which recognizes FEMA's FFRD initiative and the need to incorporate future conditions considerations in the ongoing development of FFRD.

Table 3-2: Crosswalk of Modified Future Conditions Recommendations with Themes

Future Condition No.	Theme 1: Adds clarity based on known current technology				Theme 2: Broadens existing recommendations and recognizes new needs		Theme 3: Recognizes scientific/ programmatic advances made since 2015
	Adds specificity	Recognizes science will evolve	Clarifies existing technology	Validates need for standards	Broadens scope	Recognizes need for additional research	
FC-1	✓	✓					
FC-3	✓						
FC-3.1							✓
FC-3.2	✓						
FC-3.3			✓				✓
FC-3.4					✓		✓
FC-3.5					✓		✓
FC-3.6			✓			✓	
FC-3.7	✓		✓				
FC-3.8			✓			✓	
FC-3.9							✓
FC-3.10					✓		✓
FC-3.11	✓		✓				
FC-4		✓	✓				✓
FC-4.1							✓
FC-4.2						✓	
FC-4.3				✓			
FC-4.5						✓	
FC-4.6							✓
FC-4.7					✓		✓
FC-5							✓
FC-6							✓
FC-6.1	✓					✓	
FC-6.2	✓					✓	
FC-6.3		✓				✓	
FC-7			✓				
FC-7.1					✓		✓

Note: ✓ = yes

3.3 TMAC IDENTIFICATION OF NEW 2021 FUTURE CONDITIONS RECOMMENDATION

FEMA 2021 TASKING LETTER

FUTURE CONDITIONS RECOMMENDATIONS DIRECTIVE

Review recommendations from the TMAC's 2015 Future Conditions report to:

- Identify additional recommendations for addressing future conditions with the graduated approach to flood hazard and flood risk identification.

In addition to assessing the relevancy of the 2015 Future Conditions recommendations, the TMAC was tasked with identifying new recommendations needed to address future flood conditions, given FEMA's adoption of an approach to graduated flood hazard and flood risk identification. As a result of the review and analysis process described in Section 3.2.1, the TMAC realized the increased relevance of Recommendations FC-1 through FC-7 and most of the subrecommendations because of their enhanced potential, which was created by the FFRD initiative, and the greater potential of FFRD if the 2015 Future Conditions recommendations were implemented.

The TMAC recommends the addition of a new future conditions recommendation that supports the continued advancement of FEMA's FFRD initiative. This recommendation aims, in part, to address the transition in FEMA's approach from binary to graduated flood hazard and flood risk identification, which was endorsed by the TMAC in 2021. The specific language for the new recommendation is shown below.

TMAC Future Conditions 2021 Recommendation

FEMA should incorporate the future conditions recommendations outlined in this report into the development, deployment, and continued enhancement of FFRD. This includes supporting existing partnerships to leverage best available climate science and datasets that will support future conditions analyses with an FFRD lens. Future conditions flood hazard and risk analyses should be standard approaches within the probabilistic modeling suite and resultant nonregulatory products that FFRD will employ.

As a result of these discussions, the TMAC strongly believes that through FFRD, FEMA is poised to take into consideration not only the data that characterize flood risk based on historical records of individual flood events, but also what can be anticipated when future conditions (e.g., climate change, SLR) are factored into assessing flood hazard and flood risk.

Section C.2 in Appendix C provides a more detailed discussion of the new 2021 Future Conditions recommendation.

3.4 FUTURE CONDITIONS RECOMMENDATIONS AND FFRD

This section discusses how the new 2021 Future Conditions recommendation (described more fully in Section 3.3) explicitly ties recommendations FC-1 through

FC-7 and most of their subrecommendations to the development, deployment, and continued enhancement of the FFRD initiative in its broadest sense. None of the recommendations conflict with FFRD, and most of the recommendations could have a positive impact on FFRD.

Table 3-3 summarizes the TMAC's analysis of the alignment of the 2015 Future Conditions recommendations with FFRD. The table reflects the TMAC's overarching assessment of whether FFRD is consistent with, or supportive of, each of the revised 2015 recommendations, and whether each recommendation negatively or positively impacts/influences the four primary FFRD elements summarized in the table headings:

- Shift from binary to graduated risk analysis
- Ensure a significant and appropriate role for the private sector and SLTTs
- Increase access to flood hazard data to improve resulting mitigation and insurance actions
- Modernize the management and delivery of flood hazard mapping

3.4.1 SUMMARY OF ALIGNMENT OF RECOMMENDATIONS WITH FFRD ELEMENTS

There are important potential interplays between the recommendations and FFRD. From TMAC's perspective, the impact of FFRD on achievement of the revised recommendations is an important concern. The TMAC employed its understanding of the still evolving FFRD, particularly the planned objective of shifting to a graduated depiction of flood risks, to assess whether FFRD enhanced potential implementation of the recommendations. It found that the FFRD initiative, across the full breadth of the four components, would positively affect the resultant ability of FEMA or its partners to achieve or implement most of the recommendations.

Overall, implementation of FFRD has very positive and enabling impacts on 17 of the recommendations. An additional 15 recommendations are positively impacted by FFRD. These impacts come about from one or more aspects of FFRD. For example, the shift from a binary to graduated view of flood risks through probabilistic modeling could provide an efficient means of implementing aspects of FC-4, providing flood risk products for riverine conditions, subject to assumptions required in scenario analysis.

Acknowledging and supporting appropriate roles for various partnering agencies, particularly the roles of state and local partners in land use planning and regulation, would help implementation of FC-1.5, develop guidance for using local zoning regulations in projecting future flood risks. Indeed, with such guidance, practitioners would be left to guess as to the appropriate treatment of the timeliness of anticipated increases in urban development and its impact on future runoff and flooding.

Table 3-3: Summary of Recommendation Alignment with FFRD Elements

Future Condition No.	Effect of FFRD on Recommendation (Consistent/Supportive)	Effect of Recommendation on FFRD: Shift to Graduated Flood Risk	Effect of Recommendati on on FFRD: Appropriate Roles	Effect of Recommendation on FFRD: Increased Access to Data	Effect of Recommendation on FFRD: Modernizing Management and Delivery
FC-1	Positive and enabling	Positive		Positive	
FC-1.1					Positive
FC-1.2	Positive and enabling			Positive	
FC-1.3					Positive
FC-1.4		Positive if guidance facilitates data compatible with probabilistic models	Positive		
FC-1.5	Positive and enabling	Positive	Positive	Positive	
FC-1.6	Positive and enabling			Positive	
FC-2	Positive and enabling	Positive and enabling		Positive	
FC-2.1	Positive and enabling	Positive		Positive	Positive
FC-2.2	Positive and enabling			Positive	
FC-3	Positive and enabling			Positive	
FC-3.1	Positive and enabling			Positive	
FC-3.2	Positive	Positive if guidance facilitates data compatible with probabilistic models			
FC-3.3				Positive	
FC-3.4	Positive	Positive	Positive	Positive	
FC-3.5	Positive	Positive		Positive	
FC-3.6		Positive if guidance facilitates data compatible with probabilistic models	Positive		
FC-3.7	Positive		Positive	Positive	
FC-3.8	Positive and enabling	Positive		Positive	
FC-3.9			Positive	Positive	Positive
FC-3.10		Positive		Positive	
FC-3.11	Positive				Positive
FC-4	Positive and enabling	Positive	Positive	Positive	
FC-4.1	Positive and enabling	Positive and enabling if guidance enhances data for input to probabilistic models	Positive		
FC-4.2	Positive	Positive		Positive	
FC-4.3	Positive	Positive and enabling if standard facilitates data prep for probabilistic models	Positive	Positive	

Table 3-3: Summary of Recommendation Alignment with FFRD Elements (concluded)

Future Condition No.	Effect of FFRD on Recommendation (Consistent/Supportive)	Effect of Recommendation on FFRD: Shift to Graduated Flood Risk	Effect of Recommendati on on FFRD: Appropriate Roles	Effect of Recommendation on FFRD: Increased Access to Data	Effect of Recommendation on FFRD: Modernizing Management and Delivery
FC-4.4	Positive and enabling			Positive	
FC-4.5	Positive and enabling			Positive	
FC-4.6	Positive and enabling	Positive		Positive	
FC-4.7	Positive	Positive	Positive	Positive	
FC-4.8	Positive		Positive		
FC-5	Positive and enabling		Positive	Positive	Positive
FC-5.1	Positive and enabling		Positive		Positive
FC-6		Positive if future pilots are used to develop/demonstrate probabilistic model capabilities			
FC-6.1	Positive and enabling	Positive and enabling if future pilots are used to develop/demonstrate probabilistic model capabilities			Positive
FC-6.2	Positive and enabling	Positive if future pilots are used to develop/demonstrate probabilistic model capabilities			Positive
FC-6.3	Positive and enabling	Positive if future pilots are used to develop/demonstrate probabilistic model capabilities		Positive	
FC-7	Positive and enabling	Positive and enabling s if standards facilitate use of probabilistic models		Positive	Positive
FC-7.1	Positive	Positive	Positive		
FC-7.2	Positive	Positive		Positive	Positive
FC-7.3		Positive		Positive	
FC-7.4	Positive	Positive and enabling if guidance facilitates data compatible with probabilistic models	Positive	Positive	Positive
FC-7.5	Positive			Positive	
FC-7.6	Positive	Positive			Positive
2021 RECOM-MENDATION (NEW)	Positive	Positive	Positive	Positive	Positive

3.4.2 RECOMMENDATION IMPACTS TO FFRD

TMAC assessed six recommendations as “enabling” FFRD. Most of these recommendations target the development of data standards, which are needed to align the efforts of state and local agencies who develop data with the needs of probabilistic modeling. Other enablers include recommendations for working with other agencies to refine methodologies and develop data. For example, Recommendation FC-4.7 recommends that FEMA work with other agencies to improve methods for defining flood frequencies, and Recommendation FC-7.1 recommends that FEMA support research into flood causation and storm typing.

The primary impacts of the shift from binary to graduated flood risk mapping will be to increase the availability of flood data and enhance FEMA’s ability to support the efforts of communities to understand and mitigate current and future flood risks. However, the shift will also deepen FEMA’s dependance on the ability of federal, state, and local partner agencies to supply data describing current and future watershed populations, land use, flood-control structures, and climate so that future flood risks can be projected and explored in the context of policies and ordinances impacting those risks.

As a result, FEMA must recognize, recruit, and support the efforts of state, local, and tribal agencies to grow their ability to develop such data and invest in modern data management and delivery systems. Establishing standards for data or map production would facilitate the development of appropriate roles for partnering sectors and entities. Recommendations FC-1.4 and FC-1.5 call for the creation of data or methodological standards that FEMA technical partners could employ in modeling and mapping. Recommendations FC-3.5, FC-3.7, FC-4.2, FC-4.5, FC-6.3, and FC-7.1 call on FEMA to support research that would result in improved modeling and mapping methods and thereby enhance the availability of future conditions flood data. Other recommendations call on FEMA to provide support and encouragement for proactive state and local action to reduce flood risk, such as subrecommendation FC-4.8.

Other recommendations also positively impact FFRD. For example, 31 recommendations, if successfully implemented, would positively increase the availability and usability of flood hazard data—a primary objective of FFRD. Recommendations FC-1, FC-3, and FC-4 all direct the creation of future flood hazard or risk data. Other recommendations would help modernize data management or delivery, such as FC-1.1, FC-1.3, and FC-2.1.

3.5 IMPLEMENTATION CONSIDERATIONS

Throughout its deliberations, the TMAC identified 30 Future Conditions recommendations that FEMA should begin addressing, or continue to address in the near term, especially while considering the continued evolution of the FFRD initiative. This includes the new 2021 Future Conditions recommendation that establishes the integration of future conditions into all facets of FFRD as essential. And while the TMAC identified the remaining 15 Future Conditions recommendations for FEMA's consideration in the long term, a robust discussion on the implementation priorities should continue, taking into account the various stakeholders and their respective roles that could be employed during the transition to FFRD as outlined in the TMAC 2020 Annual Report (TMAC, 2021).

Based on the TMAC's review of the 2015 Future Conditions recommendations and an analysis of the interplay and supporting role that many of the recommendations may play in the successful development of FFRD, the TMAC has formulated five principles that should guide implementation of the 2015 recommendations:

Consideration of future conditions is an imperative. The consideration of future conditions flood data, models, and maps could be considered both a driver and benefactor of FFRD. From the TMAC's perspective, it is imperative that future conditions factors be a major input to and output from the FFRD. Regardless of the source, FEMA must consider Future Conditions recommendations and seek collaborations for implementing them because they are beneficial to achieving the outcomes FEMA has identified for FFRD.

Engage partners in the development of FFRD by facilitating their participation in development of future conditions data. The development of various data sources, tools, and communication strategies necessary to fully consider and implement graduated flood hazard and risk products while also considering a wide range of future conditions scenarios may only be accomplished by engaging a broad stakeholder audience. The TMAC may be tasked to provide additional input or suggestions to identify those recommendations, future conditions components, and/or change factors for which FEMA has a direct influence in development, or whether data, assessments, and expertise related to future conditions may be identified and leveraged from other sources.

As outlined in Table 3-4, FEMA has the opportunity to collaborate with SLTT, academic, non-profit, and for-profit organizations to incorporate future conditions best practices and data into FFRD assessments and their resultant products.

Be flexible. The new approach provided by the flexibility outlined in FFRD will allow FEMA to engage stakeholders based on their distinct needs. Risk communication efforts may be couched more holistically by indicating the location of yesterday's, today's, and tomorrow's floodplain. Indeed, a dynamic, database-driven initiative such as FFRD can allow stakeholders to create and utilize products applicable to local or regional hazards. In fact, the opportunities arising from FFRD will engage stakeholders in zoning and land use decision-making that considers more than the traditional factors leading to riverine, pluvial, and coastal flooding.

Table 3-4: Possible Collaborative Roles for FEMA Stakeholders

Partner	Provide Data	Provide/ Develop Tools	Flood Risk Management Service	Notes and Examples
USGS	Y	Y	Y	Lidar – 3DEP, stream gauge data
NOAA	Y		Y	Sea-level data
NOAA-NWS	Y	Y	Y	Atlas 14 rainfall data, National Water Model, forecast models, flood inundation models
USACE	Y	Y	Y	Dam and levee information and risk assessments, flow data – riverine, reservoirs, etc., hydrologic and hydraulic models, model tools and support
States	Y		Y	Mapping data, flow data, hydraulics data, partners, outreach, education, leveraging funds, higher standard enforcement
Tribal	Y		Y	Mapping data, flow data, hydraulics data, partners/coordination, outreach, education, leveraging funds, higher standard enforcement
Local Municipalities	Y		Y	Mapping data, flow data, hydraulics data, partners/coordination, outreach, education, leveraging funds, higher standard enforcement
Regional/ watershed groups	Y		Y	Mapping data, flow data, hydraulics data, partners/coordination, outreach, education, leveraging funds, higher standard enforcement
Academia	Y			Research, mapping data, stakeholder engagement, data and tools
Non-profit Organizations	Y	Y		Project implementation, research, modeling, mapping data, outreach, education
Private Organizations	Y	Y		Data, coordination, modeling, leveraging funds

Note: Y = yes
Source: Table 5 in TMAC *2020 Annual Report* (TMAC, 2021)

Strive for a comprehensive product. Ultimately, a mapping program (such as FFRD) that leverages probabilistic flood hazard analyses; considers paleo, past, and future conditions; and depicts riverine, pluvial, and coastal flood risks (and their various combinations) from a variety of sources and assuming a graduated approach, will provide valuable information for decision-makers to use in land use, zoning, open space, and other conservation decisions.

Enhance equity. Additional considerations related to underserved and underrepresented communities should also help FEMA inform priorities related to future conditions considerations. Literature abounds that underserved communities are often those most acutely affected during times of flood-related disasters, including *Flood Recovery Outcomes and Disaster Assistance Barriers for Vulnerable Populations* (Wilson et al., 2021). Therefore, considering future flood hazards and risks is paramount for environmental justice considerations and building community resilience using FFRD as the tool.

FEMA has undertaken and made considerable strides in modernizing flood hazard and risk mapping with preliminary design and, ultimately, the transition to FFRD. This is evidenced by FEMA's willingness to engage stakeholders in various working groups, via potential rulemaking and regulatory changes, and by feedback received from the TMAC. The development of these five guiding principles for implementation afforded the TMAC an opportunity to validate the future conditions approaches outlined in the 2015 Future Conditions report (TMAC, 2015a), make suggestions on new or enhanced future conditions-related datasets and tools that FEMA could consider, and present opportunities for FEMA to seek additional input on prioritizing future conditions scenarios, datasets, and collaborations as FFRD continues to evolve.

04 ENTERPRISE RISK MANAGEMENT

FEMA TASKING LETTER

Explore risk management frameworks, such as Enterprise Risk Management (ERM), in the context of flood risk management (FRM) and explore how FEMA could apply ERM for FRM. ERM is typically applied in sectors other than FRM so the collective knowledge at the intersection between ERM and FRM is small. Risk management approaches, such as ERM, can allow federal, state, and local agencies to reduce variance and improve the ability to meet their objectives. Exploring ERM in the context of FRM can support FEMA meeting the objectives of OMB Circular A-123, which requires agencies to implement ERM.

OMB CIRCULAR A-123

"Risk management is a series of coordinated activities to direct and control challenges or threats to achieving an organization's goals and objectives. ERM is an effective Agency-wide approach to addressing the full spectrum of the organization's external and internal risks by understanding the combined impact of risks as an interrelated portfolio, rather than addressing risks only within silos. ERM provides an enterprise-wide, strategically-aligned portfolio view of organizational challenges that provides better insight about how to most effectively prioritize resource allocations to ensure successful mission delivery."

—"Management's Responsibility for Enterprise Risk Management and Internal Control" (pg. 9)

The TMAC continues to be guided by its 2020 vision of supporting the creation of "a more flood-resilient nation" (TMAC, 2021) and in 2021 was tasked by FEMA to explore Enterprise Risk Management (ERM) in the context of Flood Risk Management (FRM) and how its application might help FEMA meet the objectives of OMB Circular A-123.

This chapter:

- Explains the ERM concept for background purposes (Section 4.1).
- Presents an ERM process and reflections on the application of ERM using the FY 2021–2023 Federal Insurance and Mitigation Administration (FIMA) strategy (FEMA, 2020b) (Section 4.2).
- Documents SLTT programs that have established a strong foundation in applying elements of ERM in the context of FRM at the state and local levels (Section 4.3).
- Provides summaries, findings, and recommendations on FIMA's application of ERM. (Section 4.4).

The TMAC's recommendations for FIMA's consideration of the use of ERM to help achieve FEMA's vision of a prepared and resilient Nation (FEMA, 2020b) are provided in Chapter 5.

4.1 INTRODUCTION TO ENTERPRISE RISK MANAGEMENT

ERM is a coordinated risk management process that emphasizes cooperation among departments to manage an organization's full range of risks. An enterprise, as used in ERM, is an organization, and a risk, as used in ERM, is the risk of not meeting the organization's strategic objectives (i.e., big-picture goals). ERM provides a framework for effectively managing uncertainty, responding to risks, and harnessing opportunities as they arise.

Definition
ENTERPRISE RISK MANAGEMENT

"An effective agency-wide approach to addressing the full spectrum of the organization's significant risks by considering the combined array of risks as an interrelated portfolio, rather than addressing risks only within silos. ERM provides an enterprise-wide, strategically aligned portfolio view of organizational challenges that provides improved insight about how to more effectively prioritize and manage risks to mission delivery" (CFO and PIC, 2016, p. 6).

UNDERSTANDING RISK

Every activity conducted by an entity engages in some sort of risk. Risk is unavoidable, pervasive, and existential. Risk is present in any activity, from brushing teeth in the morning to avoid the hazard of cavities or heart disease to investing in a retirement account for the future. The outcome a loss of a tooth or loss of life due to a heart attack is uncertain just as the outcome of sufficient retirement accounts due to capital gains on investments is uncertain. Activity or inactivity are behaviors that create risk. Indeed, even maintaining the status quo creates risk because the environment around us changes. An activity that once represented an opportunity may today produce unacceptable loss risks.

Organizations traditionally have department leaders who manage risks within their areas of responsibility (silos). This approach can lead to risks that fall between the silos where no one has responsibility for them or risk transfers between departments that go unnoticed. Managing risk in silos can also lead to a narrow view that is overly focused on internal operations with little attention given to risks that emerge from outside the department or within the broader market. Managing risks at the enterprise level rather than in silos at the departmental level helps an organization reach its strategic objectives. The purpose of ERM is to develop a holistic, portfolio view of the most significant risks to an organization's ability to achieve its most important objectives. ERM's power comes from its ability to unify an enterprise as it strives to meet its strategic objectives.

ERM addresses risks where consequences are either positive or negative. In its simplest form, risk can be thought of as the product of probability and consequences. The probability side of that definition is what creates uncertainty whereas the consequences side reflects positive consequences (opportunity) or negative consequences (loss). The ERM manager's job is to keep risks in check by lowering the probability or consequences of events that negatively impact objectives and increasing the probability or consequences of events that positively impact objectives. ERM helps managers reduce uncertainty in achieving objectives by providing structure to the process of mitigating losses and taking advantage of opportunities such that the overall risk to meeting an enterprise strategic objective is within established tolerance levels.

Risk is a measure of the probability and consequence of uncertain future events. It is the chance of an uncertain outcome. That outcome could be a loss or an opportunity for potential gain. What usually creates the "chance" is uncertainty, a lack of information about events that have not yet occurred. We lack information because there are facts we do not know; the future is fundamentally uncertain, and the universe is inherently variable.

Loss and opportunity risk create two major tasks for enterprise risk managers. A hazard is the thing that causes the potential for a loss. An opportunity causes the potential for a positive consequence. When faced with risks of loss, their job is to avoid risks. Faced with opportunity risk, their job is to prudently take risks.

- Opportunity risks represent uncertain positive outcomes that require action to achieve. A risk manager must take the opportunity despite the uncertainty in the potential gain or the potential gain would not be realized.
- Loss risks represent uncertain negative outcomes that require action to avoid. A risk manager must adopt a defensive position to preserve value that may be eroded by the loss.

Often a given identified risk can be evaluated as either an opportunity risk or a loss risk, though this is not always the case. The important consideration in identification of a risk is the overall posture of the entity, perceiving all risks as loss risks sets the stage for a conservative entity constantly battling to preserve the value previously created. On the other hand, perceiving all risks as opportunity risks sets the stage for an aggressive entity constantly seeking greater gains with little concern for preserving previously created value. ERM is a flexible framework to balance risk taking with risk mitigation based on the overall posture desired by the entity.

Risk Example

Considering investments, an investment with a return of 5% per annum and a variance of 1% (e.g., investing in a government bond) when compared to an investment with a return of 5% per annum and a variance of 3% (e.g., some blue chip stock). The lower variance bond would represent less risk to the investor (all else being equal) because its return is more certain. The uncertainty and amount of return for these two choices describes the risk. Both investments have risk.

If presented with the 5% return with 1% variance and an alternative stock with 8% return and 1% variance, most investors would choose the 8% stock because there is opportunity for 3% more gain. If you do not change your investments, you miss the opportunity for gain or you are not taking an opportunity risk. In this case, maintaining status quo suffers from the missed opportunity. External factors, like a global pandemic, can impact the behavior of investments; therefore, continual monitoring of the current investment strategy, deployed along with changing environments or developments in the specific investments, is an activity of risk management, one of balancing opportunity risks with loss risks.

Taking opportunities and avoiding losses are both activities that carry risk but they are used to manage the overall risk to the greater investment portfolio. As the investor ages, the appetite for risk (uncertainty in the return on the investments) changes. Generally at younger ages, a higher appetite for risk is appropriate, but later in retirement age, a lower risk appetite is appropriate.

As illustrated in the modified ISO diagram shown in Figure 4-1, applying ERM begins by establishing the context, or identifying the organization's strategic objectives. Next, a risk assessment is conducted. The risk assessment portion—also called the risk profile—includes identifying, analyzing, and evaluating enterprise risks. The enterprise-level risks are the losses or gains that could affect the organization's ability to achieve its strategic objectives. As applicable, each enterprise is managed (see "Treat risks" in Figure 4-1) by taking action to keep risk-avoiding and risk-taking activities within the organization's appetites. The ERM process is described in greater detail in the remainder of this section.

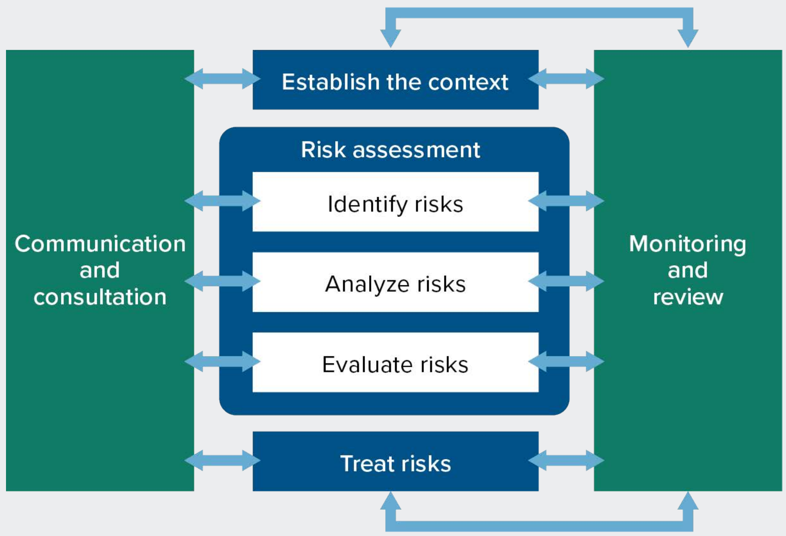


Figure 4-1: Example of ERM process

Source: Adapted from ISO 31000:2018 [ISO, 2018])

4.1.1 DIFFERENCES BETWEEN ENTERPRISE RISK MANAGEMENT AND RISK MANAGEMENT IN GENERAL

ERM is defined by the Committee of Sponsoring Organizations (COSO) as "a process, effected by an entity's board of directors, management, and other personnel, applied in strategy-setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives" (COSO, 2004). ERM helps an organization to manage uncertainty and reduce surprises while seizing opportunities to achieve the enterprise's strategic objectives.

ERM is not unique to a single type of consequence (either loss or opportunity), thus it should not be confused with FRM or beneficial use of floodplains. ERM is focused on strategic decision-making using risk to inform decisions, thus it is not simply a form of risk-informed decision-making (RIDM) that focuses on operational or tactical levels of an organization. ERM is distinct from FRM and RIDM in that it goes beyond informing decisions and by design, it seeks to identify a multitude of risks (either opportunities or losses) that increase the uncertainty in meeting an enterprise's objectives. While the purpose of ERM is to develop a holistic, portfolio view of the most significant risks to the organization's ability to achieve its most important objectives, FRM is concerned with the assessment and mitigation of flood risk specifically. FRM includes the action(s) taken to mitigate flood risks. RIDM trades off levels of risk with other criteria to arrive at a decision. Risk is an explicit consideration in all such decisions, but it is not the only consideration. RIDM is typically a decision-making approach used at the operational and tactical levels of an organization, rather than at the enterprise level, while executing its mission. It relies on some or all of the principles of risk analysis.

In general, risk analysis (either through ERM or other risk management concepts) is both an emerging science and a framework for making decisions, under uncertainty, that comprises risk management, risk assessment, and risk communication.

- **Risk management** is a process of identifying problems, requesting information, evaluating risks, and initiating action to identify, evaluate, select, implement, monitor, and modify actions taken to change unacceptable levels of risk to acceptable or tolerable levels.
- **Risk assessment** is a systematic process for describing the nature, likelihood, and magnitude of risk associated with some substance, situation, action, or event that includes consideration of relevant uncertainties. Risk assessment can be qualitative, quantitative, or a blend (semiquantitative) of both.
- **Risk communication** is the open, two-way exchange of information and opinion about risks that is intended to lead to a better understanding of the risks and better risk management decisions. Risk communication provides a forum for the interchange of information with all concerned about the nature of the risks, the risk assessment, and how risks should be managed.

In this chapter, risk in the context of "enterprise risk" means the effect of uncertainty on the achievement of objectives. An effect is a deviation from the desired outcome that may present positive or negative results (CFO and PIC, 2016). Positive results are expected to stem from opportunities whereas negative results stem from hazards. Overall risk for any given objective therefore can be thought of as the combination of all opportunity risks (+) and loss risks (-). ERM can then be used to focus action on the most critical risks to achieving organization objectives.

4.1.2 ENTERPRISE RISK MANAGEMENT PROCESS

As previously noted, ERM is an evolving discipline. For the purposes of TMAC's tasking, it has been simplified to five steps, illustrated in Figure 4-2 and described in the text that follows.

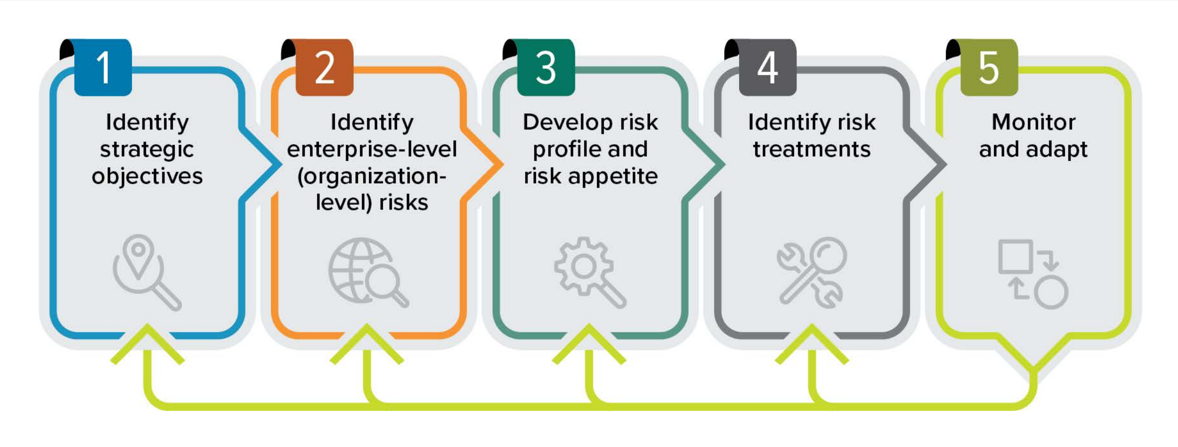


Figure 4-2: Five steps of ERM process

Step 1– Identify Strategic Objectives. In practice, ERM begins by identifying the organization's strategic objectives. Strategic objectives are purpose statements that identify an organization's desired outcomes. They define success for the organization.

Step 2 – Identify Enterprise-Level Risks. The next step is to identify enterprise-level risks. These are best thought of as high level internal or external risks that impact the organization's ability to meet its objectives. Enterprise-level risks do not typically include the operational- and tactical-level hazards and opportunities that if realized would not have a significant impact on achieving enterprise-level objectives.

Step 3 – Develop Risk Profile and Risk Appetite. The next step is to develop a risk profile that analyzes the enterprise risks relative to the identified strategic objectives. In other words, the risk profile provides an analysis of how the organization-level risks may hinder accomplishing the organization's objectives by creating circumstances that preclude their accomplishment or by significantly hindering opportunities that could allow their realization.

The purpose of a risk profile is to provide an objective understanding of an organization's enterprise-level risks. In all but the most mature ERM-practicing organizations, the profile is likely to provide a qualitative assessment of each enterprise risk and its relationship to the set of strategic objectives.

Definition
RISK PROFILE

A thoughtful analysis of the risks an agency faces to achieving its strategic objectives and arising from its activities and operations. The risk profile assists in facilitating a determination around the aggregate level and types of risk that the agency and its management are willing to assume to achieve its strategic objectives (OMB, 2016).

Definition
RISK APPETITE

Articulation of the amount of risk (on a broad, macro level) an organization is willing to accept in pursuit of strategic objectives and the value to the enterprise (CFO and PIC, 2016).

Part of the risk profile is to determine/assess the organization's risk appetite. The risk appetite is formulated to guide the organization in determining the extent to which it will avoid loss risk or seek opportunity risk in pursuit of its strategic objectives. Every organization must take risks to achieve objectives. The critical ERM question is how much risk and which risks should the entity take? Risk appetite, therefore, defines an organization's desired pursuit of risk. An organization's risk appetite includes its willingness to accept losses and its desire for upside risk taking. Risk appetites can be defined for each enterprise risk faced by the organization.

Assuming that the risk profile has qualitatively assessed each enterprise-level risk and the organization's leaders have prescribed risk appetites for each risk, it is then easy to evaluate each risk by comparing the risk appetite to the assessed risk, as shown in Figure 4-3.

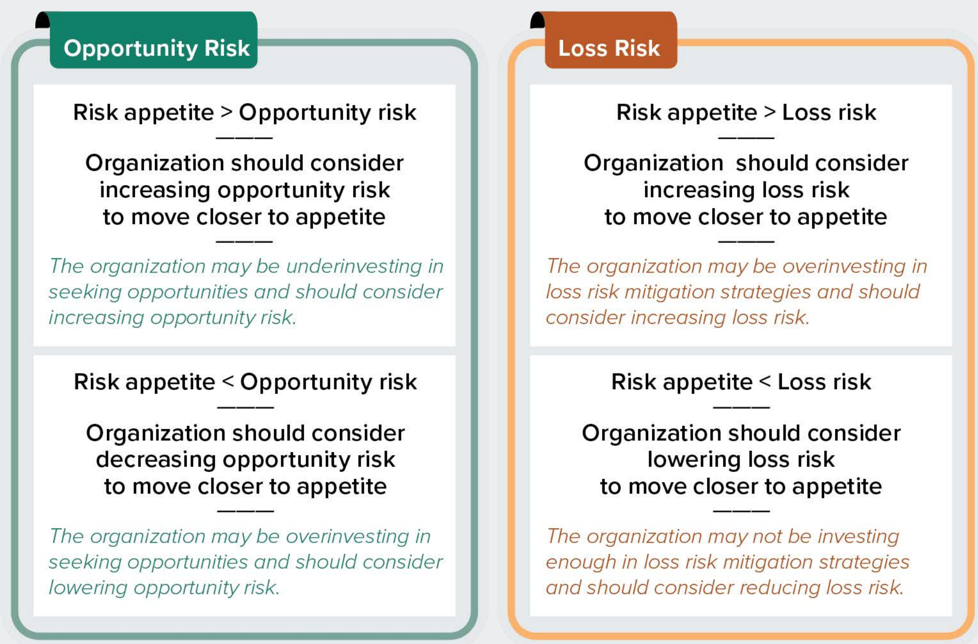


Figure 4-3: Risk appetite relative to opportunity risk and loss risk

Step 4 – Identify Risk Treatments. As indicated in Figure 4-2, the next step is to determine risk treatments or risk management measures that can be taken to keep risk mitigation and risk-taking activities within the organization's risk appetites.

Step 5 – Monitor and Adapt. The ERM process is ongoing. At any given step, but particularly after treatments are identified and implemented, risks and appetites need to be monitored and the organization needs to adapt as new information becomes available.

Implementing an ERM Program. To implement an ERM program, the next step after completing Steps 1 through 5 would be to manage risks through application of risk treatments. This critical next step for an effective ERM program would include the following general activities:

- Choose the top two to five risks to address. Pursuing all risks all the time would leave an organization spread too thin. The organization is usually best served by focusing on the biggest loss and opportunity risks.
- Choose the most logical risk treatments for those risks from the list of treatments developed during Step 4. In most cases, not all treatments work across all objectives, so organizations should choose the best treatments for the risks to best meet multiple objectives.
- Evaluate the benefits and costs of implementing the treatments. The organization should perform some level of evaluation of the benefit of the specific treatments and ensure they justify the costs. Detailed analytics may be justified, but in some cases qualitative assessments will suffice.
- Apply the treatments. Organizations should take actions to manage the identified enterprise risks.
- Monitor and review regularly. As described in Step 5, the organization should regularly monitor and review loss risks, opportunity risks, mitigation strategies, and risk appetites and adjust as needed.

4.2 ERM APPLICATION TO NFIP USING FIMA STRATEGIC VISION

FEMA TASKING LETTER

Use the strategic visions across FIMA to inform how ERM could be applied to the National Flood Insurance Program (NFIP). Evaluate whether the current FIMA strategic objectives support an ERM framework for the NFIP …

The TMAC was tasked with using the strategic vision described in the FY 2021–2023 FIMA Strategy to inform how ERM could be applied to the NFIP. Specifically, the TMAC was tasked with evaluating whether the current FIMA strategic objectives could be used to support an ERM framework for the NFIP. Applying ERM to the NFIP may require experimenting with risk appetites, tolerances, and capacity thresholds using metrics that support tracking processes to reach strategic objectives. Refer to Section 4.1 for definitions and a detailed description of the ERM concept.

As FIMA seeks to achieve its vision of reducing disaster suffering through its strategic outcomes of helping communities and individuals take well-informed actions, FIMA must evaluate viable actions (treatments) that can be taken to achieve its strategic outcomes and address possible conflicts that each action may pose to FIMA's other strategic outcomes. Specifically, activities in the mapping, hazard mitigation, insurance, and floodplain regulation elements of the NFIP can sometimes work at cross-purposes, increasing uncertainty in achieving objectives. The purpose of ERM is to reduce loss risk and take advantage of opportunity risk such that the overall risk to meeting an enterprises portfolio of objectives is within established tolerance levels.

Every activity undertaken by an organization includes some measure of risk in some context, including taking no action at all. Maintaining the status quo can introduce significant uncertainty in achieving an organization's strategic outcomes just as much or more than taking a new approach for achieving strategic outcomes, particularly when the operating environment of the enterprise changes significantly. Therefore, while change in an organization can appear to be a risk-taking behavior, it may actually decrease uncertainty in achieving desired strategic outcomes. Some opportunities present the possibility of taking actions that may have a low likelihood of being accomplished, but may have the potential for a high positive impact; this combination of low likelihood/high consequence may result in a sufficiently reduced level of uncertainty such that taking that action is more palatable for achieving the organizations' strategic objectives than not. ERM provides a framework for balancing these types of decisions.

FIMA recognized that maintaining the status quo regarding its flood insurance rating structure was an unacceptable risk. Consequently, it rolled out a new rating structure—Risk Rating 2.0. This is an excellent example of using a risk treatment (e.g., changing rating structures) to improve the likelihood that FIMA achieves its objectives of equity and fiscal soundness, among others. However, the new treatment (use of Risk Rating 2.0) may bring new risks to other FIMA strategic objectives. ERM provides an effective framework for managing risks across FIMA's various activities while allowing FIMA to balance the acceptance, mitigation, and avoidance of risks across its strategic objectives.

RISK RATING 2.0

Under Risk Rating 2.0, flood insurance rates will reflect each building's individual flood risk using structure-specific data that are easier to understand. With access to the latest industry technology and NFIP mapping data, policyholders will be able to better understand how their flood risk is reflected in the cost of their insurance.

The TMAC ERM examples, described in Section 4.2.3, demonstrate that moving to graduated flood risk and hazard products will likely affect other objectives. For example, the move to graduated risk products may create confusion for floodplain managers. The risks associated with that confusion could be treated with increased and improved training opportunities. Making a clear distinction between strategies that deal with the effect of graduated products on flood risk mitigation, floodplain regulation, and insurance purchase requirements is necessary to make progress towards positioning individuals and communities to understand their risk and take the appropriate risk-informed actions. This is just one striking example of the potential for numerous interdependencies of FIMA objectives and how progress toward one can influence or even depend on other objectives. Applying the ERM process has proven effective in helping complex organizations manage complex risk environments such as the one FIMA faces.

> "Unless Mandatory Purchase Requirements and Floodplain Regulation changes occur, there will always be a line on the map."
>
> – Laura Algeo, September 30, 2021, EMD weekly meeting

Based on its review, the TMAC concluded that FIMA would greatly benefit from ERM. ERM is a tool the Agency can use to improve its ability to consistently achieve its stated objectives. ERM can help FIMA strike a balance between risk taking, risk mitigation, risk avoidance, and risk acceptance to ensure the execution of a seemingly impossible set of objectives in a politically challenging environment.

4.2.1 TMAC DEVELOPMENT OF OBJECTIVES, SUBOBJECTIVES, AND ENTERPRISE RISKS

FIMA Strategy documents provide four Strategic Outcomes and 18 Mission Objectives. These documents informed the TMACs development of four strategic objectives, which were further divided into 10 subobjectives, roughly parallel to FIMA's Strategic Outcomes and Mission Objectives. Each of the 10 subobjectives was analyzed to create the 12 example Enterprise Risks with associated opportunity consequences/likelihoods and loss consequences/likelihoods. The TMAC developed these strategic objectives and subobjectives to create a stronger foundation upon which to apply ERM. They are not to be confused with formal recommendations by the TMAC nor is the content in the Enterprise Risk examples to be interpreted as formal recommendations.

FY2021–FY2023 FIMA Strategy Documents

FEMA provided the TMAC with the *FY 2021–2023 FIMA Strategy* documents to inform the subcommittee's application of ERM to the Strategy. These documents were as follows:

- *FY 2021–2023 FIMA Leadership Intent* (FEMA, 2020b), which describes the purpose of the strategy to build a world-class organization by focusing on customer satisfaction and empowering people to drive action together
- *FY 2021–2023 FIMA Directorate/Office Strategy Executive Summaries* (FEMA, 2020a), which summarizes the contribution of each directorate and office within FIMA to achieving the outcomes of the Strategy

Figure 4-4 shows FIMA's high-level vision, four Strategic Outcomes, and 18 Mission Objectives for FY2021–2023. FIMA's documents further defining and describing its Strategy provide additional detail.

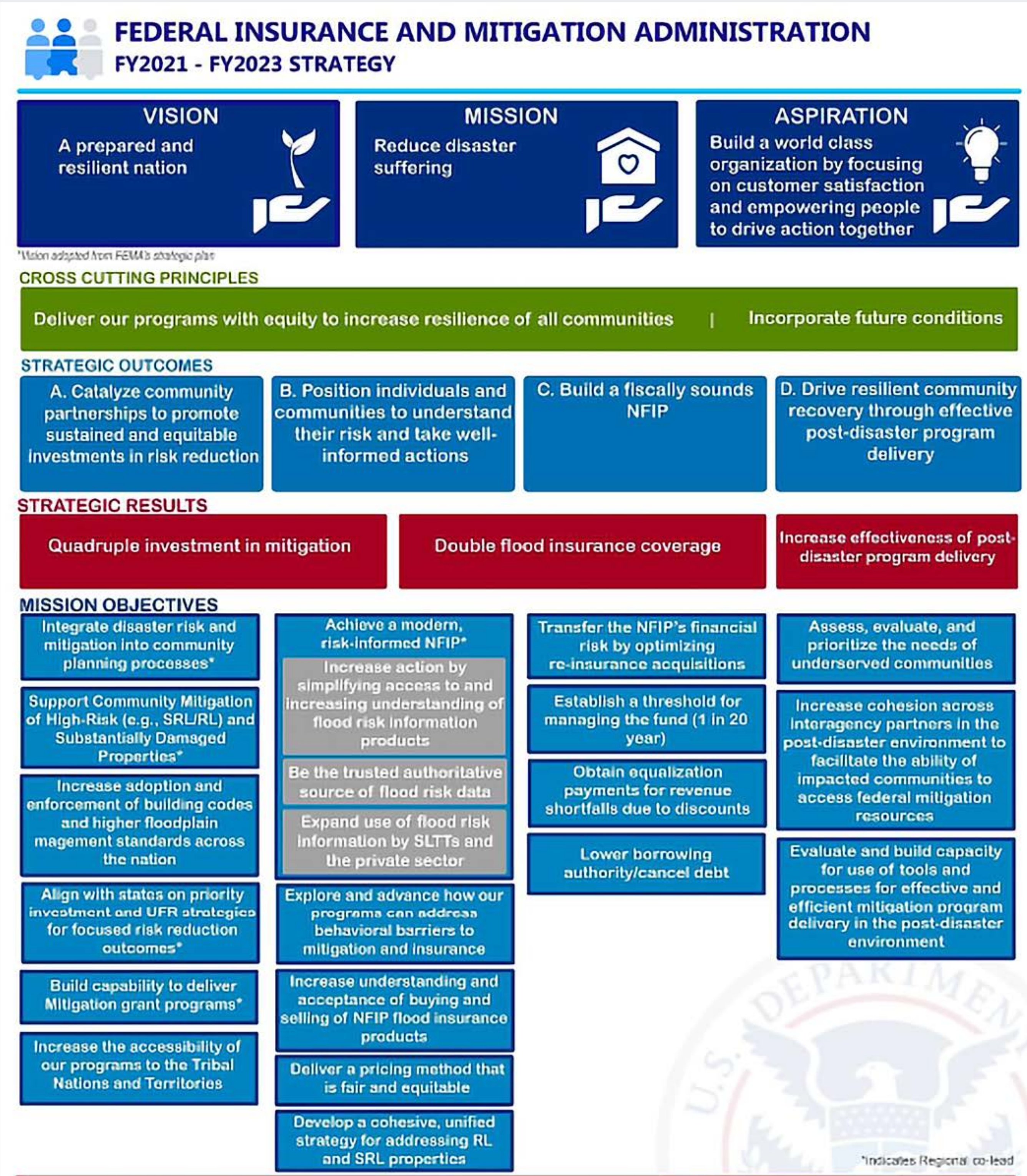


Figure 4-4: FY 2021–2023 FIMA Strategy's Vision, Mission, and Strategic Outcomes

Source: *FY 2021–2023 FIMA Leadership Intent*

TMAC Review of FIMA Strategic Outcomes

The TMAC reviewed and discussed the strategy documents and evaluated the Strategic Outcomes shown in Figure 4-4 within the context of supporting an ERM framework. The ERM framework expectations include:

- Reasonable assurance that major risks are identified
- Minimized operational surprises and reduced losses
- Alignment of risk appetite and strategic risk management actions
- Progress toward achieving strategic objectives.

Well-established design principles for creating an ERM plan are outlined in documents such as ISO 73:2009 (ISO, 2009), *Enterprise Risk Management Framework* by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) (COSO, 2017), and *Playbook: Enterprise Risk Management for the U.S. Federal Government* (CFOC and PIC, 2016).

STRATEGIC OUTCOMES IN FY 2021–2023 FIMA STRATEGY

A. Catalyze community partnerships to promote sustained and equitable investments in risk reduction

B. Position individuals and communities to understand their risk and take well-informed actions

C. Build a fiscally sound NFIP

D. Drive resilient community recovery through effective post-disaster program delivery

In consideration of these design principles, the TMAC found FIMA's Strategic Outcomes (see Figure 4-4 and textbox) aspirational but too general, and at times redundant, to function as strategic objectives for a FIMA ERM plan. For example, the TMAC discussed the meaning and intent of "Build a fiscally sound NFIP." The NFIP was originally intended to operate using the U.S. Treasury as a backstop during years when losses exceeded the program's ability to pay claims, so the TMAC was uncertain of the intent of this Strategic Outcome.

The Strategic Outcomes, as outlined in the *FY 2021–2023 FIMA Strategy,* are a mix of defining what success looks like and which tactics can be used to achieve the outcome. An example of this is Strategic Outcome A: "Catalyze community partnerships to promote sustained and equitable investments in risk reduction." The sentiment is clear, but it defines the "how" in addition to defining success. Would FIMA be successful if it promoted sustained and equitable investments in risk reduction without utilizing community partnerships? A simple revision to redefine the Strategic Outcome to "make sustained and equitable investments in flood risk reduction" improves the statement by making it more strategic without specifying how the outcome is to be met.

Within the framework of ERM, the four FIMA Strategic Outcomes function more effectively as ERM tactics due to the specification of how the objective must be met in the outcome statement. In an ERM framework, the tactics (e.g., "catalyze community partnerships") are reserved for activities to manage risks. If a risk presents itself as affecting FIMA's ability to achieve success in reducing risk, FIMA can apply the appropriate tactics to address the risk posed to its objective. This approach provides agility in achieving outcomes without specifying how the objective must be met.

TMAC Development of Strategic Objectives and Associated Risks

For the above-stated reasons, the TMAC realigned and rephrased the aspirations and tactics into four strategic objectives that center around the primary activities of the programs administered by FIMA: mapping, mitigation, flood insurance, and floodplain management. The TMAC believes this rephrasing provides a proper structure for illustrating an ERM plan without abandoning the core ideas of the *2021–2023 FIMA Strategy*. It is important to note, however, that this rephrasing was not reviewed by FEMA nor is TMAC suggesting these strategic objectives be adopted by FEMA.

Strategic Objectives and Subobjectives Developed by TMAC. To illustrate the ERM process, the TMAC developed new strategic objectives based on the observations described above. In developing ERM strategic objectives for the purposes of this report, the TMAC generally asked, What does success look like? The following section presents examples of strategic objectives that support ERM and are similar enough to the current FIMA Strategy Outcomes to function in parallel. The TMAC's work illustrates the ERM process of balancing complicated interconnected objectives relating to the NFIP and FRM more generally.

The four TMAC strategic objectives aligned with the four pertinent FEMA programs are provided herein for illustrative purposes and not as recommendations to FIMA:

- Increase understanding of flood hazards and risks (Mapping)
- Increase community flood resilience using pre- and post-disaster risk management programs (Mitigation)
- Secure widespread coverage of flood insurance (Flood Insurance)
- Help more local communities implement their own floodplain management plans that exceed minimum NFIP standards (Floodplain Management)

The four strategic objectives developed by TMAC were expanded to 10 subobjectives (Table 4-1). These subobjectives are roughly consistent with the 18 Mission Objectives from FIMA's strategic plan. The FIMA Mission Objectives, like the FIMA Strategic Outcomes, are a mix of strategies and tactics. In some cases, success is defined to specific actions, such as: "Establish a threshold for managing the fund (1 in 20 years)." If something occurs and an alternative threshold is proposed or adopted, the mission objective would be missed, even if the alternative threshold is shown to be of greater performance in managing the fund.

Table 4-1: TMAC Strategic Objectives and Subobjectives

FIMA Program	TMAC Strategic Objective	TMAC Strategic Subobjectives
Mapping	Increase understanding of flood hazards and risks.	1. **Public informed on graduated hazards and risk.** FIMA Identifies and communicates graduated flood hazards and risks across the entire flood regime for an increasing number of communities. 2. **High quality products delivered.** High quality products, including maps, are regularly updated and accessible to the public in all communities. 3. **Risk-informed decisions supported.** Communities and individuals rely on high quality products, including maps, to make risk-informed decisions on purchase of flood insurance, mitigation investments, community floodplain management, and related matters.
Mitigation	Increase community flood resilience using pre- and post-disaster risk management programs.	4. **Faster post-flood recovery.** Communities and property owners can speed post-flood recovery and build back better, in anticipation of the next flood. 5. **Increased community mitigation investment.** Communities and property owners invest, thereby reducing pre-flood hazard, exposure and vulnerability to households and communities. 6. **Reduced effect on minority/low-income populations.** Reduce the disproportionately high adverse human health or environmental effects of flood risks on minority and low-income populations.
Flood Insurance	Secure widespread coverage of flood insurance.	7. **Increased purchase of flood insurance.** Increase the willingness and ability of property owners to purchase NFIP or private flood insurance coverage. 8. **Fiscally solvent NFIP.** Premium revenue plus transfers from the US Treasury cover insurance program costs to secure a fiscally solvent NFIP.
Floodplain Management	Help more local communities implement their own floodplain management plans that exceed minimum NFIP standards.	9. **Increased community adoption of risk-informed framework.** More communities adopt formal risk management frameworks and use graduated flood risk information for planning, designing building codes and land use regulations. 10. **Increased flood risk reduction activities.** More communities are engaged in flood risk reduction inside or outside Special Flood Hazard Areas.

Note: TMAC strategic objectives and subobjectives were developed in light of the FY2021–2023 FIMA objectives, but are not intended to be recommendations to FEMA

Risks to Strategic Objectives and Subobjectives. After adjusting the FIMA Strategic Outcomes and Mission Objectives to be more in line with how ERM strategic objectives might be worded, the TMAC identified both loss and opportunity risks that impact the achievement of the strategic subobjectives TMAC created. The TMAC generated a relatively comprehensive list of risks (from the perspective of the TMAC) and in doing so, identified situations where the subobjectives needed clarification and refinement as to intent and demonstrating that the ERM process is iterative by nature.

The 60 risks identified by the TMAC were evaluated across the 10 TMAC-developed subobjectives. If multiple risks impacted the same set of objectives, the risks were evaluated for consolidation. Risks that posed no impact to any objectives were dropped. Through this process, the 60 risks were consolidated into 12 Enterprise Risks, shown in Figure 4-5 along with the 10 TMAC subobjectives. A cross-walk of the TMAC subobjectives and the Enterprise Risks associated with each subobjective is shown in Table 4-2.

TMAC SUBOBJECTIVES

1. **Public informed on graduated hazards and risk.** FIMA Identifies and communicates graduated flood hazards and risks across the entire flood regime for an increasing number of communities.
2. **High quality products delivered.** High quality products, including maps, are regularly updated and accessible to the public in all communities.
3. **Risk-informed decisions supported.** Communities and individuals rely on high quality products, including maps, to make risk-informed decisions on purchase of flood insurance, mitigation investments, community floodplain management, and related matters.
4. **Faster post-flood recovery.** Communities and property owners can speed post-flood recovery and build back better, in anticipation of the next flood.
5. **Increased community mitigation investment.** Communities and property owners invest, thereby reducing pre-flood hazard, exposure and vulnerability to households and communities.
6. **Reduced effect on minority/low-income populations.** Reduce the disproportionately high adverse human health or environmental effects of flood risks on minority and low-income populations.
7. **Increased purchase of flood insurance.** Increase the willingness and ability of property owners to purchase NFIP or private flood insurance coverage.
8. **Fiscally solvent NFIP.** Premium revenue plus transfers from the US Treasury cover insurance program costs to secure a fiscally solvent NFIP.
9. **Increased community adoption of risk-informed framework.** More communities adopt formal risk management frameworks and use graduated flood risk information for planning, designing building codes and land use regulations.
10. **Increased flood risk reduction activities.** More communities are engaged in flood risk reduction inside or outside Special Flood Hazard Areas.

Note: TMAC strategic objectives and subobjectives were developed in light of the FY2021–2023 FIMA objectives, but are not intended to be recommendations to FEMA

TMAC ENTERPRISE RISKS

A **Status quo effect on graduated risk adoption (opportunity risk).** The inertia created by adherence to program status quo as well as the lack of available and credible graduated risk information mutes demand for, understanding of, and confidence in graduated risk mapping and risk communication around graduated risk.

B **Binary notion of flood risk (opportunity risk).** Existing programs organized around the Special Flood Hazard Area (SFHA) reinforce a binary notion of flood risk and provide disincentives for communities to adopt standards higher than the federal minimum.

C **Data gaps in unmapped areas (loss risk).** Unmapped areas create a data gap causing many communities, homeowners, and businesses in these areas to be unaware of the potential for current or future flood risk exposure or the potential risk for future development.

D **Requirements that slow or limit post-flood aid (opportunity risk).** Benefit-cost analysis criteria as applied by FIMA combine with other regulations to slow FIMA post-flood aid and limit aid available to low-income communities and property owners.

E **Changing flood risk (opportunity risk).** Flood risk will change over time with climate change and increased development.

F **Inadequate personnel and fiscal resources (loss risk).** Inadequate personnel and fiscal resources at the federal, state, local, tribal and territorial levels prevent effective implementation of pre- and post-disaster mitigation programs.

G **Cost perception of flood insurance (opportunity risk).** Flood insurance is perceived as too costly for its benefit for many floodplain occupants.

H **Need for Congressional action (opportunity risk)**. Congressional action is required for current FIMA programs to function and to correct flaws in the program.

I **Lack of understanding of risk (opportunity risk).** Large segments of the population fail to understand their true risk and to realize that recovery and repair costs will be their responsibility.

J **Lack of effective flood risk management frameworks (opportunity risk).** Lack of effective flood risk management frameworks limits local communities' ability to participate effectively in flood risk management.

K **Repetitive loss/severe repetitive loss structures (loss risk).** Repetitive loss/severe repetitive loss structures, flood losses in flood zones outside SFHAs, and expected annual flood loss of the nation.

L **Unaffordability for low-income individuals.** Individuals of low-income cannot afford to mitigate or manage their flood risk, even if they are aware of the flood risk in their current home.

Figure 4-5: Summary of TMAC subobjectives and TMAC Enterprise Risks

Table 4-2: Crosswalk of TMAC Subobjectives with TMAC Enterprise Risks

		ERM Risks											
FIMA Program	TMAC Strategic Subobjectives	A. Status quo effect on graduated risk adoption (opportunity risk)	B. Binary notion of flood risk (opportunity risk)	C. Data gaps in unmapped areas (loss risk)	D. Requirements that limit post-flood aid (opportunity risk)	E. Changing flood risk (opportunity risk)	F. Inadequate personnel and fiscal resources (loss risk)	G. Cost perception of flood insurance (opportunity risk)	H. Need for Congressional action (opportunity risk)	I. Lack of understanding of risk (opportunity risk)	J. Lack of effective flood risk management frameworks (opportunity risk)	K. Repetitive loss/ severe repetitive loss structures (loss risk)	L. Unaffordability for low-income individuals (opportunity risk)
Mapping	1. Public informed on graduated hazards and risk.	✓	✓	✓				✓					
	2. High quality products delivered.	✓	✓	✓		✓	✓		✓				
	3. Risk-informed decisions supported.	✓	✓	✓			✓	✓	✓	✓	✓		✓
Mitigation	4. Faster post-flood recovery.				✓	✓		✓	✓	✓	✓	✓	✓
	5. Increased community mitigation investment.		✓	✓	✓	✓	✓			✓	✓	✓	✓
	6. Reduced effect on minority/low-income populations.				✓	✓	✓	✓	✓	✓	✓	✓	✓
Flood Insurance	7. Increased purchase of flood insurance.	✓	✓	✓	✓			✓	✓	✓			✓
	8. Fiscally solvent NFIP.			✓		✓		✓	✓	✓		✓	✓
Floodplain Management	9. Increased community adoption of formal risk management.	✓	✓	✓		✓	✓		✓	✓	✓		✓
	10. Increased flood risk reduction activities.	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

Note: TMAC strategic objectives and subobjectives were developed in light of the FY2021–2023 FIMA objectives, but are not intended to be recommendations to FEMA.

✓ = yes

Figure 4-6 demonstrates the interconnected and complex relationships of Enterprise Risks between subobjectives of different FEMA programs. The figure makes clear that a risk treatment taken to mitigate one Enterprise Risk can have an effect on other subobjectives and programs. ERM is a tool to help organizations recognize and plan for such interconnectedness.

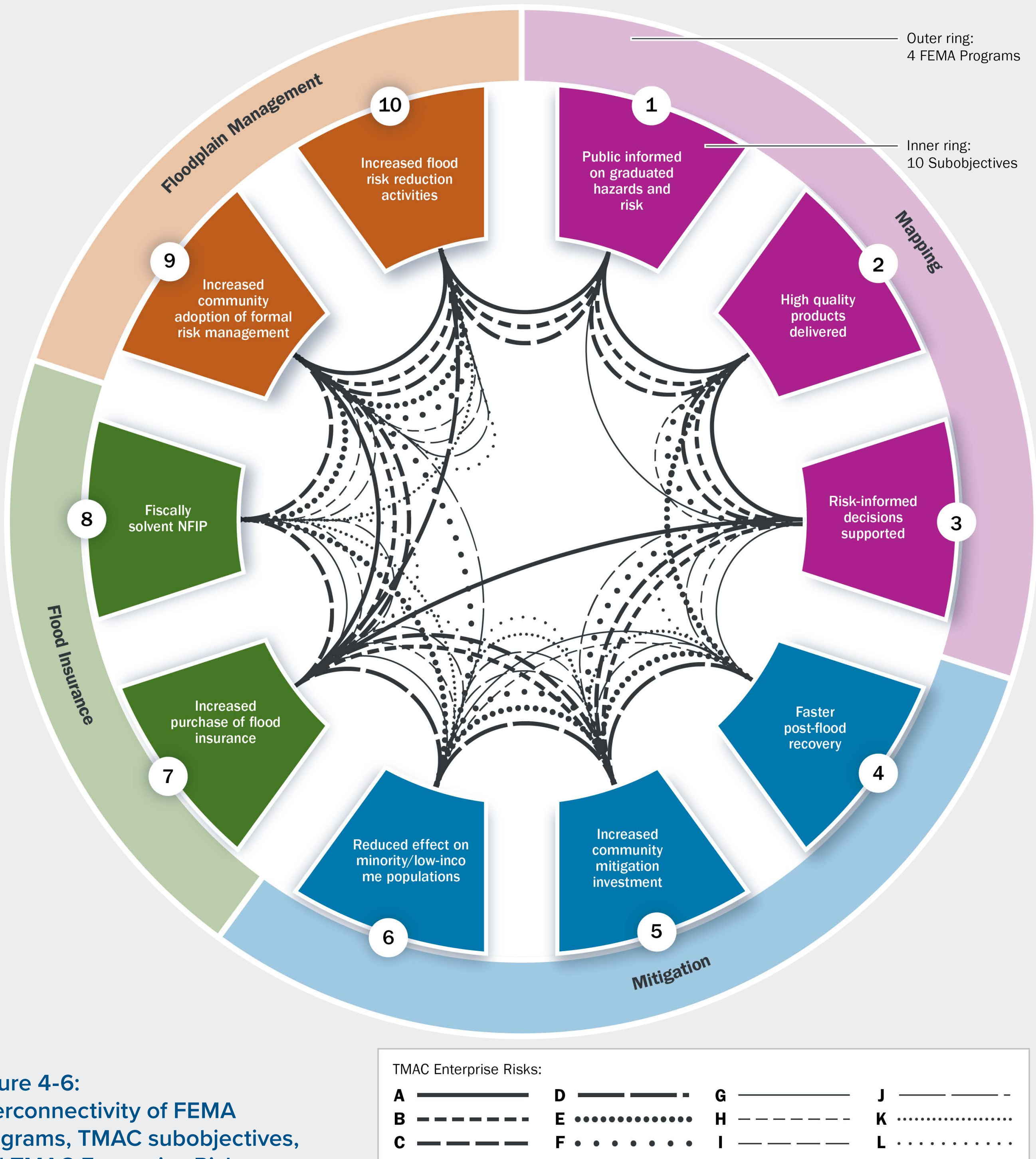


Figure 4-6: Interconnectivity of FEMA Programs, TMAC subobjectives, and TMAC Enterprise Risks

4.2.2 TMAC DEVELOPMENT OF CRITERIA FOR ENTERPRISE RISK ASSESSMENT

Definitions and explanations of key terms and concepts are provided in Key Concepts.

The TMAC developed criteria to use for assessing the 12 Enterprise Risks using definitions modified from the Chief Financial Officer/Intelligence Community (CFO/IC) ERM playbook (CFO and PIC, 2016). The developed definitions of consequence/likelihood and loss/opportunity are shown in Table 4-3. The developed risk consequence and likelihoods ratings were then used to define the risk matrix shown in Table 4-4. The risk matrix can be useful in identifying the relationship between consequence and likelihood ratings to enable agencies to make appropriate selections.

Risk appetite—the amount of risk that FIMA might be willing to accept in pursuit of its objectives relative to the objectives value to FIMA—is defined as shown in Table 4-5. Risk appetite ultimately informs how the Agency responds to the risk based on the significance of the risk.

Table 4-3: Consequence/Likelihood and Loss/Opportunity Rating Scale

Risk		Opportunity Consequences	Opportunity Likelihoods	Loss Consequences	Loss Likelihoods
High	H	Taking this risk could significantly enhance the organization's ability to achieve one or more of its objectives or performance goals.	The potential gains are reasonably expected to occur, given current operations.	The impact could preclude or highly impair the organization's ability to achieve one or more of its objectives or performance goals.	The risk is very likely or reasonably expected to occur.
Medium	M	Taking this risk could improve the organization's ability to achieve one or more of its objectives or performance goals.	The potential gains are as likely to occur as not, given current operations.	The impact could significantly affect the organization's ability to achieve one or more of its objectives or performance goals.	The risk is more likely to occur than unlikely.
Low	L	Taking this risk would have an insignificant effect on the organization's ability to achieve any of its objectives or performance goals.	The potential gains are unlikely to occur, given current operations.	The impact will not significantly affect the organization's ability to achieve one or more of its objectives or performance goals.	The risk is unlikely to occur.
None	N	Taking this risk will have no effect on the organization's ability to achieve any of its objectives or performance goals.	The potential gains will not occur, give current operations.	The impact will have no effect on the organization's ability to achieve one or more of its objectives or performance goals.	The risk cannot occur.

Table 4-4: Risk Matrix

Likelihood Rating	Consequence Rating: None	Low	Medium	High
High	N	L	M	H
Medium	N	L	M	M
Low	N	L	L	L
None	N	N	N	N

Note: H = High; M = Medium; L = Low; N = None

Table 4-5: Risk Appetite Rating Scale

Risk Rating		Risk Appetite (Opportunity)	Risk Appetite (Loss)
High	H	The Enterprise is risk seeking and believes aggressive risk taking is justified. It will seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals. It will act to maximize the likelihood that gains will be maximized when they occur because it has determined the potential upside benefits outweigh the potential costs. These are areas in which the Enterprise recognizes the need to take more risks.	The Enterprise has a preference for disciplined risk taking because of the potential for upside benefits to outweigh the potential downside costs.
Medium	M	The Enterprise is risk tolerant and is willing to take greater than normal risks. It must constantly strike a balance between the potential upside benefits and potential downside costs of a given decision. It has a preference for disciplined risk taking that promotes strategic objectives.	The Enterprise is risk neutral and will take a balanced approach to risk taking. It must constantly strike a balance between the potential upside and downside of a given decision, taking risk only if upside benefits are likely to exceed the downside costs in order to avoid losses or impediments to achieving strategic objectives.
Low	L	The Enterprise has little appetite for taking risk in these situations unless the upside benefits clearly outweigh the potential downside costs.	The Enterprise is risk averse and will accept as little risk as possible. It will avoid risk, act to minimize or eliminate the likelihood that the risk will occur, or minimize the consequences of risk that cannot be avoided because it has determined the potential downside costs are intolerable. These are the areas in which it typically seek to maintain a controlled environment.
None	N	The Enterprise will take no risk because of the devastating downside costs.	The Enterprise is absolutely risk averse and will take no risk because of the devastating downside costs.

Note: H = High; M = Medium; L = Low; N = None

4.2.3 TMAC ASSESSMENT OF ENTERPRISE RISKS USING DEVELOPED CRITERIA

Following TMACs development of strategic subobjectives and its identification of associated risks to accomplishing the subobjectives, the TMAC assessed each of the 12 Enterprise Risks using the developed criteria to provide a risk profile. A risk profile is the synthesis of the likelihood/consequence rating and the risk appetite of each Enterprise Risk as they relate to each of the 10 subobjectives and the four strategic objectives (refer to Section 4.1.2, Enterprise Risk Management Process, for additional information).

Definition
RISK

The effect of uncertainty on achievement of objectives. An effect is a deviation from the desired outcome – which may present positive or negative results (CFO and PIC, 2016).

The 12 Enterprise Risk examples developed by the TMAC are provided in Appendix D and listed in Figure 4-5. This section presents an assessment of four of the example Enterprise Risks (A, C, H, and L) to illustrate an application of ERM to the objectives and subobjectives developed by the TMAC in light of the FY2021–2023 FIMA Strategy. While illustrative only, the TMAC selected the four example risk profiles presented in this Section 4.2.3 to highlight issues of increased relevance to FIMA based upon its current strategy and the 2021 Tasking letter to TMAC:

- **Enterprise Risk A: Status Quo Effect on Graduated Risk Adoption**
  - Description: The inertia created by adherence to program status quo as well as the lack of available and credible graduated risk information mutes demand for, understanding of, and confidence in graduated risk mapping and risk communication around graduated risk.
  - Justification: FEMA Tasking Letter to TMAC
- **Enterprise Risk C: Data Gaps in Unmapped Areas**
  - Description: Unmapped areas create a data gap causing many communities, homeowners, and businesses in these areas to be unaware of the potential for current or future flood risk exposure or the potential risk for future development.
  - Justification: FIMA Strategic Objectives
- **Enterprise Risk G: Cost Perception of Flood Insurance**
  - Description: Flood insurance is perceived as too costly for its benefit for many floodplain occupants.
  - Justification: FIMA Strategic Objectives

- **Enterprise Risk L: Unaffordability of Flood Insurance for Low-Income Individuals**
  - Description: Individuals of low income cannot afford to mitigate or manage their flood risk, even if they are aware of the flood risk in their current home.
  - Justification: FIMA Strategic Objectives

The example risk profiles developed by the TMAC, as presented in this section and in Appendix D, use a qualitative approach for profiling the risks. However, quantitative, or semi-quantitative approaches can be used if preferred.

The TMAC defined the likelihood that each risk would occur and the magnitude of the consequence should that risk be realized. Each of the Enterprise Risks developed by the TMAC as examples are described as follows:

- **Enterprise Risk Statement.** A description of the example Enterprise Risk and identification as an opportunity risk or loss risk.
  - Opportunity risks are those that would enhance the organization's ability to achieve one or more of its performance objectives or goals.
  - Loss risks are those that could impair the organization's ability to achieve one or more of its performance objectives or goals.
- **Background.** A brief description that provides context and background for understanding the Enterprise Risk.
- **Risk Profile.** The risk profile includes a summary graphic of the TMAC risk profile and identifies the intersection of the Enterprise Risk with the TMAC's subobjectives (see Table 4-1). The risk profile describes and provides an evidence-based measure of the risk posed to the overall program by the enterprise risks. The risk profile examples provide a qualitative estimate of the risk. Each risk profile includes:
  - Risk appetite and rationale – a statement of the hypothesized risk appetite as determined by the TMAC. The risk appetite was established for demonstration purposes and should not be construed as a recommended level of risk FEMA should take—FEMA will need to do that on its own.
  - Risk assessment with evidence – a statement of the TMAC's rating for the Enterprise Risk consequence and likelihood and presentation of the TMAC's evidence for the elicited consequence and likelihood.
  - Risk evaluation – a comparison of the overall risk assessment to the appetite, with a recommendation for the general risk management response.
- **Illustrative Risk Treatments.** A list of possible risk treatments developed by the TMAC that gives examples of activities that could be taken to manage the risk to be within FIMA's hypothesized risk appetite. The treatments presented in this report are examples of potential risk responses and do not represent TMAC recommendations.

The example risk profile developed by TMAC uses a qualitative approach for profiling the risks. However, quantitative approaches can be used if preferred. Quantitative risk assessments require a more significant undertaking to establish methodologies for computing the likelihood and consequences for each risk in a way that keeps the risks comparable across the process.

ENTERPRISE RISK A: **Status Quo Effect on Graduated Risk Adoption**

OPPORTUNITY RISK: The inertia created by adherence to program status quo as well as the lack of available and credible graduated risk information mutes demand for, understanding of, and confidence in graduated risk mapping and risk communication around graduated risk.

BACKGROUND

The boundary of the area inundated by the 100-year flood defines a community's SFHA. This boundary defines the reach of the Mandatory Purchase Requirement (MPR) and the Federal Minimum Regulation Standard for floodplain management. Mandatory purchase stops at the boundary of the 100-year floodplain as do minimum NFIP floodplain management regulations for community participation. Consequently, the boundary of the 100-year floodplain is often mistakenly interpreted as the delineation between flood-free versus flood-prone land. This misunderstanding has led to many households concluding that the area beyond this boundary is free of flood risk because there are no flood-related regulations or consistently available flood hazard data or mapping products. It has also led some to believe that the flood hazard within the SFHA is monolithic and uniform. Of course, neither are true, yet the floodplain boundary (or SFHA) remains given legal mandates and continues to oversimplify the challenge floods pose to people and property.

A lack of access to consistent, easily interpretable, graduated flood risk and hazard products impedes understanding and thus hinders improvements in FRM beyond the Federal Minimum Regulation standards. It also affects individuals deciding whether to purchase flood insurance independent of the requirements of the MPR. Traditionally, FIMA has sought to increase the quality of the maps that delineate the boundary of the 100-year floodplain and produces only limited information on graduated flood risk such as producing non-regulatory products only in communities that express an interest in such information and contribute to the cost of developing that information. However, the lack of information explaining the range of flood risk and hazard both within the SFHA and beyond it has created and continues to create significant risk to FIMA meeting its objectives by allowing the idea that areas are either flood-free or flood-prone to exist.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk A is shown in Figure 4-7, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk A (Status quo effect on graduated risk adoption) threatens the accomplishment of the TMAC's notional subobjectives 1,2,3,7,9, and 10, which are based on FIMA's Strategic Outcomes.

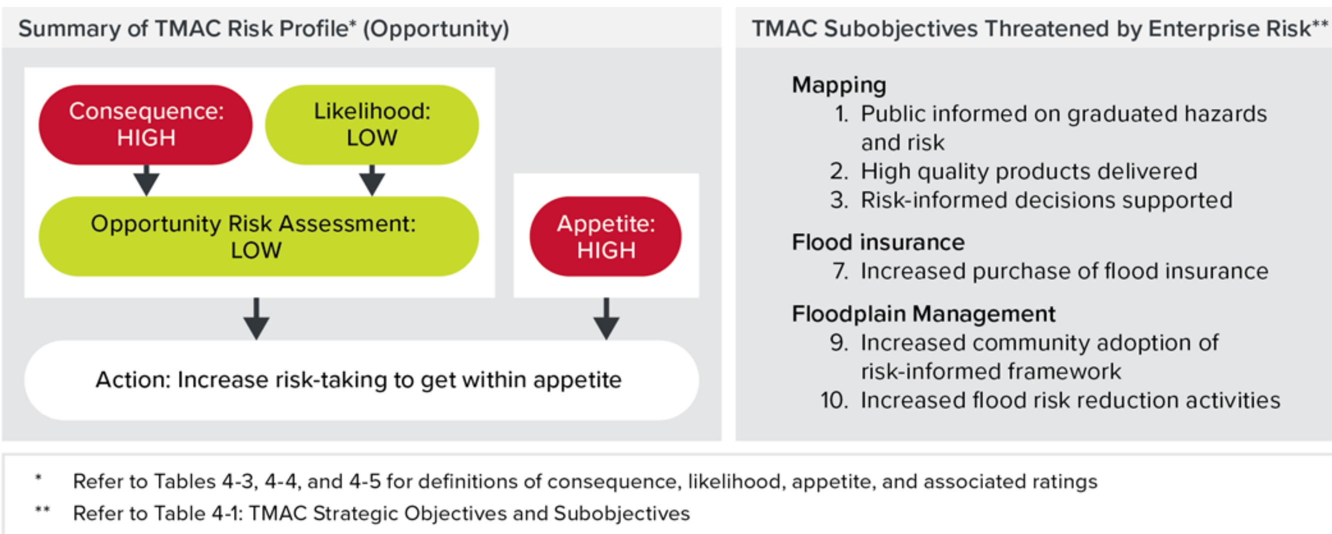


Figure 4-7: Summary of risk profile for Enterprise Risk A – status quo effect on graduated risk adoption

Risk appetite and rationale. To provide and promote the use and acceptance of graduated flood hazard and risk information, even as the tools and methods are rapidly changing, is a risk that FIMA could take.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a high risk appetite for Enterprise Risk A (opportunity). In practice, an organization in this position is likely to be risk-seeking and believe aggressive risk-taking is justified. It would likely seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals, and act to maximize the likelihood that gains would be realized or that gains would be maximized when they occur because the potential upside benefits outweigh the potential costs for taking the action.

Risk assessment with evidence. The TMAC rated Enterprise Risk A (opportunity risk) as having a high consequence and a low likelihood. Based on these assessments, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains are unlikely to occur, given current operations. The resulting overall risk assessment is low. The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence
  The TMAC rated Enterprise Risk A as having high consequence because communities and individuals rely on FIMA products, including maps, as reliable information about flood hazards as they make decisions on the purchase of flood insurance, mitigation investments, community floodplain management, and related matters.
- Likelihood evidence
  The TMAC rated Enterprise Risk A as having low likelihood because at the current time, graduated risk information is newly available, and communities and property owners may not yet be confident in the quality and consistency of graduated risk information or have the capacity to interpret and apply that information to decision-making readily and easily.
  Nonetheless, there is an opportunity created by rapidly expanded analytical capability to better identify and communicate graduated flood risks for an increasing number of communities and property owners, significantly enhancing the likelihood of achieving the at-risk objectives. In fact, BW-12 requires mapping of the 500-year floodplain, including areas of potential population growth. FEMA has responded with the FFRD initiative to communicate graduated flood risk.

Risk evaluation. The TMAC rated FIMA's risk appetite for opportunity Enterprise Risk A as high and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk A. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Specifically, FIMA could accept the Enterprise Risk opportunity of pushing forward with developing and communicating graduated flood hazard and risk information as a way of improving the Nation's understanding of flooding and promoting the adoption of risk-informed floodplain management standards, even as the state of the practice evolves, to get within its risk appetite.

ILLUSTRATIVE RISK TREATMENTS (NOT TMAC RECOMMENDATIONS)

- Develop illustrative graduated flood risk and hazard maps as well as related products with educational videos explaining the difference between the graduated products and the limitations of the SFHA.

- Prepare technical reports with "plain English" supplements to explain the technical foundation for the graduated flood risk products.
- Accelerate the FFRD initiative to build the technical foundation for characterizing graduated flood risk and hazard data, initially relying on the Risk Rating 2.0 rating system to create graduated risk and hazard maps.
- Suspend or slow the use of deterministic methods for map updating and publish all future maps with graduated risk accompanied by explanations of analytical uncertainties.

ENTERPRISE RISK C: **Data Gaps in Unmapped Areas**

LOSS RISK: Unmapped areas create a data gap causing many communities, homeowners, and businesses in these areas to be unaware of the potential for current or future flood risk exposure or the potential risk for future development.

BACKGROUND

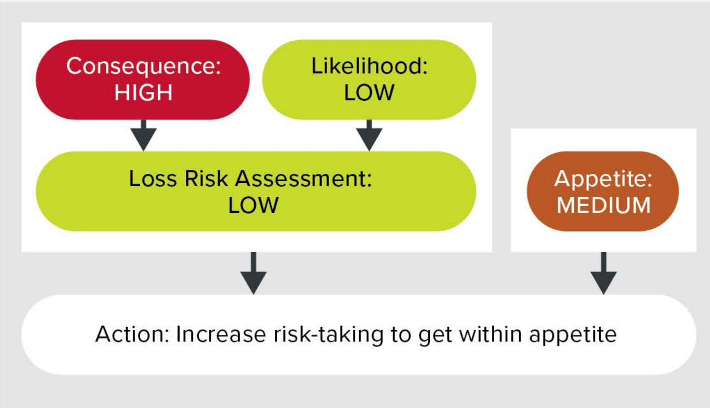
Some areas in the United States have no or only limited flood hazard modeling products. There are many reasons for this absence of flood maps or for the limited generation and portrayal of flood hazards for flooding sources beyond the 1-percent-annual-chance floodplain, such as:

- Currently, small drainage areas, such as at the end of tributaries, are not mapped due to FEMA's criteria for identifying and mapping the SFHA.
- Some areas of the Nation are not mapped because the land is federal or state recreational land (e.g., national forests). While some of these areas will certainly remain recreational, thus limiting development that may be exposed to flood hazards, other federal land faces possible privatization in the future leading to possible development and risk exposure to life and property.
- Some areas are shown as "Zone D" meaning there is reason to believe there is a flood hazard in the area, but it has not been identified by FEMA.
- In addition, many urban flood hazards are not mapped or are inadequately mapped. In most cases, if an urban flood hazard has been mapped, it was mapped as a fluvial hazard and did not account for the pluvial hazard.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk C is shown in Figure 4-8, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk C (Data gaps in unmapped areas) threatens the accomplishment of the TMAC's notional subobjectives 1, 2, 3, 5, 7, 8, 9, and 10, which are based on FIMA's Strategic Outcomes.

Summary of TMAC Risk Profile* (Loss)



TMAC Subobjectives Threatened by Enterprise Risk**

Mapping
1. Public informed on graduated hazards and risk
2. High quality products delivered
3. Risk-informed decisions supported

Mitigation
5. Increased community mitigation investment

Flood insurance
7. Increased purchase of flood insurance
8. Fiscally solvent NFIP

Floodplain Management
9. Increased community adoption of risk- informed framework
10. Increased flood risk reduction activities

* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings
** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure 4-8: Summary of risk profile for Enterprise Risk C – data gaps in unmapped areas

Risk appetite and rationale. FEMA recognizes the need for more of the Nation's flood hazards to be identified and mapped, especially given population growth and expected climate change-related migration away from the coasts, with perhaps as many as 13 million Americans being displaced by 2100 (Robinson et al., 2020).

Given the information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk C (loss). In practice, an organization in this position is likely to be risk neutral and take a balanced approach to risk-taking. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, taking risk to avoid losses or impediments to achieving its strategic objectives only if the upside benefits are likely to exceed the downside costs.

Risk assessment with evidence. The TMAC rated Enterprise Risk C (loss risk) as having a high consequence and a low likelihood. Based on this assessment, the consequences could preclude or highly impair FIMA's ability to achieve one or more of its objectives or performance goals, but the consequences are unlikely to occur. The resulting overall risk assessment is low. The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence

  The TMAC rated Enterprise Risk C as having a high consequence. Currently, these geographic areas (whether neighborhoods intersected by small tributaries, multi-family rowhomes within an urban center, recently privatized land in rural areas, or others) are outside of the federal regulatory flood requirements; therefore, families living in these areas or business owners operating businesses in these areas are likely unaware of the flood hazards and associated flood risks they may face. According to the TMAC 2018 Annual Report (TMAC, 2019), about 40% of the 3.5 million stream miles in the United States have yet to be mapped. According to the ASFPM 2020 Flood Mapping for the Nation report, the percentage yet to be mapped is a more startling 66% (ASFPM, 2021). In addition to unmapped streams or communities that do not have flood maps, areas subject to pluvial flooding are not mapped in urban centers across the country. While there are many ways to estimate the size of this data gap, one study estimates there are more than three times the number of persons living in a 1 percent-annual-chance floodplain than would be computed based solely upon the mapped SFHA (Wing et al., 2018). Turning that into gross domestic product (GDP) exposure yields an estimate of $2.9 trillion (Wing et al., 2018). FEMA cannot achieve its objectives across the Nation if so many Americans are unaware of the hazards present, therefore making uninformed decisions regarding their property, homes, and businesses.

- Likelihood evidence

  The TMAC rated Enterprise Risk C as having low likelihood rating. Currently, the National Flood Mapping Program operates as a result of Congressional appropriations plus fees collected with NFIP flood insurance policies. Historically, lack of resources and perceived lack of impact or existing risk have been reasons for areas to remain unmapped, so continuing the program as is will likely achieve stated objectives. However, greater recognition and understanding of flood risk by mapping additional flood hazards (both fluvial and pluvial) can help guide future development in communities across the Nation and lead to better decisions that help reduce personal risk exposure through the purchase of flood insurance.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk C (loss risk) as medium and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its loss risk to move closer to its risk appetite for Enterprise Risk C. FIMA may be overinvesting in loss risk mitigation strategies and may want to consider increasing its loss risk.

Specifically, FIMA could evaluate the use of reduced resolution products for areas of reduced population and little future development pressure to get within its risk appetite.

ILLUSTRATIVE RISK TREATMENTS (NOT TMAC RECOMMENDATIONS)

- Evaluate the use of reduced resolution products for areas of reduced population and little future development pressure.
- Adopt a methodology for identifying and mapping pluvial flood risk and small catchment areas.
- Engage with SLTTs with currently unmapped flood hazards to encourage participation and acceptance of FEMA's FIRMs.
- Determine an approach to identify and map flood hazards on federal lands.
- Use graduated risk principles to map unmapped areas to aid the transition from deterministic assessments.

ENTERPRISE RISK G: **Cost Perception of Flood Insurance**

OPPORTUNITY RISK: Flood insurance is perceived as too costly for its benefit for many floodplain occupants.

BACKGROUND

The value of insurance is the peace of mind that if a flood occurs, the insured will have the funds needed to recover. Property owners may not appreciate the value of insurance as a risk transfer service that, ideally, never pays out. Low voluntary purchase of flood insurance is the case throughout the developed world, and voluntary purchase insurance through NFIP is no exception. In the case of the NFIP, many of the policies in force are the result of the MPR.

Beginning in 2021, the NFIP's new Risk Rating 2.0[4] will calculate and move toward charging full-risk premiums. This new premium structure may affect the willingness or ability of some property owners to pay the full-risk premium for the risk transfer service. With Risk Rating 2.0 as a backdrop, alongside increased production and distribution of property-specific graduated risk products, FIMA must reconcile Congressional general interest in the NFIP charging full-risk premiums that support a fiscally sound and debt-free NFIP with equally intense Congressional calls for NFIP premiums to be "fair" and "affordable" so that the pool of NFIP-insured properties can grow over time.

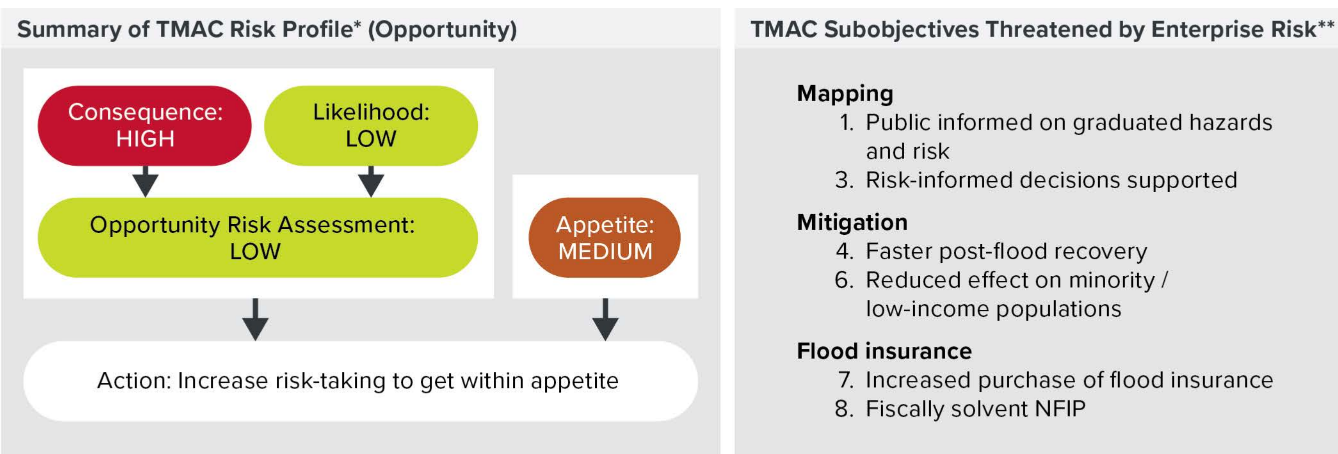
4 For more information on Risk Rating 2.0, https://www.fema.gov/flood-insurance/risk-rating

The effect of Risk Rating 2.0 on the purchase NFIP insurance is not yet predictable. The use of Risk Rating 2.0 may increase premiums for many properties outside the SFHA where mandatory purchase does not apply, and coverage may be dropped. On the other hand, premiums for lower value properties and those subject to inland flooding may be lower under Risk Rating 2.0.

Additionally, the combined effect of FIMA's communication of flood risk information, the processes by which property owners interpret and then use flood risk information for insurance purchase decision-making, and how budget constraints limit the ability of willing buyers to purchase insurance remains unknown.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk G is shown in Figure 4-9, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk G (Cost perception of flood insurance) threatens the accomplishment of the TMAC's notional subobjectives 1, 3, 4, 6, 7, and 8, which are based on FIMA's Strategic Outcomes.



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure 4-9: Summary of risk profile for Enterprise Risk G – cost perception of flood insurance

Risk appetite and rationale. The risk transfer service offered by flood insurance is the essential cornerstone for post-flood recovery, but property owners do not perceive sufficient value in the service. Innovations in flood-risk communication methods to stimulate demand are being implemented by FIMA and are expected to continue. Other actions could be taken to encourage voluntary purchase.

Given the information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk G (opportunity). In practice, an organization in this position is likely to be risk tolerant and willing to take greater than normal risk. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, while maintaining a preference for disciplined risk-taking that promotes its strategic objectives.

Risk assessment with evidence. The TMAC rated Enterprise Risk G (opportunity risk) as having a high consequence and a low likelihood. Based on these ratings, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains are unlikely to occur, given current operations. The resulting overall risk assessment is low.

The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence
  The TMAC rated Enterprise Risk G as having high consequence because the risk transfer service offered by flood insurance is the essential cornerstone for post-flood recovery, and at the same time risk-based premiums can communicate flood risk and incentivize investments in risk reduction. In fact, the number of NFIP policies in force has been constant for 30 years, the total risk pool is small, and policies are concentrated in high-risk areas. FIMA is aware of this stagnation and has a moonshot goal of doubling coverage by 2023.
- Likelihood evidence
  The TMAC rated Enterprise Risk G as having low likelihood because property owners do not perceive sufficient value in the risk service relative to the charged premium. Research in the U.S. and internationally reports that most property owners are unlikely to voluntarily purchase flood insurance, leaving a large insurance coverage gap.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk G (opportunity risk) as medium and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk G. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Specifically, FIMA could make an aggressive effort to increase the perceived value of flood insurance along with increasing efforts to make insurance affordable.

ILLUSTRATIVE RISK TREATMENTS (NOT TMAC RECOMMENDATIONS)

- Design and conduct analyses to predict the effect of the changes on NFIP insurance demand that arise from the application of Risk Rating 2.0 combined with the increased information available on graduated risk.

- Prepare a report for Congress on the predicted effect of replacing the SFHA for triggering the MPR with criteria based on Risk Rating 2.0 premiums and graduated risk.
- Encourage state regulators to require private flood coverage equivalent to NFIP as default in all homeowners' policies, with an opportunity for property owners to opt out of the coverage.

ENTERPRISE RISK L: **Unaffordability for Low-Income Individuals**

OPPORTUNITY RISK: Individuals of low-income cannot afford to mitigate or manage their flood risk, even if they are aware of the flood risk in their current home.

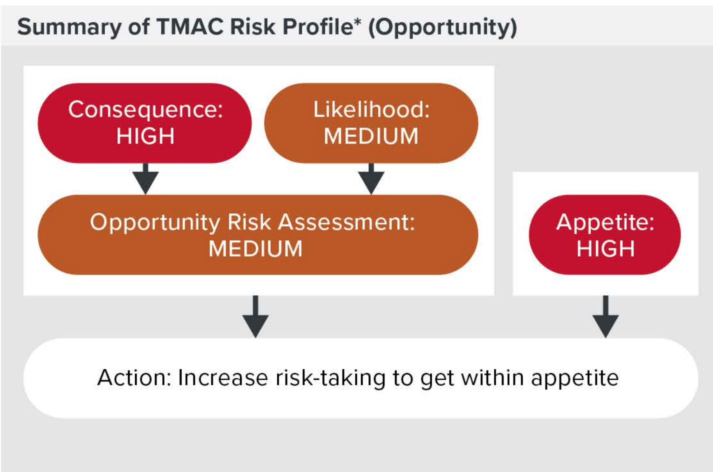
BACKGROUND

Low- to moderate-income (LMI) individuals and families facing flood risks often do not have the capability or capacity to effectively transfer (through insurance), reduce (through mitigation efforts), or avoid flood risks, which means they are left with one option: to accept the risk. Even with the removal of the cross-subsidy from low- to high-value homes as part of Risk Rating 2.0, NFIP premiums will still be unaffordable for some and in situations where the insurance is force placed, it will create a financial hardship. In summary, the lack of resources leads to a lack of choice, which in turn leads to additional financial hardship before a flood and greater suffering after it occurs.

Additionally, because LMI individuals and families often rent or own lower-value properties, they are not able to compete as effectively for assistance programs where benefit-cost analyses play a large role in project selection. In essence, when two homes are subject to the same flood hazard, investing in flood mitigation for the more valuable home is often more cost-effective. This reality tends to be even more pronounced at the neighborhood scale when the mitigation solutions involve levees or other measures that do not involve retrofitting individual structures; in these cases, those that are asset rich are better off due to the nature of traditional benefit to cost analysis. Likewise, grant applications favor those that have high asset value rather than those that are most sensitive to the impact of a hazard. Providing flood hazard and risk information to those with the means to do something about it can move them to more effectively manage their risks; however, providing information to those who cannot afford to implement risk management strategies does little more than frighten them and, in some cases, may even further devalue their property. Financial hardship combined with increasing risk and reduced access to assistance can create a downward spiraling effect making those who are already vulnerable even more vulnerable.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk L is shown in Figure 4-10, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk L (Unaffordability for low-income individuals) threatens the accomplishment of the TMAC's notional subobjectives 3, 4, 5, 6, 7, 8, 9, and 10, which are based on FIMA's Strategic Outcomes.



TMAC Subobjectives Threatened by Enterprise Risk**

Mapping
3. Risk-informed decisions supported

Mitigation
4. Faster post-flood recovery
5. Increased community mitigation investment
6. Reduced effect on minority / low-income populations

Flood insurance
7. Increased purchase of flood insurance
8. Fiscally solvent NFIP

Floodplain Management
9. Increased community adoption of risk-informed framework
10. Increased flood risk reduction activities

* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure 4-10: Summary of risk profile for Enterprise Risk L – unaffordability for low-income individuals

Risk appetite and rationale. The administration and Congressional interest in increasing LMI community and household access to flood resiliency programs provides the impetus for TMAC's assumption that FIMA has a high risk appetite for Enterprise Risk L (opportunity). In practice, an organization in this position is likely to be risk-seeking and believe aggressive risk-taking is justified. It would likely seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals and act to maximize the likelihood that gains would be realized or that gains would be maximized when they occur because the potential upside benefits outweigh the potential costs for taking the action.

Risk assessment with evidence. The TMAC rated Enterprise Risk L (opportunity risk) as having a high consequence and a medium likelihood. Based on these ratings, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, and the potential gains are as likely to occur as not occur, given current operations. The resulting overall qualitative risk assessment is medium.

The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence

  The TMAC rated Enterprise Risk L as having high consequence. Socially vulnerable populations suffer disproportionately more from floods in part due to their limited resources and inability to compete for assistance programs with an emphasis on economic returns. These issues are well documented and span a wide variety of impacts, including income sensitivity, food security, and medical supply security. Over the long term, these relationships—along with other incentive structures—have contributed to an intensification of the flood risk experienced by vulnerable populations rather than a reduction. FIMA can directly impact these populations through pre- and post-flood preparation and recovery programs. As one example, FEMA set up the Equity Enterprise Steering Group in 2021, which created a definition of equity for the Agency.

- Likelihood evidence

  The TMAC rated Enterprise Risk L as having medium likelihood. The 2021 Justice40[5] is a recent federal initiative, among others, that seeks to secure environmental justice and to spur economic opportunity in disadvantaged communities. Moreover, in 2018, as required by law, FEMA release a report entitled "An Affordability Framework for the National Flood Insurance Program" that laid out options for addressing the insurance affordability challenge (FEMA, 2018). Lastly, acting on this opportunity risk has the additional benefit of aligning FIMA with recent administration and Congressional initiatives for LMI flood resiliency.

Risk evaluation. The TMAC rated FIMA's risk appetite for opportunity Enterprise Risk L as high and the overall risk assessment as medium. Using these assumptions and Table 4-5, FIMA may want to consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk L. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increased risk taking.

5 For more information of Justice40 initiative, https://www.whitehouse.gov/omb/briefing-room/2021/07/20/the-path-to-achieving-justice40/.

Specifically, FIMA could adopt a more aggressive stance on helping low-income families manage their flood risk more effectively, especially in post-flood circumstances.

ILLUSTRATIVE RISK TREATMENTS (NOT TMAC RECOMMENDATIONS)

- Develop programs with decision criteria directed specifically to the administrative capacities to support low-income communities and the needs of their residents.
- Develop, in partnership with HUD, a program with criteria that support the federally funded relocation of LMI households living in flood-prone properties to habitable and affordable housing with low flood risk.
- Develop and provide mitigation and NFIP products targeted to landlords who commit to offering habitable and affordable housing to LMI renters.
- Reduce the impact of benefit-cost analyses on flood mitigation project selection by including additional value streams, such as lowering life loss risk, enhancing environmental quality, and serving LMI people and families.

4.2.4 CONCLUSION OF ILLUSTRATIVE APPLICATION OF ERM TO FIMA STRATEGIC PLAN

The ERM profiles described in Section 4.2.3 and further documented in Appendix D are considered examples of the type of ERM process that could be used by FIMA. As previously stated, the Enterprise Risks presented in Section 4.2.3 represent illustrations that intersect with issues pertinent to the TMAC. For a complete ERM process, the profiles presented in Appendix D would be used to identify the highest two or five Enterprise Risks according to FIMA leadership and the evidence presented in the risk profile. These Enterprise Risks and the associated risk treatments would be further evaluated to refine tactics to address the risks and right-align FIMA to its risk profile. As with any strategic decision-making process, the engagement of the FEMA and FIMA leadership teams in such a process would add legitimacy and insight that this example and the TMAC cannot provide.

Since the TMAC 2021 Tasking Letter was delivered, the TMAC has become aware of efforts to initiate ERM at the FIMA leadership level. The TMAC learned that FIMA started the ERM work in 2017 (FY 2018) by developing FIMA's ERM capacity. Beginning in fall 2020, FIMA's ERM efforts progressed to the point of identifying its Enterprise Risks and discussing appropriate risk appetites. The TMAC hopes the ongoing FIMA effort may benefit from the example presented here.

4.3 EXAMPLES OF COMMUNITY PROGRAMS USING RISK-INFORMED DECISION-MAKING

ERM is a formal framework for managing risks associated with achieving the desired outcomes of the organization. For ERM to be effective across entity boundaries, the mission, vision, and strategic objectives of the entities must be perfectly aligned. In the case of local jurisdictions, aligning ERM components with FIMA is simply not possible. A local community may have strategic objectives of increasing economic vitality that is at odds with FIMA's strategic objectives associated with floodplain management.

FEMA TASKING LETTER

Illustrate an example of how a community ERM application can feed metrics for a state ERM application and support the Federal ERM application ...

FIMA can support communities taking actions to meet their objectives in a balanced way if it provides information to clearly articulate the risk associated with activities in the floodplain. In this way, FIMA can support RIDM at the state, local, tribal, and territorial levels that supports a balanced view of the competing objectives of those entities. FRM is the activity of managing flood risk, which may take many forms at different levels of government, but fundamentally any RIDM must rely upon evidence of the risks involved in the decision-making. Although some communities have the facility to do their own modeling to inform their evaluation of risks beyond the federal minimum standard, others do not. Even within those communities that do local risk evaluations, there is great disparity in approaches in the void of information that is conducive for a graduated view of risk.

The following two examples outline practices taken by a county and a state. Each example shows how the entity took action to manage risk beyond the federal minimum standard. Each example shows a different approach to filling the data gaps faced in making decisions for how to manage flood risk. Both examples show how an absence of readily available, credible graduated hazard and risk information provides a significant hurdle to supporting RDIM.

FIMA has an opportunity to greatly improve the starting point for state, local, tribal, and territorial entities to leverage information driven by the latest science and data to manage their own risks beyond the federal minimum standard. For the Nation to break free of a deterministic line on a map or the notion of BFE + X, FIMA must take the risk of providing graduated risk products; otherwise, there will continue to be significant differences in the approaches taken by various entities throughout the Nation. By providing graduated risk products, FIMA can improve the evidence available for communities and individuals to act upon and improve the consistency by which flood risk is managed throughout the Nation. Doing so can improve FIMA's ability to meet multiple objectives with greater certainty.

4.3.1 FLOOD RISK MANAGEMENT IN MECKLENBURG COUNTY, NORTH CAROLINA

Although Charlotte-Mecklenburg Storm Water Services (CMSWS) has not formally applied the full ERM framework to its local FRM program, CMSWS has implemented several tactics to deal with the operational risks posed by flood hazards. The CMSWS FRM program and tactics are described below.

CMSWS's goals are to reduce risk to life and property and enhance the natural and beneficial functions of the floodplain. The risks of not meeting these goals include the following:

- Existing residential and commercial structures will experience flood damage.
- Occupants will be exposed to flood hazards and experience the loss of personal property.
- The community will suffer from disruption.
- Current and future construction will face a threat of future flood damage due to worsening flood hazards.

CMSWS has implemented the following tactics to address the identified risks:

- Higher standards for floodplain development that include:
  - Increased stream discharges to account for future land use, yielding higher BFEs
  - 1 foot of freeboard over the future conditions BFE, increasing to a total of +2 feet of freeboard while the future conditions methodology is being reviewed
  - Lower allowable surcharge for floodway determination
  - Minimum ground elevation relative to the BFE for commercial parking lots
  - Dry-land access connection from structures in the SFHA to a dry public street
- Higher standards for land development. General land development standards in Mecklenburg County include identifying and protecting streamside buffers and no-build / tree-save areas. Given these standards, developers and homeowner associations often donate protected land to the county to avoid property taxes, maintenance, and liability issues.
- Implementation of Flood Information and Notification System (FINS). FINS consists of a network of rain and stream gages that are tied to alert systems that warn emergency management and CMSWS. The network was expanded recently during a study of low-cost stream gage sensors.[6] The rain gages provide local precipitation data that are used to support hydrologic analyses for mapping updates.

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6 "Charlotte-Mecklenburg Flood Management Risk Tools and Flood Sensors." U.S. Department of Homeland Security Directorate of Science and Technology. Contract Number 70RSAT18CB0000022.

- Participation in the CRS. Within Mecklenburg County, the unincorporated areas of the County, the City of Charlotte, and the Towns of Matthews, Pineville, and Huntersville all participate in CRS. CRS encourages communication with elected officials and public outreach and supports hazard identification and risk mitigation work outside the SFHA.
- Mitigation of existing flood risk using locally developed criteria. A major tactic in addressing local flood risk has been acquiring properties and demolishing structures. Retreating from the flood hazard has been effective in Mecklenburg County because there is undeveloped and/or underdeveloped property remaining in the community and aside from a few selected areas, the water that produces the flood hazard is not regarded as an amenity. The flood hazard exists primarily along small urban streams that are generally unnoticeable during base flow conditions. People choose to live along these streams not to have waterfront property but because the location is affordable, convenient to work, or in a good school district.

In the early years of flood mitigation activity, the selection of properties for acquisition was based on eligibility under the various Hazard Mitigation Assistance (HMA) grant programs. As the obvious properties were either acquired or found to be non-participants, the local funds used as grant match[7] were redirected to acquisitions meeting local rather than federal needs. To guide this local mitigation effort, a data-driven Risk Analysis Risk Reduction Tool (see Figure 4-11) was completed in 2013 to score individual properties for flood risk and to evaluate mitigation options.

The tool considers 13 impact-based components, 4 location-based components, and 17 mitigation techniques. For the impact-based components (e.g., floodwater touching a building, floodwater inside a building, floodwater at a vehicle parking area), the elevation of the feature is compared to calculated water surface elevations for the 2-, 5-, 10-, 25-, 50-, and 100-year existing, 100-year future, and 500-year return intervals. The location-based components are multipliers that increase parcel flood risk scores for locations in a high depth-velocity zone, in a medium depth-velocity zone, in an area impacted by frequent storm drain overflows, or in a floodway. Each impact-based component has a point value. The individual flood risk score for a property is the sum of the products of each impact-based component point value times the likelihood of that component being impacted times the location multiplier (defaults to 1 when no other location criteria are met).

Mitigation techniques run the gamut, from acquisition/demolition, relocation, elevation, and wet/dry floodproofing to high-water alarms and flood insurance. Each technique is rated “further evaluation is needed,” “effective,” or “highly effective.” U.S. Army Corps of Engineers (USACE) depth-damage functions and FEMA benefit-cost analysis tools are incorporated to provide indications of the effectiveness of the more aggressive mitigation techniques.

7 A countywide stormwater utility fee provides a steady source of funding for flood mitigation activities.

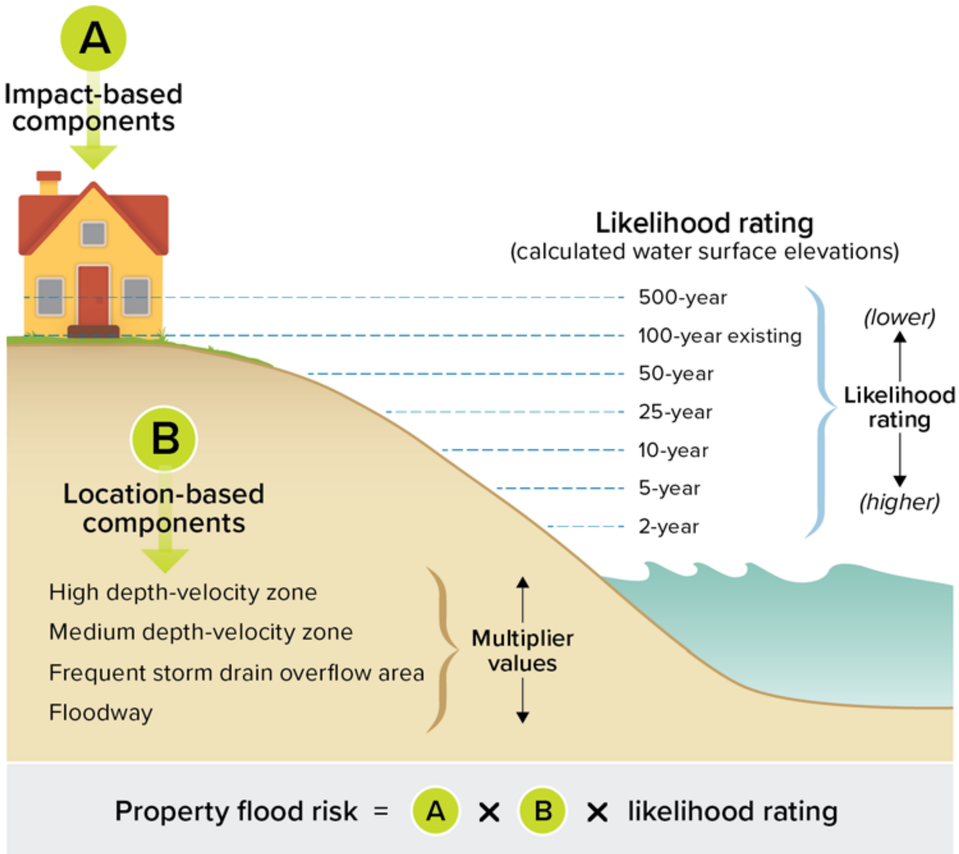

Figure 4-11: Example of Mecklenburg Risk Analysis Risk Reduction Tool

The tool was updated and enhanced recently with assistance from the U.S. Department of Homeland Security, Science and Technology Directorate. The enhancements include the ability to consider social vulnerability issues and filter mitigation recommendations by viability (estimate of effectiveness in terms of mitigation cost versus flood risk reduction). For more information on the enhanced risk analysis tool and its applicability to other communities, see the *Flood Risk Assessment and Reduction Community Guidebook* (Mecklenburg County, 2021).

The output from the risk analysis tool can be expressed as a countywide flood risk pool. Beginning with the 2022 fiscal year, the flood mitigation program became more focused on the cost of mitigating a pre-determined number of flood risk points from the countywide pool rather than determining how much risk might be reduced given a set budget. In this effort to shift the focus of its program, CMSWS also began tracking private mitigation (e.g., noncompliant pre-FIRM structure demolished and replaced with compliant new construction) as well as the addition of new flood risk points created by permitted new development in the floodplain. Application of the enhanced tool with mitigation viability set to 5 (mid-range) generated the current target for an “acceptable”/ residual level of flood risk. Project viability can range from 1 (extremely effective project with a low cost and a high mitigation value) to 10 (high cost and low mitigation value). A project with a viability of 5 will meet one or more of the following criteria: (1) total cost for acquisition < $800k or cost for in-place mitigation such as elevation or wet floodproofing < $125k; (2) benefit-cost ratio > 1; (3) mitigation point reduction > 400; or (4) cost per point reduction < $1200.

The countywide flood risk pool is represented by the orange, red, and blue lines in Figure 4-12 with the orange segment representing mitigation achieved through 2020, the red segments proposed mitigation over the next 15 years to 2035 with slope varying by level of mitigation funding, and the blue segments, proposed mitigation from 2035 to 2050, again with slope varying by level of mitigation investment. This graphic was used recently to support a request for an increase in the stormwater utility fee that funds the County's mitigation program and to convey the effect of the level of funding on reaching the residual flood risk goal.

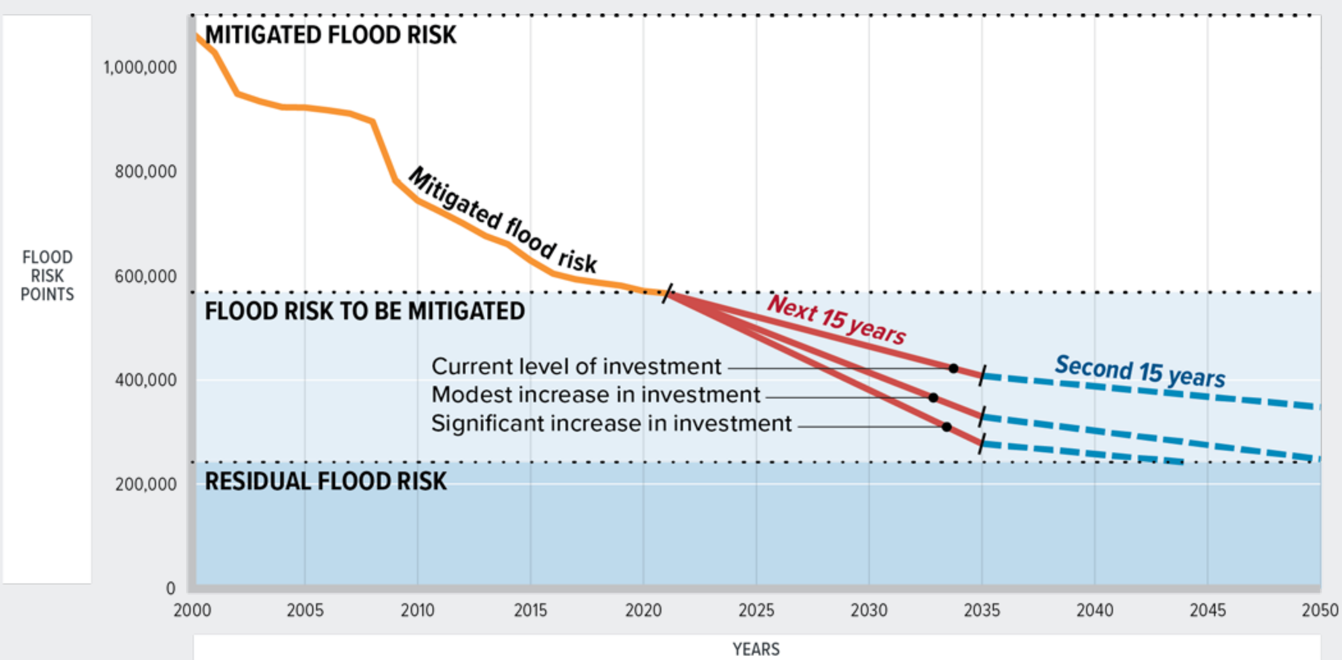

Figure 4-12: Mecklenburg County flood risk over time

Data source: Charlotte-Mecklenburg Storm Water Services

Since 2016, local flood risk mitigation through acquisition and demolition has been complemented by the retroFIT grant program, which provides technical and financial assistance to property owners who undertake approved flood mitigation measures. These include demolition, elevation, relocation, basement abandonment, wet or dry floodproofing, and protection of mechanical and electrical equipment.

Funding is provided at 75% to 95% of project cost with a sliding scale inversely related to assessed tax value. Because the County is not buying land and displacing homeowners, this program has been an incredibly effective tool in its current risk point reduction mitigation effort.

Explicit examples of ERM for FRM are proving to be rare if not non-existent. However, use of a property-level risk analysis tool with community-level risk reduction goals and tolerance levels, such as used by CMSWS, can provide a bottom-up type of support for the implementation of ERM.

4.3.2 HORIZONTAL FREEBOARD IN MARYLAND

In Maryland, the State Coast Smart Councils – Climate Ready Action Boundary (CS-CRAB), is an example of how a local community can exceed federal minimum standards for floodplain management. The CS-CRAB leverages the concept of horizontal freeboard to extend the floodplain boundary beyond those delineated in the NFIP digital FIRMs for the purpose of reducing development in areas that incur risk from flooding. This use of horizontal freeboard is an example of how a community can take steps to adopt higher standards than the NFIP based on its own risk tolerance. Many communities already have a higher vertical freeboard of 1 foot, 2 feet, or 3 feet that they have adopted and enforced inside the FEMA floodplain. Typically, this is because most of the community's floodplain regulations are tied to the community's floodplain ordinance or regulations and based on their NFIP floodplain maps (FIRMs), which regulate activities inside the floodplain.

Almost all communities use the FIRM as the reference for floodplain regulations, which means that floodplain regulations stop at the mapping limit of the floodplain. As a result, most communities with freeboard enforce a more restrictive regulation (i.e., higher elevation) known as a flood protection elevation inside the floodplain and allow development outside the floodplain to occur at grade in the adjacent areas, usually below the flood protection elevation. Many of these communities receive credit from FEMA's CRS for setting and enforcing higher standards in their floodplain; however, from a resiliency standpoint, the communities are treating risks inside and outside floodplains differently. People in areas outside and immediately adjacent to mapped floodplains are falling further behind in risk awareness because they are not required to meet the freeboard elevation requirement though their exposure to flooding is very similar. Higher elevations used for a vertical freeboard inside the floodplain imply that flood water will stop at the limits of a floodplain map. Any veteran floodplain manager recognizes that flooding does not stop at an arbitrary map boundary, and that the higher vertical elevations used to enforce freeboard inside the floodplain should be expanded horizontally beyond the floodplain as shown in Figure 4-13.

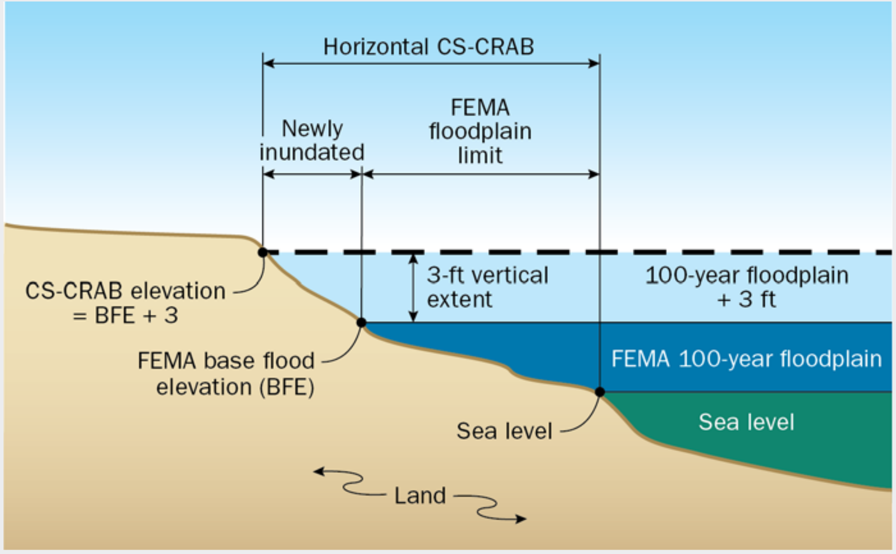

Figure 4-13: Maryland horizonal CS-CRAB extends beyond FEMA 100-year floodplain limit

Data source: https://mdfloodmaps.net/crab/

Maryland has taken the step of defining, mapping, and adopting higher regulatory elevations horizontally beyond the floodplain for state projects in coastal floodplains to address resiliency in state construction and funding for projects that cost more than $500,000 or receive more than 50% of their funding from the state where the state cost share above $500,000. The CS-CRAB Program uses the 100-year floodplain + 3 feet to determine the higher floodplain elevations and maps the wider limits to the floodplain + 3 feet for consideration when designing projects in Maryland's coastal areas. Floodplain managers will recognize this standard as the same standard recently adopted by the federal government as the Federal Flood Risk Management Standard in 2016 and reenacted in 2021. The Maryland state guidelines were adopted in September 2020 and all state agencies must review and follow these guidelines for all new projects. A public-facing website (https://mdfloodmaps.net/crab/) illustrates the limits and higher elevations in the existing floodplain and in the areas beyond the floodplain that must be applied to reach the CS-CRAB and corresponding elevation. The GIS map viewer illustrates the CS-CRAB elevations that when applied are matched with a community's flood protection elevations. These conditions are applied beyond the limits of the FEMA floodplain. Several Maryland communities are considering adopting the CS-CRAB to make their communities more resilient via higher standards for higher bond ratings and expanding or enrolling in FEMA's CRS Program.

In a more traditional NFIP aerial view in Figure 4-14, Maryland's CS-CRAB illustrates the FEMA 100-year floodplain, the local digital elevation model elevations, and the transitional colors of the +3, +2, and +1 elevations above the ground to reach the

CS-CRAB (also known as the flood protection elevation). The FEMA 100-year floodplain + 3 feet freeboard over open water is illustrated in light blue along the shore, the limits of the existing FEMA BFE + 3 vertical feet over the land boundaries are illustrated in the blue striped areas over a purple solid background. The horizontal extents of the CS-CRAB are illustrated in solid purple and indicate depths between + 3 feet and + 2 feet, the solid green illustrates CRAB depths between + 2 feet and + 1 feet, and the solid yellow indicates the CRAB depths between + 1 feet and 0 feet. The three text boxes on the map illustrate user-generated points that represent the current ground elevation (A), the vertical distance or depth needed (B) to reach the CRAB, and the final elevation of the CRAB at each point (A + B). In summary, this map illustrates the areas that would be inundated at the 100-year + 3 feet elevations beyond the current FEMA map and the elevations needed to meet the Maryland CS-CRAB elevation or the flood protection elevation.

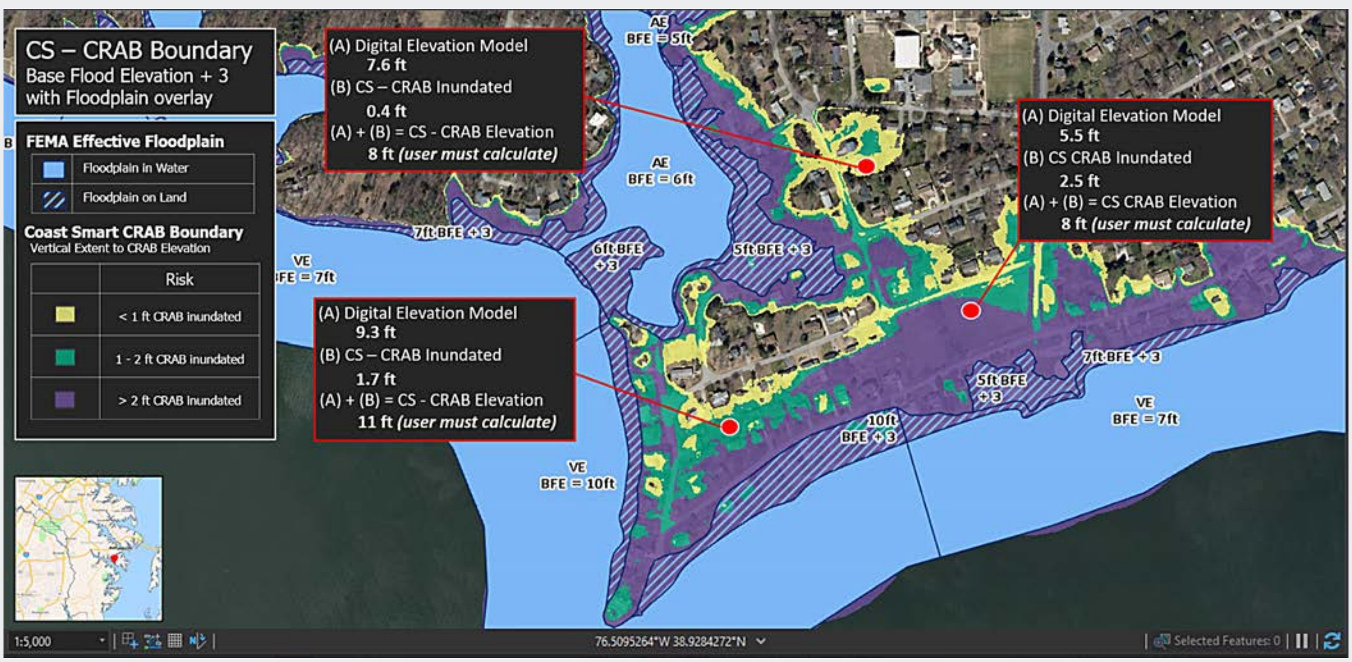

Figure 4-14: NFIP aerial view of Maryland's CS-CRAB and local Digital Elevation Model

Source: https://mdfloodmaps.net/crab/

For illustrative purposes, Maryland has completed a preliminary analysis of buildings within the current FEMA floodplain in comparison with the number of additional buildings that would be flooded within the extents of the CS-CRAB. In almost every case of coastal flooding, the number of buildings within the extents of the CS-CRAB is at least twice as many as the number or buildings in the 100-year floodplain. Figure 4-15 illustrates this example.

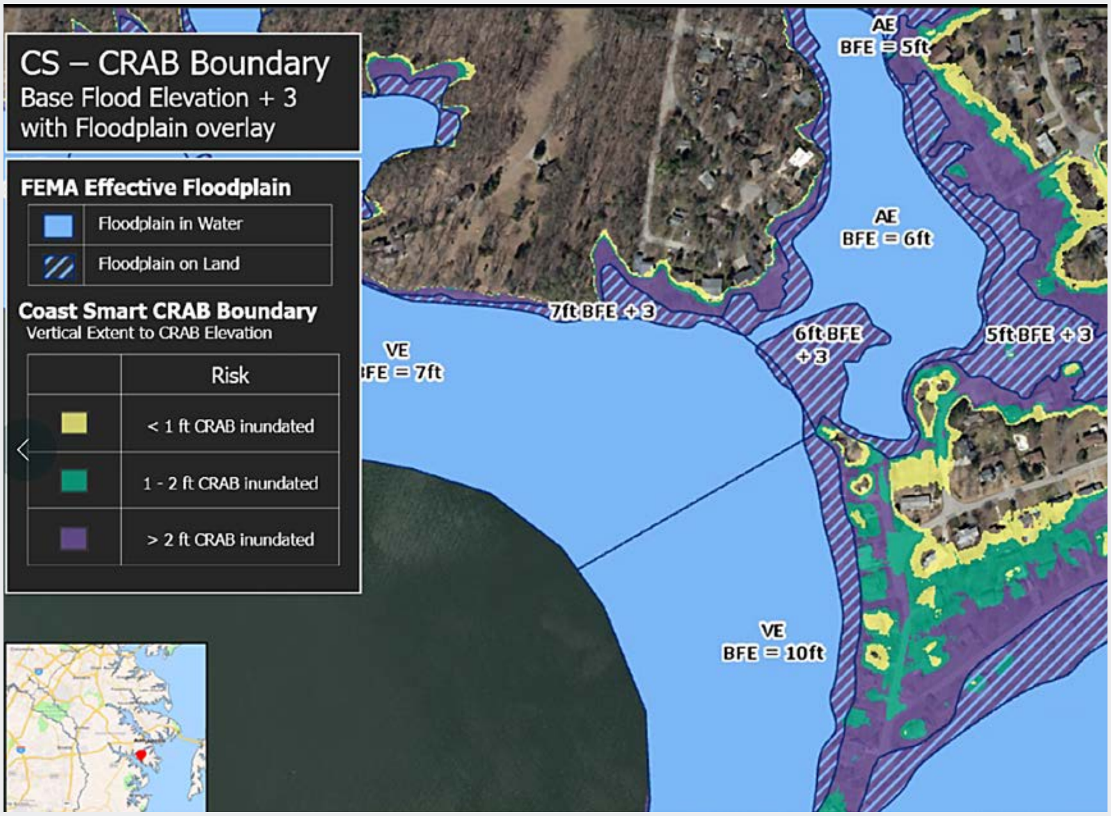

Figure 4-15: Example of buildings within FEMA floodplain and within the extents of the FEMA CS-CRAB

Horizontal freeboard, when linked to a community's current floodplain regulations, provides an effective method of establishing resiliency that can be implemented immediately and serve as an effective ERM tool until FEMA develops graduated flood data and fully implements ERM.

As a point of reference, Maryland is currently developing a 100-year + 3 feet layer in riverine or nontidal streams across the state for community information to promote resiliency. The data are anticipated to be available by the time that this TMAC document is completed and released. A link to the data will be available on Maryland's outreach site at mdfloodmaps.com.

4.4 SUMMARY, FINDINGS, AND RECOMMENDATIONS

FEMA TASKING LETTER

The TMAC should consider the following activities to guide its exploration:

- Conduct a review of community, state, and federal agencies that have applied ERM in the context of FRM;
- Use the strategic visions across FIMA (e.g., FY2021-2023 FIMA Strategy) to inform how ERM could be applied to the National Flood Insurance Program (NFIP). Evaluate whether the current FIMA strategic objectives support an ERM framework for the NFIP. This may require experimenting with risk appetites, tolerances, and capacity thresholds on metrics that support tracking progress to reach strategic objectives;
- Illustrate an example of how a community ERM application can feed metrics for a state ERM application and support the Federal ERM application; and,
- Based on the explorations above, suggest next steps for how FEMA could implement ERM for FRM.

This section provides a summary of TMAC actions and pertinent findings of the TMAC ERM subcommittee related to FIMA's FRM program (Section 4.4.1), followed by presentation of two TMAC recommendations related to ERM.

4.4.1 SUMMARY OF FINDINGS

The summary of activities and associated findings are organized to be direct responses to FEMA's Tasking Letter (see text box).

Conduct Review of ERM Application

Little evidence was uncovered to suggest that state and local FRM authorities have successfully implemented ERM (refer to Section 2.4.5). Of the 491 respondents to a stakeholder engagement survey, only 57 claimed to use ERM to some degree. The 57 respondents were contacted for a second survey to learn more about their ERM practices and 7 responded. Of the 7, some appear to have rather rigorous ERM practices, but none were willing to share their ERM plans. Consequently, it was not possible to learn more about the extent of their usage of ERM for FRM.

The results of the outreach effort in this TMAC survey suggest that few if any public agencies are robustly employing ERM for FRM.

Application of Strategic Visions to Inform Application of ERM to NFIP

Summary of TMAC application. The FIMA FY21–2023 Directorate/Office Strategy provided useful resources for the TMAC's development of a demonstration ERM plan for FIMA. The four strategic outcomes (see Figure 4-4) in the strategy were modified by the TMAC to better position them for an example ERM application. The TMAC, mindful of the FIMA Strategy content, identified four alternative strategic objectives to demonstrate what solid ERM ready objectives might look like. These notional objectives are:

1. Increase understanding of flood hazards and risks.

2. Increase community flood resilience using pre- and post-disaster risk management programs.
3. Secure widespread coverage of flood insurance.
4. More local communities implementing their own floodplain management plans that exceed minimum NFIP standards.

These four objectives were expanded into 10 subobjectives, which were used to develop a sample ERM Plan for FIMA.

Discussion of TMAC findings. Based on its work related to this 2021 Annual Report, the TMAC finds that FEMA, in general, and FIMA, in particular, have excellent potential to benefit substantially from the implementation of ERM. FEMA's external environment forces it to pursue conflicting and, at times incompatible, objectives. ERM provides FEMA with a transparent way to confront and attempt to manage these contradictions.

Using community-level ERM metrics to generate state and then federal ERM metrics is neither likely nor desirable because of the distinctly different strategic objectives at each level of government. ERM is designed to be followed at the organization or entity level, not on a national level. Leveraging ERM internal to FIMA would improve FIMA's ability to meet its stated objectives, which include sustained risk reductions all the way down to the community and individual levels.

FIMA can improve stakeholders' ability to establish methods that could be tailored by communities to manage their operational risks based on local conditions and tolerances. Providing data, examples of risk management frameworks, and training materials that communities could adopt would allow them to identify, evaluate, manage, and communicate risk. This would empower communities to move beyond the adherence to a deterministic flood boundary that represents a federal minimum regulation not intended to drive risk management strategies. Doing so requires foundational data to describe graduated risks. Establishing programs in FIMA to allow for application of ERM can align interests of locals with the interests of FIMA so that locals can have credible information upon which to base their flood risk mitigation activities.

Illustration of Community ERM Application

The TMAC evaluated Mecklenburg County, NC, and the State of Maryland as examples of organizations with FRM programs that go beyond NFIP minimums and embrace elements of ERM. These programs provide examples of operational FRM metrics applied at the state and local government levels that could have broad appeal and value to other government entities. FIMA can take the single most useful step toward unifying the approach to flooding at all levels of government by providing foundational data to describe graduated flood risk and graduated flood hazard. This provides an avenue for states and counties to manage flood risk without a deterministic boundary, which artificially complicates both operational FRM and ERM.

Next Steps for Implementing ERM

FIMA's ongoing efforts to implement ERM were described in an overview manner to the TMAC. The effort was not available in time for the TMAC to align with FIMA's ongoing efforts. FIMA should continue and complete its ERM efforts with the TMAC subcommittee standing by to provide support resources or to collaborate as appropriate. The ERM example and outputs presented in this TMAC 2021 report demonstrate an approach to ERM. The approach is not intended to impinge on FIMA's independent ERM initiatives in any way.

4.4.2 RECOMMENDATIONS

The TMAC sees tremendous opportunity to leverage graduated flood risk and flood hazard data to decrease the risks FEMA faces in delivering its ambitious mission outlined in the 2021–2023 Strategic Plan. For state, territorial, tribal, and local governments to take risk mitigation actions beyond the federal minimum standard, it is critical that they have the information necessary to do so. Resistance to graduated risk products spans a range of concerns about regulatory products, quality of the information, and appropriate use of the information. Clearly, there is risk associated with developing and delivering the information. The TMAC believes that the absence of the information creates a greater risk to the public. Disciplined risk-taking activities regarding the production and delivery of graduated risk products can improve FEMA's ability to meet its vision of a prepared and resilient Nation. Through ERM, FIMA can find a path to production and delivery that mitigates the critical risks associated with its overall strategic vision. The TMAC recommends that FIMA leverage ERM to prudently take opportunity risks to reap the benefits of graduated risk products.

TMAC ERM Recommendation No. 1

The TMAC recommends that FIMA use ERM to accomplish its strategic objectives. ERM can guide FIMA's efforts to prioritize and then mitigate or take prudent risks that increase the likelihood that FIMA can achieve its organizational objectives.

TMAC ERM Recommendation No. 2

FIMA is building an analytical foundation of graduated risk data, concepts, and products, as recommended by TMAC in 2017. FIMA should leverage ERM processes and concepts to prudently take opportunity risks to promote widespread use of graduated risk in FRM decision making by governments, businesses, and individuals.

05

CONCLUSIONS AND RECOMMENDATIONS

Through the National Flood Insurance Program (NFIP) and the National Flood Mapping Program, FEMA aims to provide comprehensive flood hazard and risk data to inform flood insurance pricing and flood risk mitigation activities, including floodplain management. The TMAC supports FEMA in its efforts by sharing conclusions and offering recommendations on matters related to flood hazard and risk mapping.

In 2021, FEMA tasked the TMAC with the three tasks shown below.

1. Continue engaging with external stakeholders to understand the potential applications of graduated flood hazard and risk data for a broad range of users.
2. Review recommendations from the TMAC's 2015 Future Conditions report (TMAC, 2015a) to determine which still apply and if there are any additional recommendations to address future conditions.
3. Explore risk management frameworks, such as Enterprise Risk Management (ERM), in the context of flood risk management (FRM) and explore how FEMA could apply ERM.

5.1 STAKEHOLDER ENGAGEMENT CONCLUSIONS

Through the ongoing processes of engagement, the TMAC was able to better understand the following:

- Respondents have remained steady with a slight increase when acknowledging benefits to graduated flood hazard and risk data in 2021 compared to 2020,
- Terms like "graduated risk" do not have a wide nor common understanding in the public and should be considered when communicating flood hazards and risk to stakeholders,
- Tools and products, such as graduated hazard maps and graduated hazard risk scores, can help FIMA to overcome the barriers to acceptance and adoption within communities and the public at large,
- The TMAC survey suggest that few, if any, public agencies are robustly employing ERM for FRM, and
- While regulatory and statutory were considered the most significant barriers to adopting flood hazard and risk data for communities, we also found that approximately 86% of respondents view equity (rated anywhere between "low to significant"), as barrier to flood mitigation.

Moving forward into the next reporting cycle, the TMAC will look to expand the stakeholders that we reach, engage in webinars, and create focus groups earlier on in the process providing an opportunity to have more dialogue with stakeholders and learn more from practitioners and experts.

As the TMAC explored the application of ERM for FRM purposes, it found that (1) not many in the FRM community use ERM; (2) though FIMA strategies needed to be adjusted in order to provide a more solid foundation for ERM principles, overall FIMA would benefit from applying ERM principles to the execution of its portfolio of programs; (3) some states and localities are applying ERM principles to FRM; however, an application of ERM spanning multiple federal, state, and county entities is ill-advised; (4) the ERM process must involve FIMA leadership and thus TMAC's illustration of ERM in this report is for reference only.

Beyond the illustrative ERM application, TMAC recommends that FIMA use ERM to accomplish its strategic objectives (Recommendation 1), and that it should leverage analytical foundation of graduated risk data, concepts, and products in doing so (Recommendation 2). By doing so, FIMA will better position itself to prudently take risks to achieve its goals and reduce or avoid risks that jeopardize them.

5.2 TMAC FUTURE CONDITIONS CONCLUSIONS

The TMACs review of the 2015 Future Conditions report (TMAC, 2015a) indicated that no substantive changes have occurred since 2015 that render any major recommendation invalid, and that the premises of most, if not all of the subrecommendations, remain valid. The TMAC reviewed in detail all 7 primary recommendations and 37 subrecommendations identified in the 2015 Future Conditions report in light of FEMA's transition from a binary to graduated view of flood hazard and flood risk data. The TMAC identified 27 recommendations that it believed would benefit from added or modified language in order to improve relevancy on going FEMA programs, especially the FFRD initiative; increased research, knowledge, data, and modeling tools; and development of national standards.

Additionally, the TMAC developed one new recommendation to addresses the need for FEMA to incorporate the Future Conditions recommendations, outcomes, and available tools outlined in this report into the development, deployment, and continued enhancement of the FFRD initiative.

5.2.1 TMAC FUTURE CONDITIONS RECOMMENDATION

The TMAC recommends the addition of a new Future Conditions recommendation that supports the continued advancement of FEMA's FFRD initiative. This recommendation aims, in part, to address the transition in FEMA's approach from binary to graduated flood hazard and flood risk identification, which was endorsed by the TMAC in 2021.

AR-38 Recommendation

FEMA should incorporate the future conditions recommendations outlined in this report into the development, deployment, and continued enhancement of FFRD. This includes supporting existing partnerships to leverage best available climate science and datasets that will support future conditions analyses with an FFRD lens. Future conditions flood hazard and risk analyses should be standard approaches within the probabilistic modeling suite and resultant nonregulatory products that FFRD will employ.

5.3 TMAC ERM CONCLUSIONS

In the 2020 TMAC report, Recommendation AR 35 stated "TMAC recommends that FEMA explore how to implement enterprise risk management frameworks that help communities whose objectives are to become more flood resilient and transition toward proactive FRM while meeting or exceeding existing minimum federal floodplain management requirements." As a result, in the 2021 TMAC Tasking Letter, FEMA requested that the TMAC investigate the topic with four, pointed charge questions. The TMAC investigated these topics and presented the broad conclusions in the previous section. The TMAC also found that it is not advantageous to leverage community-level ERM metrics to generate state and then federal ERM metrics for FRM because the strategic objectives of the various entities, which guide ERM activities, are not intrinsically congruent. The 2021 TMAC investigation has led to a more nuanced view of the proper application of ERM and other risk management frameworks to support a more resilient Nation. ERM best functions within a singular entity, such as FIMA or FEMA, where the strategic objectives are shared. As such, FIMA leveraging ERM to improve its ability to meet its own strategic objectives in an increasingly complex environment is most advantageous. Climate risk, political risk, and changes in flood computing capabilities have presented a series of challenges that require a disciplined approach to risk taking to meet strategic objectives. Based on these findings, the TMAC recommends FIMA implement ERM for its programs.

5.3.1 TMAC ERM RECOMMENDATIONS

The TMAC sees tremendous opportunity to leverage graduated flood risk and flood hazard data to decrease the risks FEMA faces in delivering its ambitious mission outlined in the 2021–2023 Strategic Plan. For SLTT governments to take risk mitigation actions beyond the federal minimum standard, it is critical that they have the information necessary to do so. Resistance to graduated risk products spans a range of concerns about regulatory products, quality of the information, and appropriate use of the information. Clearly, there is risk associated with developing and delivering the information. The TMAC believes that the absence of the information creates a greater risk to the public. Disciplined risk-taking activities regarding the production and delivery of graduated risk products can improve FEMA's ability to meet its vision of a prepared and resilient Nation. Through ERM, FIMA can find a path to production and delivery that mitigates the critical risks associated with its overall strategic vision. The TMAC recommends that FIMA leverage ERM to prudently take opportunity risks to reap the benefits of graduated risk products.

AR-39 Recommendation

The TMAC recommends that FIMA use ERM to accomplish its strategic objectives. ERM can guide FIMA's efforts to prioritize and then mitigate or take prudent risks that increase the likelihood that FIMA can achieve its organizational objectives.

AR-40 Recommendation

FIMA is building an analytical foundation of graduated risk data, concepts, and products, as recommended by TMAC in 2017. FIMA should leverage ERM processes and concepts to prudently take opportunity risks to promote widespread use of graduated risk in FRM decision making by governments, businesses, and individuals.

5.4 2021 TMAC RECOMMENDATIONS

Table 5-1 presents the TMAC's 2021 recommendations.

Table 5-1: TMAC 2021 Recommendations

AR-#	Description
AR-38	FEMA should incorporate the future conditions recommendations outlined in this report into the development, deployment, and continued enhancement of the Future of Flood Risk Data (FFRD) initiative. This includes supporting existing partnerships to leverage best available climate science and datasets that will support future conditions analyses through the lens of the FFRD initiative. Future conditions flood hazard and risk analyses should be standard approaches within the probabilistic modeling suite and resultant nonregulatory products that the FFRD initiative will employ.
AR-39	The TMAC recommends that FIMA use Enterprise Risk Management (ERM) to accomplish its strategic objectives. ERM can guide FIMA's efforts to prioritize and then mitigate or take prudent risks that increase the likelihood that FIMA can achieve its organizational objectives.
AR-40	FIMA is building an analytical foundation of graduated risk data, concepts, and products, as recommended by TMAC in 2017. FIMA should leverage ERM processes and concepts to prudently take opportunity risks to promote widespread use of graduated risk in flood risk management decision making by governments, businesses, and individuals.

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APPENDIX

A

FEMA 2021 TASKING LETTER

U.S. Department of Homeland Security
Washington, DC 20472

FEMA

February 23, 2021

Mr. Jeffrey Sparrow, P.E., CFM
Chair, Technical Mapping Advisory Council
21308 Small Branch Place
Ashburn, VA 20148

Dear Mr. Sparrow:

The Biggert-Waters Flood Insurance Reform Act of 2012 established the Technical Mapping Advisory Council (TMAC) to review and make recommendations to the Federal Emergency Management Agency (FEMA) on matters related to the National Flood Mapping Program (NFMP). FEMA is expanding the approaches it uses for flood hazard and risk analysis: in addition to the binary approach that the agency currently uses, FEMA is exploring graduated approaches that will ultimately result in a national-scale flood hazard and flood risk dataset. Graduated hazard and risk data is derived from probabilistic analyses and takes into account a comprehensive range of flood frequencies, including future scenarios, and hazard sources (e.g., fluvial, pluvial, coastal). The development of graduated data will support a more consistent and comprehensive understanding of flood risk across the Nation.

In 2020, the TMAC worked with stakeholders to recommend elements of FEMA's Future of Flood Risk Data (FFRD) and inform the transition path to a future program by identifying obstacles, opportunities, and useful elements of the current program, and by proposing specific roles for state, local, tribal, territorial (SLTT), and other partners in the future program. FEMA appreciates the TMAC's work last year to engage stakeholders and develop annual recommendations. FEMA would like the TMAC to build on its work in 2020 by continuing to provide advice on adopting graduated approaches to support a more comprehensive understanding of flood risk. FEMA tasks the TMAC with the following:

1. Continue engaging with external stakeholders, to include local officials/Floodplain Managers, State NFIP coordinators, Community Rating System (CRS) communities, emergency managers, and professional organizations, to understand the potential applications of graduated flood hazard and risk data for a broad range of users. Specifically, the TMAC should work with stakeholders to consider the following questions:
    - What opportunities does graduated flood hazard and risk data offer in developing policies and driving behavioral change to enhance flood resilience?
    - What are the challenges in applying graduated flood hazard and risk data, including regulatory barriers for floodplain management and challenges to data access by internal and external stakeholders and the public?
    - To enhance the use of graduated flood hazard and risk data, what changes (if any) do you recommend to FEMA's floodplain management strategies?
    - What kind of products will assist our stakeholders in understanding and communicating graduated flood risk and incentivizing mitigation actions?

- How can graduated flood hazard and risk data help stakeholders prepare for climate change and other future conditions that the current binary approach (i.e., mapping the 1%-annual-chance flood) does not offer?
- What is the role of SLTTs in developing a more localized understanding of flood hazard and flood risk, leveraging FEMA's graduated data?

2. Review recommendations from the TMAC's 2015 Future Conditions report to:
   - Determine which of the recommendations still apply, in light of FEMA's transition from a binary to graduated approach to flood hazard and flood risk identification; and
   - Identify additional recommendations for addressing future conditions with the graduated approach to flood hazard and flood risk identification

3. Explore risk management frameworks, such as Enterprise Risk Management (ERM), in the context of flood risk management (FRM) and explore how FEMA could apply ERM for FRM. ERM is typically applied in sectors other than FRM so the collective knowledge at the intersection between ERM and FRM is small. Risk management approaches, such as ERM, can allow federal, state, and local agencies to reduce variance and improve the ability to meet their objectives. Exploring ERM in the context of FRM can support FEMA meeting the objectives of OMB Circular A-123, which requires agencies to implement ERM. The TMAC should consider the following activities to guide its exploration:
   - Conduct a review of community, state, and federal agencies that have applied ERM in the context of FRM;
   - Use the strategic visions across FIMA (e.g., FY2021-2023 FIMA Strategy) to inform how ERM could be applied to the National Flood Insurance Program (NFIP). Evaluate whether the current FIMA strategic objectives support an ERM framework for the NFIP. This may require experimenting with risk appetites, tolerances, and capacity thresholds on metrics that support tracking progress to reach strategic objectives;
   - Illustrate an example of how a community ERM application can feed metrics for a state ERM application and support the Federal ERM application; and,
   - Based on the explorations above, suggest next steps for how FEMA could implement ERM for FRM.

The insight that the TMAC provides this year will help FEMA continue to refine the future of its flood hazard and flood risk identification program in a way that is forward-thinking and supports the needs of a wide range of stakeholders. FEMA will continue to support the TMAC's engagement with stakeholders to gather feedback. As in previous years, the TMAC should formulate its findings into an annual report.

FEMA appreciates the dedication and expertise of the TMAC. I am confident that the TMAC's insights will support FEMA's objective to position individuals and communities to understand their flood risk and take well-informed actions to reduce their risk. The TMAC's recommendations will also support a more risk-informed NFIP, in which more comprehensive flood hazard and flood risk data supports all elements of the NFIP, including insurance, mitigation, planning, and floodplain management.

Sincerely,

MICHAEL M GRIMM

Digitally signed by MICHAEL M GRIMM
Date: 2021.02.23 08:54:11 -05'00'

Michael M. Grimm
Assistant Administrator for Risk Management
Federal Insurance and Mitigation Administration
Federal Emergency Management Agency

APPENDIX

B

STAKEHOLDER OUTREACH SURVEY AND DOCUMENTATION

B.1 REPORT ON SURVEY RESULTS BY RS21, INCLUDING FIRST TIER SURVEY, 9.30.2021

DESCRIPTION OF SURVEYS

The TMAC conducted a review of community, state, and federal stakeholders through a two-tier survey process. The first tier surveys were conducted during the Association of State Floodplain Managers (ASFPM) national conference in May 2021, and a separate survey conducted during the National Flood Conference by American Property Casualty Insurance Association in June 2021. Additionally, the TMAC conducted a second tier survey to focus on first tier respondents who were familiar with the ERM concept and applications to solicit more detailed information and feedback.

Detailed information on the surveys is included in this appendix.

First Tier Survey. The first tier survey consisted of 26 questions of various formats—multiple choice, matrix, and free response—that assessed respondents' backgrounds, experience, and attitudes toward and experience with binary and graduated risk analysis. The first tier survey had two versions to accommodate different stakeholders. While largely the same, some changes were made in wording tailored to those specific audiences. Nevertheless, the results were largely consistent across both versions, so the results presented in this 2021 TMAC Annual report reflect the combined results from both surveys, except where noted. Where possible, the results from the 2021 survey were compared to the 2020 survey to better track trends and changes over time. Personal Identifiable Information (PII) was redacted from results and thus not accessible during any data analysis. Survey results and an analysis report are included in this appendix.

The general nature of the first tier survey questions follows (full surveys are included later in this appendix):

- Identify participant's role as stakeholder and how that role aligns with elements of current NFIP (mapping, mitigation, management, insurance)
- Determine which existing regulatory and non-regulatory map products are being used by survey participant and how they are useful or not
- Asks what tools are needed by survey participant to improve personal understanding of flood risk and promote understanding within the community
- Asks what obstacles or barriers exist to using graduated risk
- Asks what is needed to implement a floodplain management strategy capable of leveraging graduated flood hazard risk

- Gauge understanding of FEMA's Risk Rating 2.0
- Asks whether future flood conditions are included in stakeholder forecasting
- Asks about the use of ERM as it relates to flood risk management
- Asks whether survey participant would be interested in further participation through webinar and/or focus group

Second Tier Survey. The TMAC conducted the second tier survey to focus on first tier respondents who were familiar with the ERM concept and applications to solicit more detailed information and feedback.

The final questions in the first tier stakeholder engagement surveys were intended to identify individuals and organizations that are applying ERM to Flood Risk Management programs and to the extent possible, find out who is interested in discussing the topic further with the TMAC. Questions and results of these questions in the first tier survey were as follows:

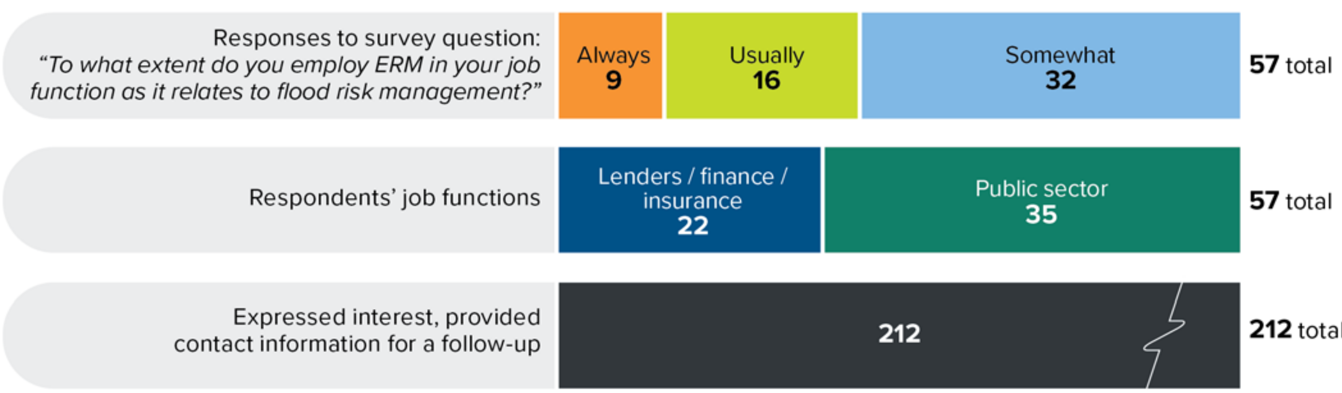


Figure B-1: ERM Survey Feedback Use of ERM

Question: "To what extent do you employ ERM in your job function as it relates to flood risk management?"

Answer: Of the 491 respondents to the ASFPM and National Food Conference surveys, 57 replied always (9), usually (16), or somewhat (32). Of the 57 respondents to the question, 35 were from the public sector and 23 represented primarily lenders/financial institutions or the insurance industry.

Question: "Are you interested in further engagement opportunities related to future flood hazard and flood risk conditions, ERM, or flood risk management in underserved communities. If so, provide your email address."

Answer: A total of 212 respondents expressed interest in further engagement on ERM and provided contact information for a follow-up.

A second tier ERM survey was sent to the 57 respondents who indicated they always, usually, or somewhat employed ERM for FRM. The survey, which was adapted from the 2020 Guidehouse1 survey of federal agencies on ERM use, consisted of 11 questions about the extent of the organization's ERM use, one question about whether respondents would share their ERM plans with the TMAC, and one question about whether respondents would provide contact information to the TMAC for a follow-up interview. The questions and responses are provided in Appendix B. Personal Identifiable Information (PII), was redacted from results and thus not accessible during any data analysis.

Seven people responded to the second tier ERM survey. Two represented a public agency. Four reported having ERM programs (greater than 5 years old), two reported programs 1 to 5 years old, and one reported a program less than 1 year old. All of the respondents with programs one or more year old reported that a chief-executive-level employee was responsible for the ERM program. Cybersecurity/privacy risks, followed by reputational risk, were reported most often as concerns of the organization. When looking at the reported perception of risk by type, climate/flood risk equaled the reporting of strategic, financial, and compliance risks. See Figure B-2.

Figure B-2: Reported perception of risk by type

Of the standard ERM methods and procedures in use (see Section 3.1), five respondents reported having identified strategic objectives, four identified specific risks to the strategic objectives, and four reported developing risk profiles. Three reported identifying risk tolerances and the development of risk appetites, controls, and metrics was reported by two respondents. Four respondents replied that they used risk reports and other risk communication measures. See Figure B-3.

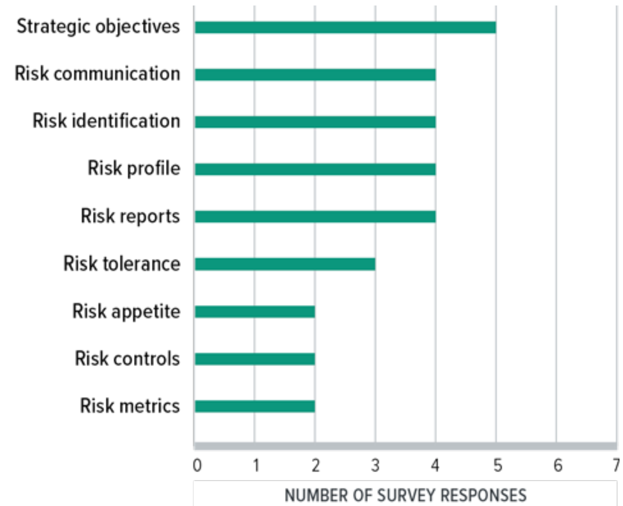


Figure B-3. Reported ERM methods and procedures in use

One second tier respondent offered to share his or her organization's ERM plan with the TMAC but did not respond when contacted later. The results of the outreach effort in this TMAC survey suggest that few if any public agencies are robustly employing ERM for flood risk management.

B.2 RS21 TMAC PRESENTATION, SEPT 2021 (PPT)

FEMA TMAC SURVEY FINDINGS

15 September 2021

FEMA

AGENDA

FEMA

FEMA TMAC| KEY TERMS

In an effort to stay aligned as we move through out this presentation, we first must define various **key terms** included through out this presentation.

Risk Rating 2.0	Definition: A new, modernized approach for pricing flood insurance. Leveraging industry best practices and current technologies to deliver flood insurance rates that are “fairer, easier to understand, and better reflect a property’s unique flood risk.”
Graduated Approach	Definition: The graduated depiction and communication of risk includes using data and tools that can enhance understanding of the probability of flood scenarios beyond the current practice of binary risk assessment

FEMA TMAC| EXECUTIVE SUMMARY

Preliminary results from the 2021 TMAC Engagement Survey identify several key findings about how participants understand FEMA's graduated flood mapping approach and what they view as its major benefits and challenges.

Analysis Scope

Survey Versions	Responses
2 survey versions: Association of State Floodplain Managers (**ASFPM**) Survey, Flood Conference (**FC**) Survey	491 total responses (as of August 30th, 2021)
Question Format	**Confidence**
Multiple choice and multi-row matrix questions	95% confidence with 4% margin of error

Key Findings

RESPONDENT OVERVIEW

- **19%** Identify as Floodplain Manager or Floodplain Administrator
- **21%** Work in FEMA Region 4 (AL, FL, GA, KY, MS, NC, SC, TN)

UNDERSTANDING GRADUATED APPROACH

- **49%** State technical literacy posed many or significant barriers to using graduated flood hazard and risk information
- **28%** 'Extremely' or 'Very' familiar with Risk Rating 2.0

BENEFITS OF GRADUATED APPROACH

- **71%** State that graduated flood hazard and risk data creates a positive impact when preparing for climate change
- **60%** Believe the graduated approach presents 'Somewhat' or 'Great' opportunity for mitigation

CHALLENGES OF GRADUATED APPROACH

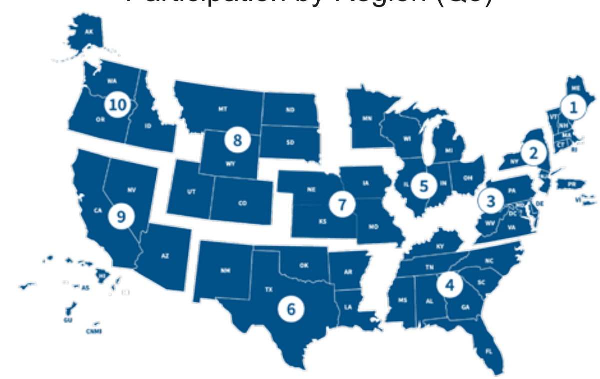
- **73%** Agree that there at least some equity barriers to graduated flood hazard and risk information
- **6%** Of respondents saw no regulatory barriers

FEMA TMAC| RESPONDENT OVERVIEW

The combination of the 2021 surveys sheds light on the most frequent job functions and respondents' geographic coverage.**19%** of respondents serve in floodplain management/administration roles, while **21%** were from FEMA Region 4.

Most Common TMAC Responder's Job Types (Q1)

Participation by Region (Q5)

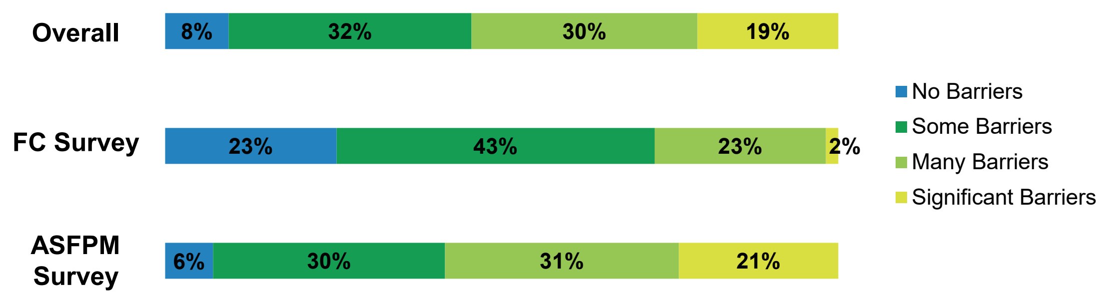


Region	%	Region	%	Region	%	Region	%
1	5	5	18	9	4	N/A	3
2	3	6	4	10	9		
3	5	7	13	&	5		
4	21	8	7	HQ	3		

FEMA TMAC| UNDERSTANDING NEW APPROACHES

For both the graduated approach and Risk Rating 2.0, many respondents report some level of familiarity (e.g. 77%, Q20) but do not feel completely comfortable. Flood Conference Survey participants are significantly more familiar with Risk Rating 2.0.

Respondent attitudes towards technical literacy as a barrier to graduated flood hazard and risk information (Q11)



23% (ASFPM)

have never heard of the Risk Rating 2.0 or are "not at all" familiar (Q20)

17% (FC)

26% (ASFPM)

"very" or "extremely" familiar with the Risk Rating 2.0 (Q20)

45% (FC)

45% (ASFPM)

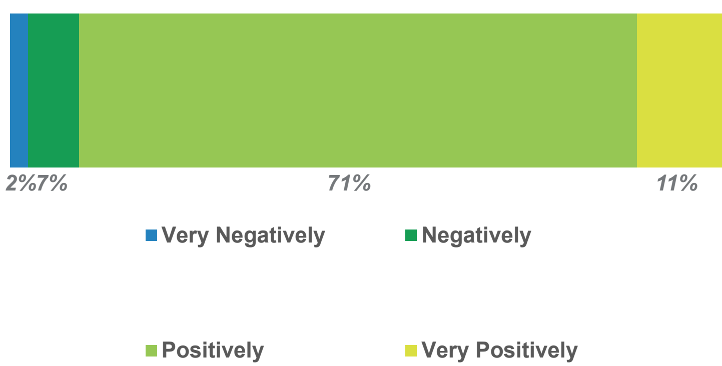
are "comfortable but cautious" in integrating modeled future flood conditions (Q23)

Note: Percentages shown capture the total respondents, including those who did not respond, which are not represented above

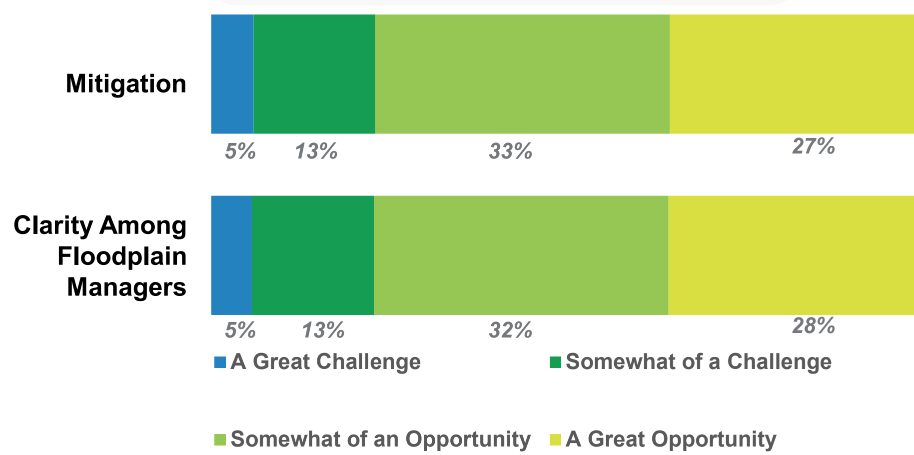
FEMA TMAC| BENEFITS OF GRADUATED APPROACH

Respondents report several major benefits to the graduated approach: improved clarity, flood mitigation, and greater ability to prepare for climate change.

How would graduated flood hazard and risk data help you prepare for climate change, as compared to the current binary approach?(Q16)



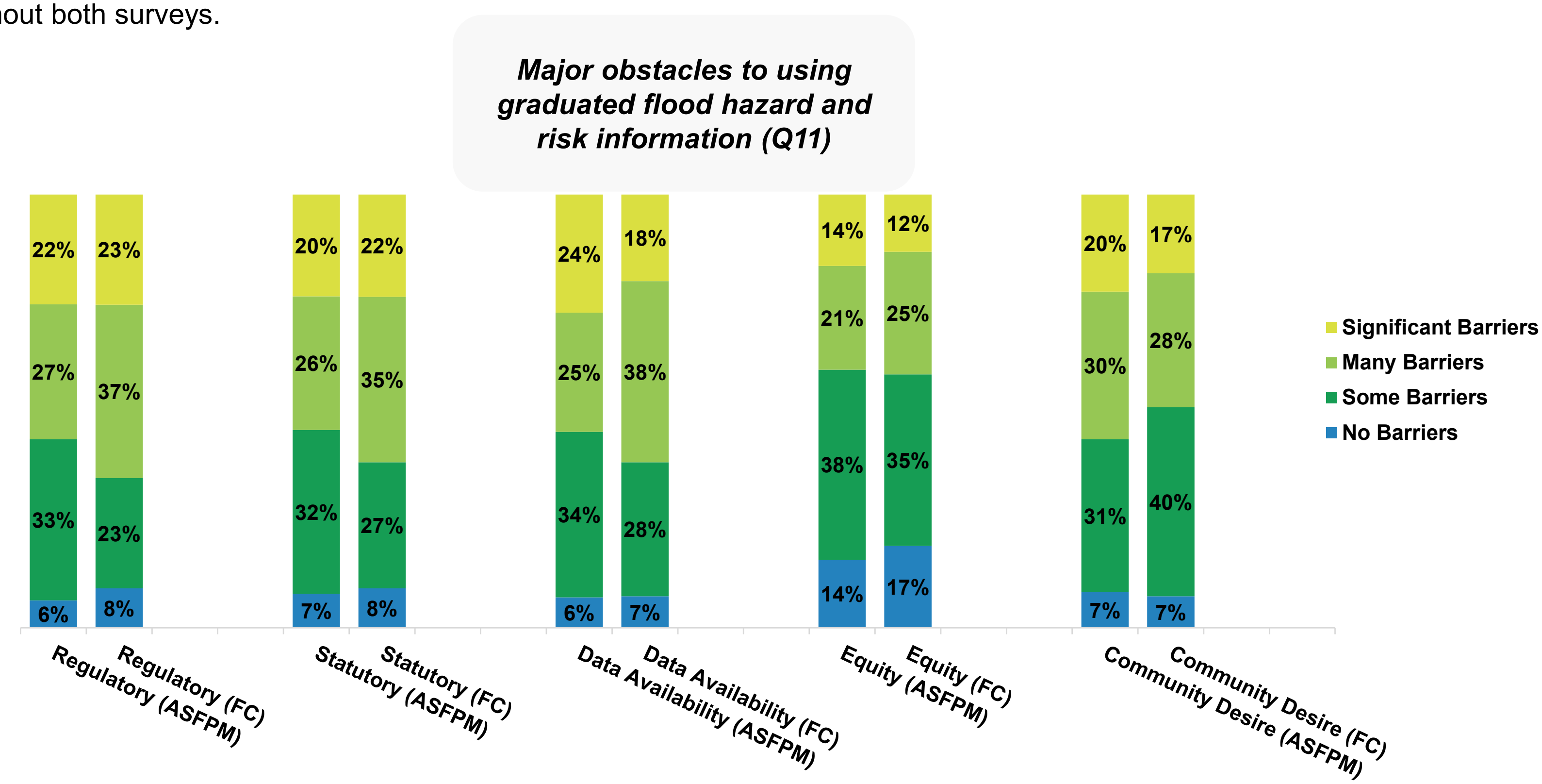
Does graduated flood hazard and risk data present opportunities or challenges as you help your community prepare for climate change in the following areas? (Q17)



Note: Percentages shown capture the total respondents, including those who did not respond, which are not represented above

FEMA TMAC| CHALLENGES OF GRADUATED APPROACH

Respondents are comparatively more concerned about **statutory consistency, data availability** and **regulatory** consistency throughout both surveys.



Note: Percentages shown capture the total respondents, including those who did not respond, which are not represented above

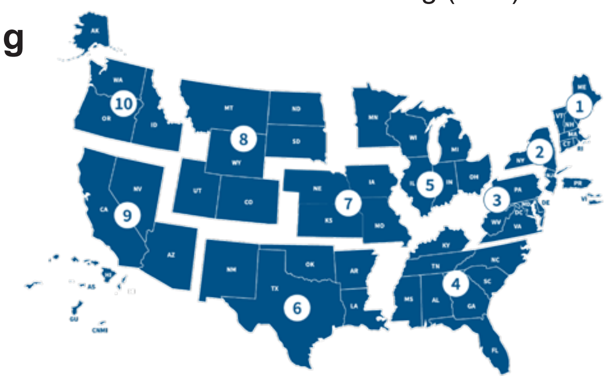
FEMA TMAC| SUB-COMMITTEE QUESTIONS

Results for sub-committees on Future Conditions and ERM reflect potential growth opportunities.

Most respondents (58%) were comfortable integrating information about modeled future flood conditions:

- **11%** very comfortable
- **45%** comfortable but cautious
- **16%** uncomfortable
- **7%** very uncomfortable

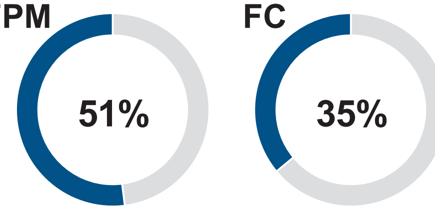
Regional Variation in Respondent Use of Future Flood Forecasting (Q22)



	%		%		%		%
1	42	5	27	9	50	N/A	23
2	25	6	31	10	16		
3	59	7	25	&	50		
4	38	8	26	HQ	45		

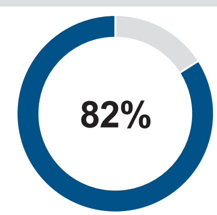
Q24

ASFPM FC



Chose **'Not At All'** when asked "what extent do you employ ERM in your job function as it relates to flood risk management?"

Q25



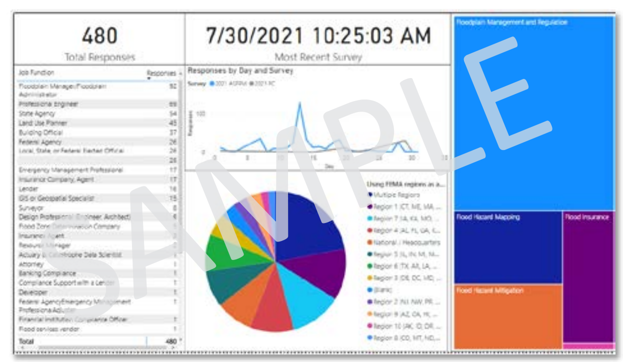
Are interested in increasing their community's use of ERM

FEMA TMAC| FUTURE VISUALIZATION PLANS

As we continue our journey to leverage new and innovative technologies throughout FEMA, we reached a critical juncture where the introduction of **Microsoft Power BI** was needed. We used this platform to develop a **dynamic** dashboard that facilitates stakeholder engagement and drives insights for future decision making.

Needs

- Trend Analysis
- Dynamic Visualizations
- Data Updates
- Analytical Insights



THANK YOU.

Kaitlyn Webster
Katie@rs21.io

Emily Hunt Neilson
Emily@rs21.io

Marc Dion
Marc@rs21.io

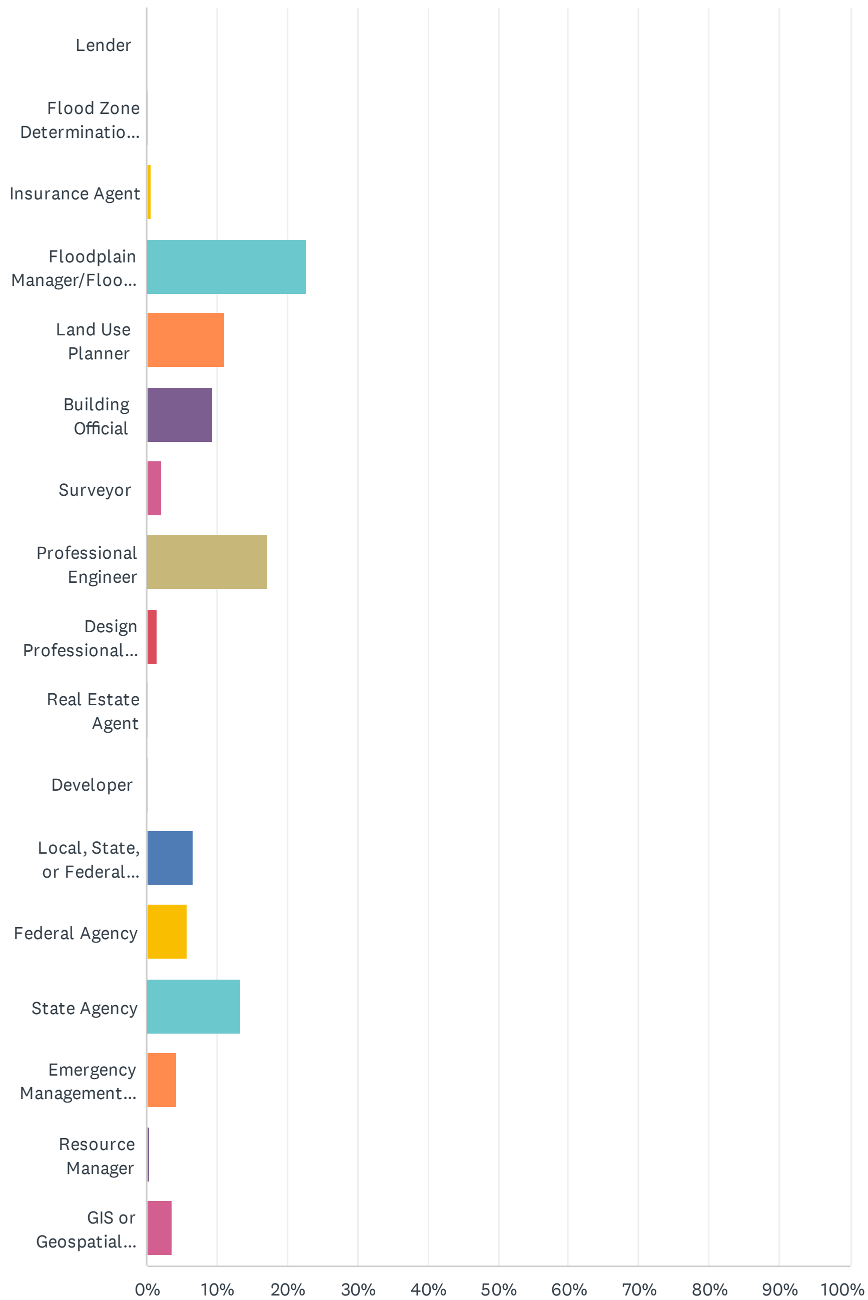
Chris Harley
Chrish@rs21.io

B.3 TMAC FIRST-TIER ASFPM SURVEY AND RESPONSES

2021 TMAC Stakeholder Engagement Survey

Q1 What is your primary job function?

Answered: 404 Skipped: 27



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2021 TMAC Stakeholder Engagement Survey

ANSWER CHOICES	RESPONSES	
Lender	0.00%	0
Flood Zone Determination Company	0.25%	1
Insurance Agent	0.74%	3
Floodplain Manager/Floodplain Administrator	22.77%	92
Land Use Planner	11.14%	45
Building Official	9.41%	38
Surveyor	2.23%	9
Professional Engineer	17.33%	70
Design Professional (Engineer, Architect)	1.49%	6
Real Estate Agent	0.25%	1
Developer	0.25%	1
Local, State, or Federal Elected Official	6.68%	27
Federal Agency	5.69%	23
State Agency	13.37%	54
Emergency Management Professional	4.21%	17
Resource Manager	0.50%	2
GIS or Geospatial Specialist	3.71%	15
TOTAL		404

#	OTHER (PLEASE SPECIFY)	DATE
1	Flood Control Facility Planner	8/31/2021 9:58 AM
2	Non-Profit Policy Specialist	8/23/2021 9:51 AM
3	local government panner	8/5/2021 5:18 AM
4	and professional engineer	7/23/2021 4:10 PM
5	County Engineer	7/22/2021 9:08 AM
6	planning & zoning administrator	7/20/2021 8:30 AM
7	City Administrator	7/19/2021 3:43 PM
8	City Clerk/Treasure	7/19/2021 12:15 PM
9	Chief Building Inspector	7/19/2021 9:03 AM
10	City Clerk	7/17/2021 7:08 AM
11	Town Manager of Rock Hall, MD	7/16/2021 11:19 AM
12	Building Inspector	7/16/2021 8:23 AM
13	agronomist	7/16/2021 7:48 AM
14	Local Government	7/16/2021 5:50 AM
15	Floodplain Admin	7/14/2021 8:03 AM

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2021 TMAC Stakeholder Engagement Survey

16	County-level planning and zoning, not elected	7/13/2021 3:32 PM
17	City Engineer	7/13/2021 3:21 PM
18	Planning & Zoning Administrator	7/13/2021 2:36 PM
19	Floodplain Coordinator	7/13/2021 2:26 PM
20	Mitigation Planner	7/13/2021 2:17 PM
21	City Manager	7/13/2021 7:27 AM
22	City Clerk designated w/ Flood Plain Manager duties	7/13/2021 6:53 AM
23	City Clerk	7/13/2021 6:30 AM
24	Public Works Director	7/13/2021 5:44 AM
25	Code Enforcement Officer	7/12/2021 10:45 AM
26	Floodplain Manager/Planner	7/12/2021 10:39 AM
27	code enforcement officer	7/12/2021 9:45 AM
28	NFIP Trainer	7/12/2021 7:55 AM
29	State Floodplain Administrator	7/9/2021 2:46 PM
30	Natural Hazard Planner	7/9/2021 2:13 PM
31	State NFIP Coordinator/State Floodplain Manager	7/9/2021 2:13 PM
32	Floodplain Administrator	6/2/2021 2:15 PM
33	Floodplain Administer	5/31/2021 5:20 AM
34	City Dir Planning &Engineering	5/28/2021 11:57 AM
35	Hydrologist	5/28/2021 11:10 AM
36	Homeowner in Rocky Ripple	5/28/2021 7:55 AM
37	USDA - NRCS	5/28/2021 7:26 AM
38	Flood Plain Manager	5/28/2021 6:43 AM
39	Jefferson County Indiana Surveyor	5/28/2021 6:15 AM
40	Local Zoning Administrator	5/28/2021 5:09 AM
41	Hazard Mitigation, Resilience Officer, Floodplain Administrator	5/26/2021 7:47 AM
42	State NFIP Coordinator	5/24/2021 9:04 AM
43	Village Administrator	5/19/2021 6:08 PM
44	Permit Review for wetland impacts	5/19/2021 7:34 AM
45	CRS Coordinator	5/18/2021 1:43 PM
46	Floodplain Manager + Architect	5/18/2021 8:44 AM
47	Community Development Director	5/18/2021 6:26 AM
48	Retired	5/18/2021 5:19 AM
49	GISP Specialist	5/18/2021 4:56 AM
50	Town Clerk	5/17/2021 10:59 AM
51	Retired local floodplain manager	5/17/2021 8:32 AM
52	County Administration	5/14/2021 11:49 AM
53	Town Clerk	5/14/2021 9:26 AM

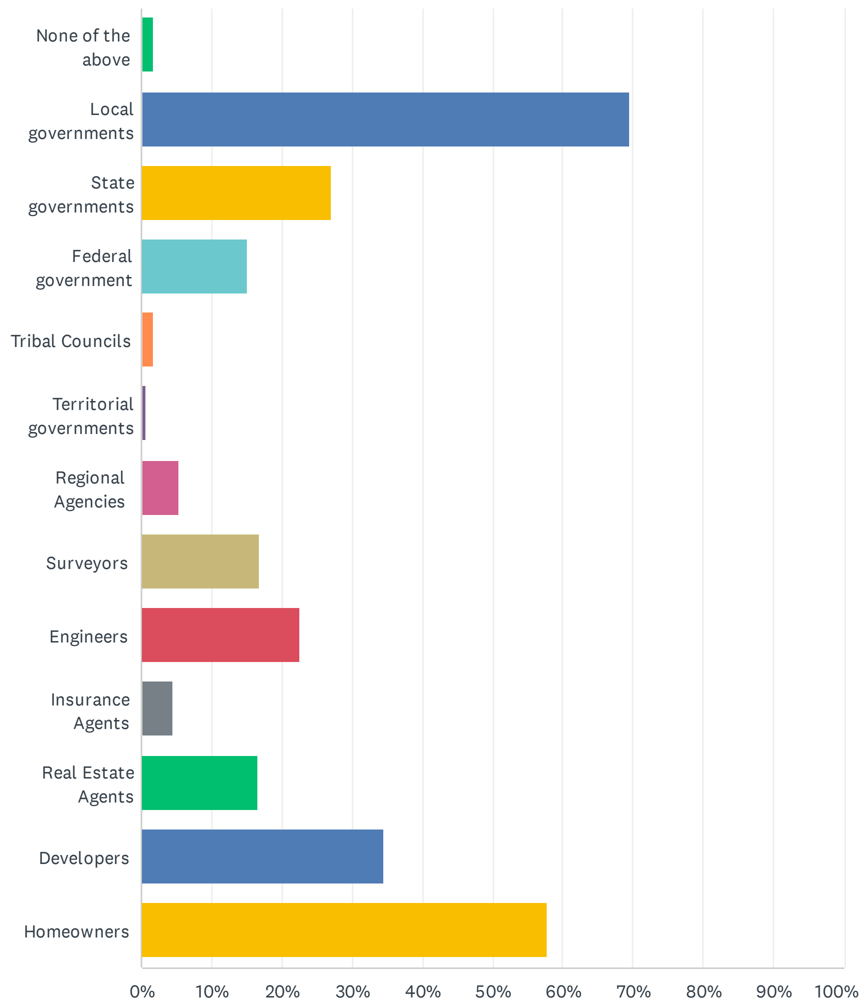
2021 TMAC Stakeholder Engagement Survey

54	City manager supervising water & wastewater utility, roads, planning, and parks	5/14/2021 6:26 AM
55	Resilience Planner	5/13/2021 1:12 PM
56	NFIP/Floodplain Management	5/13/2021 12:42 PM
57	Sustainability Staff	5/13/2021 12:25 PM
58	Public Works Director	5/13/2021 12:00 PM
59	Local Floodplain Manager	5/13/2021 11:34 AM
60	Retired Local Floodplain Administrator	5/13/2021 11:32 AM
61	Assistant Village Manager	5/13/2021 10:57 AM
62	Community Development Director	5/13/2021 10:40 AM
63	Chief Administrative Officer	5/13/2021 10:37 AM
64	Floodplain Administrator	5/13/2021 9:47 AM
65	water resources engineer	5/13/2021 9:17 AM
66	SHMO	5/13/2021 9:10 AM
67	Floodplain Program Analyst, County	5/12/2021 7:19 PM
68	hazard mapping	5/12/2021 8:37 AM
69	Stormwater and Erosion Control (NPDES & MS4)	5/12/2021 6:15 AM
70	Planning and Zoning Coordinator	5/11/2021 8:58 AM
71	university	5/11/2021 6:57 AM
72	Project manager NGO Non Profit	5/10/2021 7:05 PM
73	FPM	5/7/2021 4:17 PM
74	Flood Hazard Mitigation Consultant	5/7/2021 1:49 PM
75	Flood Insurance and Claims Professional	5/7/2021 12:52 PM
76	State	5/7/2021 12:01 PM
77	Delaware county soil and water conservation district	5/7/2021 11:33 AM
78	Floodplain Manager	5/7/2021 11:16 AM
79	Stormwater inspector, CFM	5/7/2021 10:46 AM
80	Data Analyst Contractor for FEMA	5/7/2021 10:37 AM

2021 TMAC Stakeholder Engagement Survey

Q2 In your primary job function, who are the top 3 stakeholders you most often provide products or services for/to? (Select 3)

Answered: 429 Skipped: 2



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2021 TMAC Stakeholder Engagement Survey

ANSWER CHOICES	RESPONSES	
None of the above	1.63%	7
Local governments	69.46%	298
State governments	27.04%	116
Federal government	15.15%	65
Tribal Councils	1.63%	7
Territorial governments	0.70%	3
Regional Agencies	5.36%	23
Surveyors	16.78%	72
Engineers	22.61%	97
Insurance Agents	4.43%	19
Real Estate Agents	16.55%	71
Developers	34.50%	148
Homeowners	57.81%	248
Total Respondents: 429		

#	OTHER (PLEASE SPECIFY)	DATE
1	Congress	8/23/2021 9:51 AM
2	farm producers	7/16/2021 7:48 AM
3	Renters, and Businesses	7/13/2021 6:53 AM
4	Special Districts	7/9/2021 2:13 PM
5	For ourselves	5/19/2021 1:25 PM
6	Contractors	5/18/2021 5:32 PM
7	Engineering consultants	5/18/2021 5:32 AM
8	I work with agricultural landowners	5/16/2021 11:11 AM
9	Elected Officials	5/14/2021 11:49 AM
10	all of the others are also important stakeholders	5/14/2021 6:48 AM
11	Builders	5/13/2021 12:16 PM
12	local sponsors	5/13/2021 9:21 AM
13	other business units within my federal agency	5/13/2021 9:12 AM
14	Residents	5/13/2021 8:55 AM
15	We don't specify products, nor can we recommend, we can provide a list of resources	5/12/2021 6:15 AM
16	All of the above	5/11/2021 6:57 AM
17	Developers	5/7/2021 4:17 PM
18	lenders	5/7/2021 1:12 PM
19	Insurance Carriers (WYOs, NFIP Direct, Others)	5/7/2021 12:52 PM
20	contractors	5/7/2021 11:48 AM

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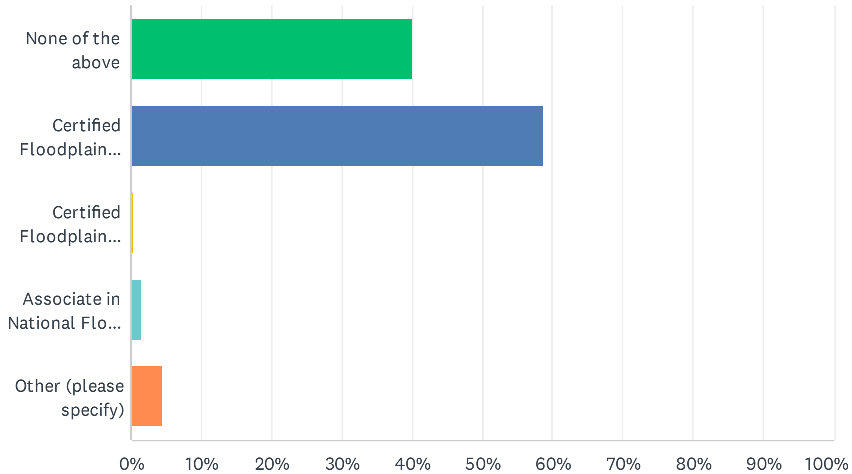
2021 TMAC Stakeholder Engagement Survey

21	Municipality (town supervisor and village mayor)	5/7/2021 11:33 AM
22	Surveyors & Engineers come in a very close 4th place. I review ECs.	5/7/2021 10:37 AM

2021 TMAC Stakeholder Engagement Survey

Q3 Do you currently hold any of the following National Flood Insurance Program-supporting designations? (Select all that apply)

Answered: 418 Skipped: 13



ANSWER CHOICES	RESPONSES	
None of the above	40.19%	168
Certified Floodplain Manager (CFM)	58.61%	245
Certified Floodplain Surveyor (CFS)	0.48%	2
Associate in National Flood Insurance (ANFI)	1.44%	6
Other (please specify)	4.55%	19
Total Respondents: 418		

#	OTHER (PLEASE SPECIFY)	DATE
1	Multiple ICC certifications	7/19/2021 9:03 AM
2	Professional Engineer (emeritus)	7/16/2021 8:28 AM
3	I was a CFM, but County would not pay dues during recession	7/15/2021 10:17 AM
4	AICP	7/12/2021 8:20 AM
5	Director - Planning and Zoning, Jefferson County Indiana	5/28/2021 6:15 AM
6	AICP	5/26/2021 7:47 AM
7	GISP	5/25/2021 6:30 AM
8	Florida Professional Emergency Manager (FPEM)	5/20/2021 5:44 AM
9	PE	5/19/2021 9:02 AM
10	P.E.	5/18/2021 8:04 AM

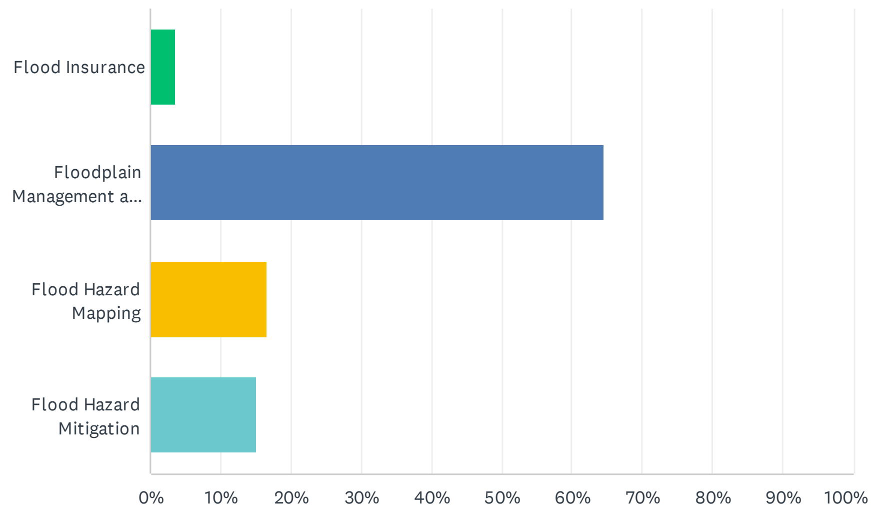
2021 TMAC Stakeholder Engagement Survey

11	Building Official	5/18/2021 6:26 AM
12	American Institute Certified Planners (AICP)	5/13/2021 2:23 PM
13	Professional Engineer	5/13/2021 11:28 AM
14	American Institute of Certified Planners (AICP)	5/13/2021 9:51 AM
15	AICP	5/13/2021 9:16 AM
16	Registered Sanitarian	5/13/2021 9:11 AM
17	Project Management Professional	5/13/2021 9:02 AM
18	On the CFS we are just gaining ground on that in Montana and I guess I am kind of heading up the charge	5/7/2021 4:17 PM
19	Professional Licensed Engineer	5/7/2021 1:10 PM

2021 TMAC Stakeholder Engagement Survey

Q4 Of the four main elements of the National Flood Insurance Program, which element does your professional role most closely align? (Select one)

Answered: 429 Skipped: 2

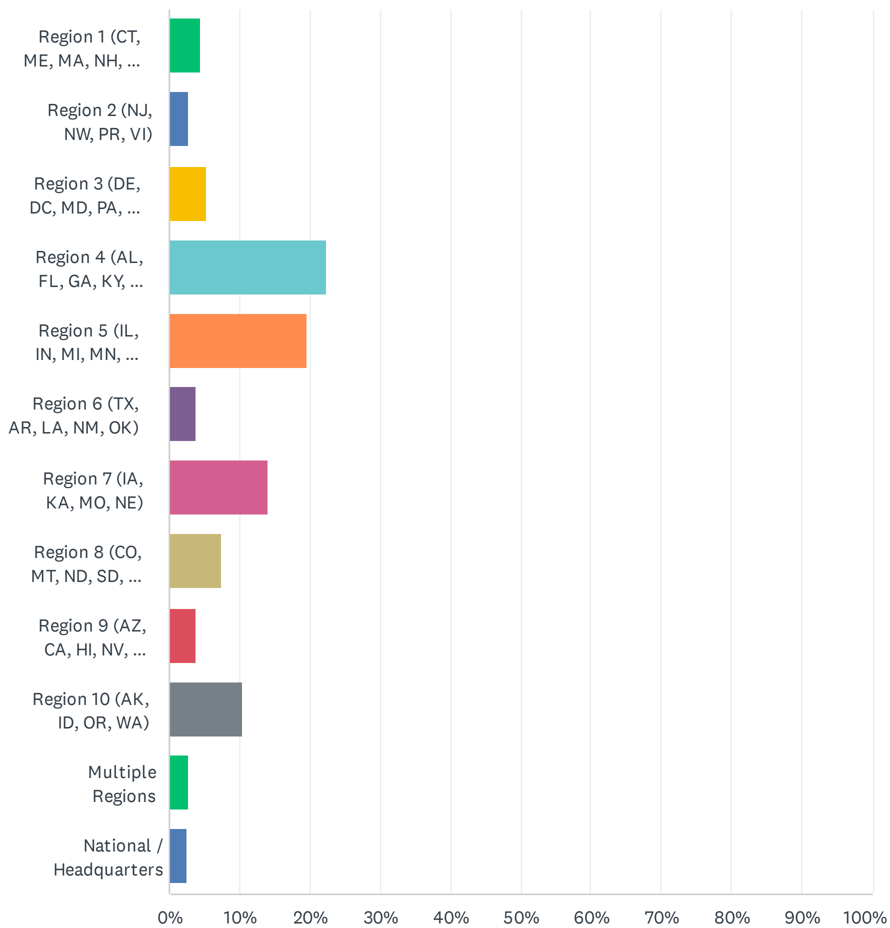


ANSWER CHOICES	RESPONSES	
Flood Insurance	3.73%	16
Floodplain Management and Regulation	64.57%	277
Flood Hazard Mapping	16.55%	71
Flood Hazard Mitigation	15.15%	65
TOTAL		429

2021 TMAC Stakeholder Engagement Survey

Q5 Where do you do most of your work?

Answered: 418 Skipped: 13



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ANSWER CHOICES	RESPONSES	
Region 1 (CT, ME, MA, NH, RI, VT)	4.55%	19
Region 2 (NJ, NW, PR, VI)	2.87%	12
Region 3 (DE, DC, MD, PA, VA, WV)	5.26%	22
Region 4 (AL, FL, GA, KY, MS, NC, SC, TN)	22.49%	94
Region 5 (IL, IN, MI, MN, OH, WI)	19.62%	82
Region 6 (TX, AR, LA, NM, OK)	3.83%	16
Region 7 (IA, KA, MO, NE)	14.11%	59
Region 8 (CO, MT, ND, SD, UT, WY)	7.42%	31
Region 9 (AZ, CA, HI, NV, GU, AS, MP, MH, FM)	3.83%	16
Region 10 (AK, ID, OR, WA)	10.53%	44
Multiple Regions	2.87%	12
National / Headquarters	2.63%	11
TOTAL		418

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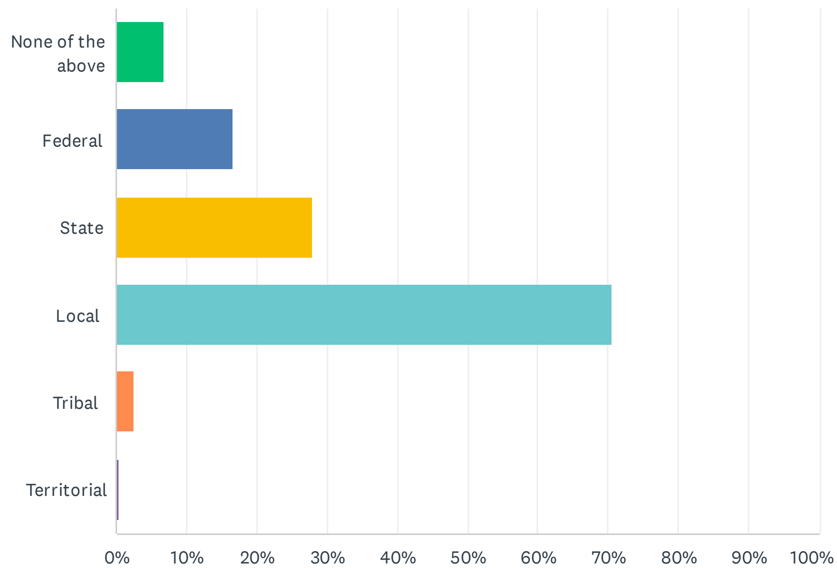
2021 TMAC Stakeholder Engagement Survey

Q6 Which of the following governmental entities do you support or represent?

Answered: 429 Skipped: 2

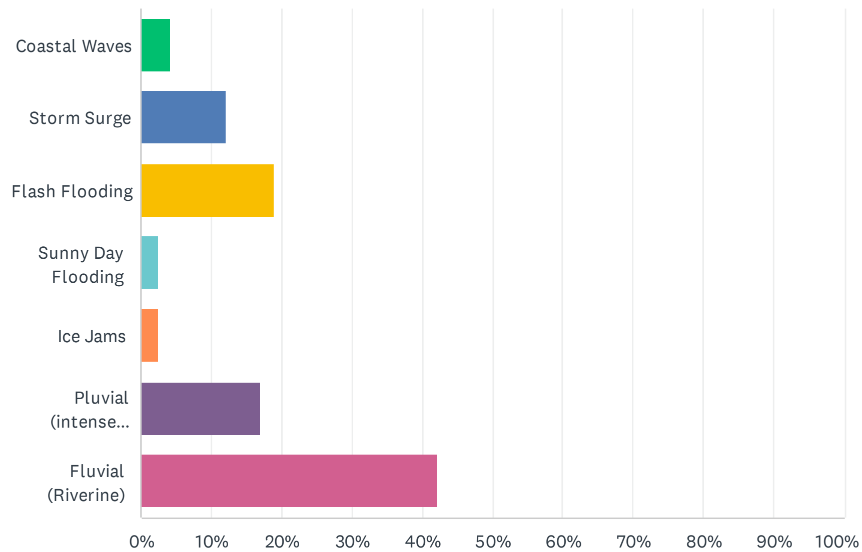


ANSWER CHOICES	RESPONSES	
None of the above	6.76%	29
Federal	16.55%	71
State	27.97%	120
Local	70.63%	303
Tribal	2.56%	11
Territorial	0.47%	2
Total Respondents: 429		

2021 TMAC Stakeholder Engagement Survey

Q7 What would you categorize as the primary source of flood damage that you face in your area of responsibility?

Answered: 420 Skipped: 11



ANSWER CHOICES	RESPONSES	
Coastal Waves	4.29%	18
Storm Surge	12.14%	51
Flash Flooding	19.05%	80
Sunny Day Flooding	2.62%	11
Ice Jams	2.62%	11
Pluvial (intense rainfall)	17.14%	72
Fluvial (Riverine)	42.14%	177
TOTAL		420

#	OTHER (PLEASE SPECIFY)	DATE
1	storm surge in coastal areas	8/23/2021 9:51 AM
2	ice jams	7/16/2021 7:48 AM
3	Fluvial historically but flood after fire (mud slide/flash flood) becoming increasingly more frequent	7/14/2021 2:13 PM
4	Flash Flooding	7/13/2021 7:27 AM
5	storm surge	7/12/2021 10:39 AM

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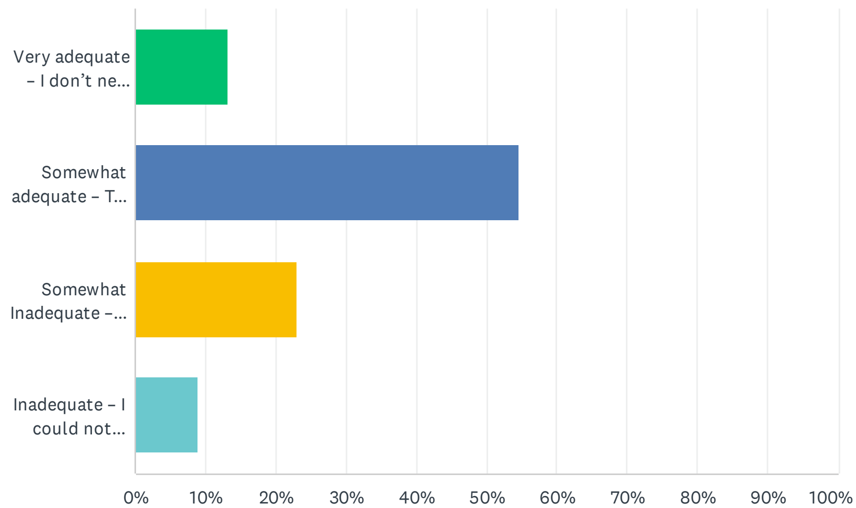
6	Fluvial	7/12/2021 10:09 AM
7	flash flooding	7/12/2021 9:45 AM
8	Flash Flooding	7/12/2021 3:29 AM
9	Pluvial and riverine too	7/10/2021 6:40 AM
10	Pluvial	7/9/2021 2:46 PM
11	Prolonged Rainfall	7/9/2021 2:13 PM
12	don't know	7/9/2021 1:42 PM
13	This is changing to pluvial over time	6/1/2021 4:17 PM
14	Sinkhole/karst	5/28/2021 8:29 AM
15	Riverine, but also work with communities affected by snow melt and runoff through burn scar areas	5/26/2021 7:47 AM
16	Storm surge	5/24/2021 5:38 PM
17	Local storm sewer conveyance issues	5/21/2021 1:34 PM
18	Flash Flooding	5/19/2021 8:58 AM
19	Also Coastal Storm Surge	5/18/2021 7:24 AM
20	All	5/18/2021 5:19 AM
21	Potential Levee failure	5/16/2021 11:11 AM
22	flood following fire	5/13/2021 10:52 AM
23	Post-fire flooding	5/13/2021 9:35 AM
24	Lake flooding, similar but not so quite to coastal	5/13/2021 9:17 AM
25	Flood after fire	5/13/2021 9:16 AM
26	Creeks from the Bay Area	5/13/2021 9:08 AM
27	Nuisance/stormwater flooding	5/13/2021 9:04 AM
28	fluvial & flash flooding	5/12/2021 7:19 PM
29	waves and erosion	5/11/2021 6:57 AM
30	Debris flows	5/9/2021 3:16 PM
31	lake inundation	5/7/2021 1:08 PM
32	wind	5/7/2021 1:04 PM
33	All the above	5/7/2021 12:52 PM
34	Flash floods and ice jams	5/7/2021 11:33 AM
35	We are a national program, so fluvial, pluvial and flash flooding are primary sources as well.ding.	5/7/2021 10:37 AM
36	Both coastal and pluvial	5/7/2021 10:36 AM

2021 TMAC Stakeholder Engagement Survey

Q8 How adequate are the NFIP flood maps (FIRMs, FHBMs, etc.) in helping you manage flood risk?

Answered: 428 Skipped: 3



ANSWER CHOICES	RESPONSES	
Very adequate – I don't need or use any other information	13.32%	57
Somewhat adequate – They are my primary source of information but I sometimes supplement them with other information	54.67%	234
Somewhat Inadequate – They are an important source of information for me but I often have to supplement them with other information so I can do my job effectively	23.13%	99
Inadequate – I could not effectively manage flood risk with that data alone	8.88%	38
TOTAL		428

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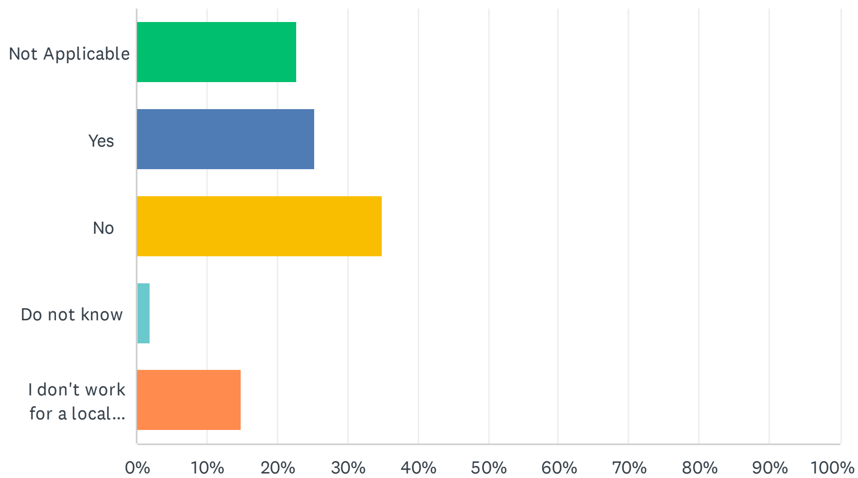
Q9 If you work for a local community, does your community have a full-time, dedicated Floodplain Manager?

Answered: 425 Skipped: 6



ANSWER CHOICES	RESPONSES	
Not Applicable	22.82%	97
Yes	25.41%	108
No	35.06%	149
Do not know	1.88%	8
I don't work for a local community	14.82%	63
TOTAL		425

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Q10 What does graduated risk mean to you, in the context of flood risk management and mitigation?

Answered: 353 Skipped: 78

#	RESPONSES	DATE
1	Not binary	8/31/2021 7:40 PM
2	Variation in severity of potential damage among properties subject to flooding from the same source	8/31/2021 9:58 AM
3	Departing from binary system (in a flood zone or not), it mean risk is communicated in terms that demonstrate flood risk which is applicable and relatable to the public and tailored to my location, incorporating all flood risk factors, including development changes and climate change. Terms that are understandable to the public are number of times they are likely to be flooded over a 30 year mortgage or feet of water their home will be flooded and the frequency it will happen over a time period.	8/23/2021 9:51 AM
4	Accurately nuanced … not the false dichotomy of in/out of a floodplain.	8/16/2021 10:05 AM
5	non-binary supported with non-regulatory products structure specific risk	8/12/2021 8:37 PM
6	A clear/semi-clear gradation from no risk to high risk. Something to consider in design or placement of uses in a design. But like everything nothing is guaranteed.	8/12/2021 6:02 AM
7	One size does NOT fit all	8/5/2021 5:18 AM
8	Level of impact a flood event has on structures located on a parcel.	8/4/2021 1:45 PM
9	Increased more detailed flood risk analysis beyond traditional methods	8/2/2021 12:15 PM
10	a means of discerning and prioritizing management and mitigation dollars	7/30/2021 7:25 AM
11	The risk is higher the closer you are to the flooding source vertically and horizontally.	7/26/2021 12:53 PM
12	I have no idea	7/23/2021 4:10 PM
13	I don't what graduated risk means	7/23/2021 1:48 PM
14	Using outside information such as weather patterns and re-occuring losses to supplement flood maps	7/23/2021 8:13 AM
15	The ability to demonstrate risk in a manner of least risk to most risk.	7/23/2021 7:51 AM
16	Risk beyond mandated requirements	7/22/2021 9:08 AM
17	the closer the proximity to an area that is prone or at risk for flooding, the greater the risk over time with changing/more intense conditions.	7/21/2021 9:21 AM
18	I am not sure. I would guess different levels of risk.	7/20/2021 8:30 AM
19	There are different levels of risk from low to high.	7/19/2021 3:43 PM
20	Risk falls on a continuum, with multiple variables within the continuum.	7/19/2021 1:32 PM
21	the different levels of flood risk from least risk to most extreme	7/19/2021 12:15 PM
22	tiered approach to assessing who is most at risk	7/19/2021 11:26 AM
23	Calculated risk based on a range of variables, rather than simply the nature of the 100-year floodplain.	7/19/2021 9:50 AM
24	A method of technology to apply insurance rates that are fair and accurate.	7/19/2021 9:03 AM
25	I don't know what this means other than maybe risk has been satisfactorily mitigated?	7/19/2021 8:03 AM
26	low risk we can control, medium risk need help, high risk out of our hands	7/19/2021 6:26 AM

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27	Not a concern for me. My work is associated solely with the regulated base flood.	7/19/2021 6:12 AM
28	high risk	7/17/2021 7:08 AM
29	I don't understand this question.	7/16/2021 12:36 PM
30	Site specific probabilistic risk assessment, asset pricing, and litigation planning.	7/16/2021 11:51 AM
31	areas of hazard by priority	7/16/2021 11:19 AM
32	Rather than rating policies on , basically, elevation in the current system, I would speculate that graduated risk accounts for elevation, prior damages and claims, extent of any sustained damages, potential flooding possibilities and sources, value of an asset (house) subject to flood damages.	7/16/2021 8:28 AM
33	Using more resources and data to improve risk levels.	7/16/2021 8:23 AM
34	Opportunity!? Moreover, the pollutants leaking into rivers is liquid gold!?	7/16/2021 7:56 AM
35	means we can have varying degrees of event and damages will vary	7/16/2021 7:48 AM
36	FFRD	7/16/2021 7:01 AM
37	n	7/16/2021 6:54 AM
38	Likely occurrence of loss	7/16/2021 6:21 AM
39	Using a wider array of data to determine risk rather than a binary in or out of the floodplain approach.	7/16/2021 5:50 AM
40	?	7/15/2021 3:22 PM
41	Calculated risk with correlated insurance fee	7/15/2021 2:20 PM
42	More detail and precise flooding data and maps	7/15/2021 1:51 PM
43	More location specific risk information.	7/15/2021 1:38 PM
44	Risk is higher, say in the floodway or directly next to the flooding source, as opposed to the fringe areas where there is still risk, but less	7/15/2021 10:17 AM
45	The level of risk varies based a specific parameter or flood condition, e.g. risk of flooding from a 100-year riverine event versus a flash flood event that occurs in a few hours.	7/15/2021 9:56 AM
46	Ranking risks by relevant facts and potential outcomes.	7/15/2021 9:32 AM
47	Graduated risk would mean instead of the "0" and "1" in terms of floodplain risk (in or out of the floodplain) the approach is to incorporate some risk factors so that it would take a more realistic approach. For example it may consider the distance the property is located from the flooding source to determine he percentage of the risk the property is exposed to.	7/15/2021 8:46 AM
48	More in the floodplain you are, the more likely you are to get flooded?	7/15/2021 8:44 AM
49	That nature does not recognize a line on a map. Flood events come in different shapes and sizes and a changing environment changes the potential extent of a hazard.	7/15/2021 8:27 AM
50	don't know	7/15/2021 8:07 AM
51	To look at risk/impacts associated w/ a range of flood levels or events as opposed to just focusing on the 100-yr flood.	7/15/2021 7:52 AM
52	Everywhere has risk - it's just a matter of how much risk.	7/14/2021 4:36 PM
53	It means identifying and communicating the probability and magnitude of multiple degrees of flooding either by symbolizing the extent and depth of flooding using multiple discrete return frequency "events" or using a continuum to symbolize the relationship between magnitude and probability (perhaps in three dimensions). It might also include the identification and communication of the probability and magnitude of flooding over varying degrees from multiple types of flooding sources, rather than just the source for which the highest magnitude (at one or more probabilities) can be identified.	7/14/2021 2:54 PM
54	unsure	7/14/2021 2:51 PM

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55	Different levels of risk.	7/14/2021 2:51 PM
56	low, moderate, high risk = X, shaded X, A	7/14/2021 2:13 PM
57	impacts from flooding can occur outside of larger presidentially-declared events	7/14/2021 12:23 PM
58	different levels of flood risk	7/14/2021 12:10 PM
59	degrees of reduction in the possibility of when it is going to flood	7/14/2021 11:44 AM
60	provides a more comprehensive picture of the country’s flood hazards and risk by leveraging new technologies to include more efficient, accurate, and consistent flood risk information across the nation.	7/14/2021 9:42 AM
61	Insurance premium increases as potential exposure (vertical & horizontal proximity) to flooding source increases.	7/14/2021 8:03 AM
62	risk - benefit	7/14/2021 7:28 AM
63	nothing. Did it go to college and graduate?	7/14/2021 7:13 AM
64	multiple levels of flood risk	7/14/2021 6:48 AM
65	closer to the source is at greater risk and as you move away from the source, the risk is gradually less	7/14/2021 5:45 AM
66	Have not held the position long enough to lend educated insight.	7/13/2021 3:32 PM
67	Graduated risk assesses more than just in/out of the floodway/plain. It takes into account proximity to water sources, dams and hydro ratings to determine flood risk. The risk is graduated in severity depending on the factors involved.	7/13/2021 3:21 PM
68	It means assigning a varying degree of risk to a development instead of 100% in the floodplain or completely not in the floodplain.	7/13/2021 3:21 PM
69	some buildings are at a greater risk of flood damage than others in the same flood zone	7/13/2021 3:20 PM
70	I have no idea.	7/13/2021 3:19 PM
71	An increasing risk, change in the floodway or floodplain	7/13/2021 3:02 PM
72	There is more risk when land and rivers are not maintained.	7/13/2021 2:36 PM
73	Risk varies under different circumstances.	7/13/2021 2:26 PM
74	looking a multiple variables of flood risk and the extent in which the effect a flood event	7/13/2021 2:05 PM
75	Graduated risk means property specific flood damage risk vs generic FIRM and FIS risk	7/13/2021 2:00 PM
76	Amore nuanced, less black-and-white approach to assessing flood risk.	7/13/2021 1:34 PM
77	measured risk	7/13/2021 1:22 PM
78	Not a lot for my main job. Quite a lot to my county's residents whose home are rezoned to a higher flood risk level	7/13/2021 12:44 PM
79	N/A	7/13/2021 11:36 AM
80	Graduated risk is evaluating risk levels in and around flood zones and determining the potential cost impact that would result from flooding. Doesn't use the traditional line on a paper for the flood limits.	7/13/2021 11:14 AM
81	Graduated risk assessment that distinguishes incremental levels of risk for properties located both “in” and “out” of designated floodplains.	7/13/2021 9:16 AM
82	More risk the closer you are to the source of flooding	7/13/2021 8:54 AM
83	Rather than communicating flood risk as "in or out" , graduated risk provides a gradient of risk, more in line with the probability across all return periods.	7/13/2021 7:45 AM
84	Levels of risk according to elevation, location, flood proofing, etc	7/13/2021 7:27 AM
85	Using past flood events to better determine flood hazards and risks.	7/13/2021 7:13 AM

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86	Risk graduated getting worse	7/13/2021 7:00 AM
87	Different levels of risk from extremely low to extremely high	7/13/2021 6:53 AM
88	Retrofitting existing buildings in flood hazard areas; requiring new and substantially improved structures to be built with lowest floor 1 foot above 0.2% flood elevation; restricting concentrated populations (jails, hospitals, convalescent facilities) from being located in a flood hazard area.	7/13/2021 6:32 AM
89	Unsure	7/13/2021 6:30 AM
90	Factors associated with flooding beyond just the general flood maps.	7/13/2021 6:14 AM
91	closer/lower to source, more flood risk	7/13/2021 6:05 AM
92	Risk by severity of potential damage and likeliness to occur.	7/13/2021 5:20 AM
93	the flood risk is greater the nearer the structure is to the resource.	7/13/2021 4:49 AM
94	A range of potential flood risk.	7/12/2021 10:54 AM
95	Since the details around how FEMA defines graduated risk seem to be vague it's difficult to say what it means to me without a well defined context.	7/12/2021 10:39 AM
96	Looking at more than the binary, in or out, decision of being in a floodplain or SFHA.	7/12/2021 10:09 AM
97	? not sure in terms of management - I thought it was only for insurance.	7/12/2021 9:45 AM
98	Graduated risk means differing levels of the risk of flooding in a particular area, ways to engineer the buildings and building sites to avoid those risks or engineer the site so the risk is mitigated to the greatest practical extent. .	7/12/2021 9:45 AM
99	Looking at flood events that are less or more frequent than the base flood	7/12/2021 9:17 AM
100	the further and higher from the water source, there is generally less risk	7/12/2021 8:48 AM
101	calculating risk based on a number of factors rather than just the line on the map.	7/12/2021 8:42 AM
102	ambiguous term - not able to convey this term to th public	7/12/2021 8:20 AM
103	Different levels of risk based on various attributes (location, weather, use, etc.)	7/12/2021 8:05 AM
104	someone in a 10year floodplain is more at risk than someone in a 50 year floodplain, who is more at risk than someone in a 100 year floodplain, who is more at risk...	7/12/2021 7:55 AM
105	Everyone has a risk, it is used to define your risk in the largest realm.	7/12/2021 7:12 AM
106	It means incorporating the history or a community's flooding events, creating a more comprehensive look at the current and future risks, involving the entire community (public and private), and improving risk communication.	7/12/2021 3:29 AM
107	Managing to the higher State standards and future sea level rise and precipitation projections. There are too many properties at risk Statewide to afford to mitigate them all or protect them. More focus is needed in adaptation and prevention. Buildings built now should reflect projected risks.	7/10/2021 6:40 AM
108	Communication to the public that you are not simply "in" or "out" of the floodplain, everyone has some form of risk	7/9/2021 2:57 PM
109	Graduated risk means be able to determine if you are inches above a floodplain elevation versus a foot or multiple feet above. FEMA's issuance of LOMA-OAS will hopefully stop being issued due to RR 2.0.	7/9/2021 2:46 PM
110	proximity to the known or likely floodway	7/9/2021 2:13 PM
111	Risk is determined by the actual risk related to the property. The risk may be low at one end of the street, but extremely high at the other end. Floods are not constrained by lines on a map.	7/9/2021 2:13 PM
112	triaging risk factors specific to a community or area?	7/9/2021 1:42 PM
113	How much of a risk is there and how bad it may be depending on how far away a structure is, how high the normal water table be, etc.	7/1/2021 9:11 AM

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114	Rather than a binary "in/out" of the SFHA, it considers that there is risk everywhere, with the amount of risk varying based on a number of factors.	6/29/2021 6:19 PM
115	balance of risk vs. cost to mitigate	6/9/2021 2:20 PM
116	I am not familiar with this term or the context in which it is used	6/9/2021 7:48 AM
117	For one thing, using a regulatory additional two feet to the Base Flood of 1% is less risk than just using the base flood.	6/7/2021 11:39 AM
118	if i understand what you have, their current risks, and the types of storms you encounter, then you can guess the probability 7 the consequences, in which case you can better prepare mitigation startagories.	6/3/2021 9:13 AM
119	Risk variation is shown within the calculated flood extent	6/2/2021 2:48 PM
120	A visual method of showing the degree of possible flood risk	6/2/2021 10:09 AM
121	Graduated risk means some properties have a greater chance of flooding than others.... The flood risk depends on many factors.	6/2/2021 7:50 AM
122	I think of it in two ways, gradation of flooding events, and buy down of risk through insurance and mitigation.	6/1/2021 5:01 PM
123	your risk is directly related to distance to a source of flooding, be it a stream, an irrigation ditch, or a stormwater conveyance system.	6/1/2021 4:17 PM
124	Looking forward to see what areas are next in line for flooding.	6/1/2021 3:04 PM
125	Address both frequent/smaller events and rarer/larger events. Address current and climate-changing risks.	6/1/2021 12:33 PM
126	Flood risk that is identified along a continuum as opposed to being in or out of a flood zone.	6/1/2021 7:45 AM
127	impact of different flood depths on structure	6/1/2021 7:31 AM
128	Risk determination based on the location and unique characteristics of a specific asset.	6/1/2021 7:04 AM
129	Graduated Flood Risk would describe Floodway / 1% Floodplain and perhaps the 0.2 percent chance flood in a graduated depiction of elevation. This would be a better way to communicate risk to a landowner and help them prepare. It might also allow for changing climate conditions to be adapted into regulation maps rather than just a binary map.	6/1/2021 6:33 AM
130	calculated risk	6/1/2021 6:03 AM
131	As surroundings change flooding can get more intense.	6/1/2021 5:57 AM
132	It means that properties would be evaluated based on there true risk in regards to the flooding source. Rather than a blanket.	5/31/2021 5:20 AM
133	To me, it means being aware of problems and concerns that have arisen in other communities and learning how they addressed and solved them. Then seeing if some of those same types of problems exist in my area and act proactively to hopefully ward off any major disasters.	5/30/2021 10:46 AM
134	Rating risk	5/29/2021 11:34 AM
135	USING A LONGER TIME PERIOD OR STORM EVENTS TO MAKE BETTER ASSESSMENT OF FLOOD HAZARD POTENTIAL.	5/28/2021 1:16 PM
136	Incremental	5/28/2021 11:57 AM
137	More and better information to assess risks.	5/28/2021 11:47 AM
138	As water rises the cost and damage increase.	5/28/2021 11:14 AM
139	progressive risk associated with the increasing probability of flood inundation	5/28/2021 11:10 AM
140	I am very new to this position. I am a full time EMA Director for 2 years now that was given the additional position as flood plain manager earlier this year.	5/28/2021 6:43 AM
141	The more intense the flood event, the more risk will have to be managed.	5/28/2021 6:20 AM
142	Many factors may influence flood ratings for a specific property or situation.	5/28/2021 6:15 AM

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143	Basing flood insurance rates on mathematical probabilities for flooding.	5/28/2021 5:52 AM
144	I am not sure what it means in this contect.	5/28/2021 5:49 AM
145	Increased risk	5/28/2021 5:46 AM
146	Graduated risk would mean the various levels of possible flooding or flood control measures in a given area.	5/28/2021 5:09 AM
147	As am I just learning this role of Floodplain Administrator, I am not sure	5/28/2021 5:06 AM
148	Taking several factors into account to evaluate flood risk.	5/28/2021 5:04 AM
149	A measured and calculated approach to managing flood risk based on known information.	5/28/2021 4:57 AM
150	risk proportional to exposure	5/28/2021 4:52 AM
151	Not enough experience to answer this question. Floodplain management is a small portion of overall job responsibilities.	5/28/2021 4:39 AM
152	not sure	5/27/2021 4:41 AM
153	It means that the higher the number, the higher the risk.	5/26/2021 8:39 AM
154	In the past cartographic days, it is as a graduated thematic map, which illustrates degrees of change.	5/26/2021 7:47 AM
155	a way to show varying degrees of flood beyond just the 100 year event	5/25/2021 11:32 AM
156	looking ahead for future risks	5/25/2021 7:38 AM
157	hard to explain unless we know all the variables that go into developing a graduated risk index, but is much more effective than the "in or out" context for risk management and mitigation.	5/25/2021 6:30 AM
158	actual risk of flooding and depth of flooding (amount of flood damage)	5/24/2021 10:34 AM
159	That flood risk can be highest at the source of flooding, and then gradually lessened by the distance from the flood source. Of course this doesn't take many other things into consideration, such as elevated structures, stormwater run-off flooding, riverine erosion projections, etc.	5/24/2021 9:04 AM
160	Utilization of other factors such as variability of storm occurrence in lieu of using the simple 1 % occurrence risk.	5/24/2021 7:43 AM
161	risk based on elevation of the structure compared to BFE. The more below the BFE the more risk	5/21/2021 1:34 PM
162	Variation of risk	5/21/2021 4:21 AM
163	There are different levels of risk based on where you live. Risk could generally be differentiated based on flood zones, grading, soils, etc.	5/20/2021 6:45 AM
164	Not sure. In comparison to binary risk, I could only assume this is associated with looking at various sources of data, and their associated VARIOUS options for mitigation.	5/20/2021 5:44 AM
165	a range of risk associated with various flood frequencies to better demonstrate actuarial risk	5/19/2021 10:02 PM
166	Flooding can happen anywhere … it helps to show this to everyone.	5/19/2021 7:02 PM
167	Incremental and various steps towards protection that can help alleviate flood damage of property.	5/19/2021 6:08 PM
168	Risk presented as a continous variable over space as opposed to the discrete zone designations currently used	5/19/2021 5:51 PM
169	Nothing	5/19/2021 1:49 PM
170	Graduated risk means utilizing a greater range of event recurrence and/or storm variability in order to better define flood hazards and associated risk, as opposed to simply evaluating based on the 1% (100yr) risk.	5/19/2021 1:42 PM
171	Preferably the higher the damage risk the lower the potential flood risk and vice versa.	5/19/2021 12:06 PM

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172	able to input specific parameters locally-internally in order to obtain more accurate/relevant results based on data input	5/19/2021 11:06 AM
173	for the same event frequency, changing damage due to differences in depth of flooding.	5/19/2021 10:31 AM
174	The term graduated is vague to me. Setting flood premiums by saying a property is "in" the 100 year floodplain is chaotic since the 100 year event is now more like the 25 year event due to climate change. So folks are not being properly protected. Urban flooding is a different issue, (perhaps storm sewer system related?) that FEMA needs to address.	5/19/2021 9:02 AM
175	Credit for structural improvements and flood protection measures, credit for out of the floodway vs floodplain, shallow floodplain or 50yr+ floodplain vs deep floodplain/floodway	5/19/2021 8:58 AM
176	Identifying risk as the continuum it is rather than a stark 'in or out' of a administratively convenient threshold metric like the 1% annual chance floodplain.	5/19/2021 7:48 AM
177	There are varying degrees of risk, and each structure has its own specific probability of damage. It is not one size fits all.	5/19/2021 7:37 AM
178	It means being able to improve the prioritization of limited resources.	5/19/2021 7:36 AM
179	Risk that is allocated by distance from the flooding source.	5/19/2021 7:36 AM
180	The are certain properties that have a greater likelihood of flooding.	5/19/2021 7:36 AM
181	Having higher or lower flood risk based on the presence of greater or fewer flood risk-related factors, respectively. Also based on the ability to mitigate or minimize flood risk factors.	5/19/2021 7:34 AM
182	It is good.	5/19/2021 7:31 AM
183	The prioritization of risk management and mitigation of flood.	5/18/2021 5:32 PM
184	increased detail/resolution of risk.	5/18/2021 3:52 PM
185	incremental levels of risk	5/18/2021 1:43 PM
186	Increasing or decreasing risk based on multiple influencers	5/18/2021 9:16 AM
187	An incremental level of risk assessment based on varying levels of risk for properties located in and out of designated floodplains.	5/18/2021 8:44 AM
188	Computer modeling	5/18/2021 8:19 AM
189	Allow developers to overcrowd floodplain areas and more claims paid by taxpayers when disaster strikes. Leveraging new technologies to include more efficient, accurate, and consistent flood risk information. More focus for levees right now.	5/18/2021 8:04 AM
190	insurance ratings are dependent on a lot of things other than just being within the SFHA	5/18/2021 7:41 AM
191	scale of risk, persons, property, etc, long-term or widespread	5/18/2021 7:32 AM
192	It means analyzing the risk beyond the 'in/out' of the SFHA. Using other information to show the true level of risk.	5/18/2021 7:24 AM
193	Taking a wholistic look at a structures location in relation to possible flooding sources as well as the elevation of the structure in considering overall risk.	5/18/2021 6:26 AM
194	Risk factor establishment	5/18/2021 5:53 AM
195	More than just in the floodplain or outside the floodplain.	5/18/2021 5:53 AM
196	Varying levels of flood risk beyond low, medium, and high. Taking into account various factors when determining flood risk.	5/18/2021 5:32 AM
197	The ability to identify the particular risk for each property or structure.	5/18/2021 5:19 AM
198	Risk levels based on a location.	5/18/2021 5:09 AM
199	Graduated Risk means the risk in increased or decreased in direct relation to mitigation efforts and detail of conditions.	5/18/2021 4:44 AM
200	To examine the anticipated risk of flood for a specific location or use and evaluate that risk so an actuarial rate for flood insurance may be applied based upon the risk, use, construction and	5/18/2021 4:32 AM

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	other mitigating or aggravating factors	
201	Risk to flooding from multiple severity storm levels	5/17/2021 7:44 PM
202	A more comprehensive approach.	5/17/2021 12:53 PM
203	Requiring less mitigation for the less at risk properties and focusing on the highest risk sites.	5/17/2021 12:16 PM
204	Although a property may be in a SFHA, it doesn't mean it has the same risk as other properties in different areas of the SFHA.	5/17/2021 8:32 AM
205	identifiy, Manage, incidents	5/17/2021 7:10 AM
206	Risk can be "bought" down through specific mitigation activities, but over time can change and can never be completely eliminated.	5/14/2021 6:27 PM
207	Using modeled and actual flood depths and frequency rather than simple binary zonations.	5/14/2021 5:42 PM
208	Local rural and semi-rural floodplain administrators and other relevant professionals will not have the means or time to be adequately trained and and remain skilled in such specialized knowledge.	5/14/2021 2:24 PM
209	the compounding risk of flood throughout a waterway system based on geography and weather patterns throughout the basin over a individual storm even or due to a series of storm events over a short period of time.	5/14/2021 12:15 PM
210	Varying risk based mon many different variables	5/14/2021 11:49 AM
211	Statistics	5/14/2021 11:02 AM
212	I'm unsure.	5/14/2021 9:59 AM
213	My understanding is that it can help us plan for impact at different levels of flooding as opposed to worst-case impact . Currently I don't see any benefit to the graduated risk model.	5/14/2021 9:30 AM
214	Using other statistical methods to reflect a better assessment of probabilities involved in the risk of a flood.	5/14/2021 9:26 AM
215	Risk is a function of hazard, exposure, and vulnerability. Each location, therefore, has unique risk. I believe this survey is really more about graduated hazard, than it is about graduated risk. That is, how the flood hazard changes gradually across the landscape, in terms of depth, velocity, inundation duration, probability of flooding, etc.	5/14/2021 8:20 AM
216	Increased or decreased levels of risk.	5/14/2021 7:26 AM
217	graduated risk is an attempt to provide a more complete picture of risk, and is useful for making FPM and mitigation decisions, but there are limitations also	5/14/2021 6:48 AM
218	a process wherein the flood risk is assessed in more detail and more accurately so we can determine how to better mitigate and protect our communities	5/14/2021 6:46 AM
219	As amount of rain increases, so does our risk of flooding	5/14/2021 6:26 AM
220	using a great range of event recurrence	5/14/2021 5:59 AM
221	Incremental increases in flood risk	5/14/2021 5:54 AM
222	Sea Level Rise and development over time.	5/13/2021 2:42 PM
223	Gradual increase in flooding probability	5/13/2021 2:23 PM
224	graduated would mean risk represented along a spectrum.	5/13/2021 2:22 PM
225	Nothing much except for a buzzword given that graduated flood risk products do not exist writ large.	5/13/2021 2:11 PM
226	Depicting a range of severity, vulnerability, and chance of occurrence of various events	5/13/2021 1:17 PM
227	Ability to understand flood probabilities that take into consideration a broader range of factors.	5/13/2021 1:13 PM
228	a fuller spectrum of risk, no in/out of flood zone	5/13/2021 1:12 PM
229	A proactive approach to reduce the flood risks through better management of hazards and	5/13/2021 1:12 PM

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	removal of risks through mitigation methods.	
230	To me, graduated risk for floodplain management means to take a more comprehensive look at a property's potential for flood, not just in or out of a SFHA. It means looking at the effects of development, covering of permeable area, more comprehensive topographic maps with more than the 100-year flood level shown.	5/13/2021 1:07 PM
231	Graduated Risk means assessing the variety of risk factors with weighted and/or distinctive measures to apply to the specific geography under study.	5/13/2021 1:01 PM
232	the idea of 'Zone X' goes away and information beyond the SFHA on flood risk is made apparent for emergency management, mitigation, floodplain management and insurance decisions	5/13/2021 12:58 PM
233	evaluation of flood risk	5/13/2021 12:50 PM
234	Means taking other factors into account such as Pluvial causes and climate change.	5/13/2021 12:42 PM
235	Recognizing that the regulatory floodplain is a line on a map, not a flood barrier.	5/13/2021 12:25 PM
236	Additional measures taken to mitigate flood damage.	5/13/2021 12:17 PM
237	Involve as many stakeholders as possible and improve the dissemination of information to them for sharing and planning.	5/13/2021 12:00 PM
238	It would be an assessment of the risk for monetary damages at given flood frequency. So, protective measures need to consider governance of that risk, which means some things may be allowable in a floodplain and others are prohibited. If the intent of graduated is climate change, the hydrology data and stream flow history likely have a larger impact than predicting unknowns.	5/13/2021 11:49 AM
239	various levels of risk in coastal zones	5/13/2021 11:34 AM
240	Transitioning from primarily providing the 1% chance floodplain to multiple flood risks to better inform current and expected (future) conditions.	5/13/2021 11:32 AM
241	Risk assessment based on various probable flood events, not just a 1% (100-year) flood, such as risk for any event that breaches a levee or NLF.	5/13/2021 11:28 AM
242	I think it is a great idea for mitigation. I think it's much harder to apply to management.	5/13/2021 11:21 AM
243	Depth grids and future conditions.	5/13/2021 11:17 AM
244	Not much	5/13/2021 11:07 AM
245	an evaluation of flood risk considering reoccuring flooding cycles or events and mitigating factors (improvements) to reduce impacts from floods	5/13/2021 10:57 AM
246	Graduated risk means modeling and communicating risk as a series of discrete probabilities and impact levels rather than as a binary phenomenon.	5/13/2021 10:55 AM
247	Varying mitigation actions translate to varying levels of reduced risk.	5/13/2021 10:52 AM
248	An assessment that looks beyond the FIRM by looking at more granular data to obtain a finer risk analysis assessment.	5/13/2021 10:42 AM
249	There is risk in everything, graduated risk is deciding the severity of the risk.	5/13/2021 10:42 AM
250	Nothing	5/13/2021 10:41 AM
251	Incremental measurement of risk	5/13/2021 10:40 AM
252	More accurate information about potential risk to properties.. The ability to provide better answers to constituents.	5/13/2021 10:37 AM
253	degree of probability, insurance hazard from a specified cause	5/13/2021 10:37 AM
254	graduated map in cartography is merely blurring the hard lines, my guess is this would be the same in graduated risk	5/13/2021 10:23 AM
255	Some sort of phased risk consideration, unfortunately I can find no specific information regarding a definition on the FEMA website. Hmmmm.... hard to answer question if you do not	5/13/2021 10:17 AM

	define what it is.	
256	Determining risk based on the situation.	5/13/2021 10:14 AM
257	The Risk Management Graduation Model is a pathways-based, best practice standard for risk management in the microfinance sector.	5/13/2021 9:53 AM
258	I am unfamiliar with the term	5/13/2021 9:53 AM
259	It means property-specific risk and mitigation, based on individual building conditions present on the site and based on hydraulic risk factors unique to each site.	5/13/2021 9:51 AM
260	I am not sure I've heard the term 'graduated risk'. I would surmise it has to do with all the levels of prevention that my Town has in place to mitigate flooding. And our continued quest to further reduce flooding risk by adopting more stringent requirements on all forms of development.	5/13/2021 9:51 AM
261	The higher development in SFHA the higher risk of flooding and damage to the community.	5/13/2021 9:50 AM
262	Graduated risk means utilizing a greater range of event recurrence and/or storm variability in order to better define flood hazards and associated risk, as opposed to simply evaluating based on the 1% (100yr) risk.	5/13/2021 9:47 AM
263	It represents what my flood risk is for different time return intervals at a particular location - it can also give me what my probability of being flooded is under these frequencies. Based on this info, I could then mitigate my risk by taking structurally or non-structurally measures. Communities can then be equipped with information that can be used to regulate development accordingly.	5/13/2021 9:42 AM
264	Risk and resilliance	5/13/2021 9:42 AM
265	The degree of flooding risk a property may have. Not just in or out.	5/13/2021 9:42 AM
266	risk varies based on location, local circumstance and structure build condition/mitigation	5/13/2021 9:36 AM
267	Increased risk over a period of time. (Not sure of context of this and more info is needed to fully understand)	5/13/2021 9:36 AM
268	Incremental levels of risk based on actual elevation in relation to BFE.	5/13/2021 9:35 AM
269	Acurate risk communication. People who own property 0.10 feet above the BFE do not see the need for insurance. In/our scenario is a false predictor for mother nature’s true risk.	5/13/2021 9:34 AM
270	In terms of flood risk, graduated risk is related to distance from flooding source.	5/13/2021 9:34 AM
271	Sounds more applicable than "in" or "out" of the floodplain	5/13/2021 9:29 AM
272	don't know, never heard the term before	5/13/2021 9:22 AM
273	Conveying the full range of flood risks to our partners/stakeholders. Debunking the concept of "flood protection".	5/13/2021 9:21 AM
274	This term has not been discussed with me or brought to my attention. I would assume that graduated risk means elevated risk in term of future risks.	5/13/2021 9:17 AM
275	graduated risk means having a more defined picture of the more frequent flooding events. Although, the effect that graduated risk definitions on insurance cost and mitigation measures is unclear.	5/13/2021 9:17 AM
276	risk increases over time	5/13/2021 9:16 AM
277	Technically accurate modelling, maps, and reasonable regulatory requirements based on regional conditions (topo, precipitation, soils).	5/13/2021 9:16 AM
278	Problems are solved	5/13/2021 9:15 AM
279	I don't know - I have not heard that term before.	5/13/2021 9:12 AM
280	Risk from climate fluctuations and changing conditions to RR 2.0 disengaging insurance from mitigation, mapping, and regulatory requirements. It is a perfect storm for increased risk as property owners are inundated with to much information that is often at odds with the other. Or risk information that is not being released. Flood Risk Management and mitigation will be lost	5/13/2021 9:12 AM

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	at sea trying to navigate these rough waters. Increased violations and development in high risk areas will increase because of this.	
281	Risk that is not limited to the 1% floodplain.	5/13/2021 9:11 AM
282	Cannot answer	5/13/2021 9:11 AM
283	Not sure in what context you are speaking but I'm thinking that you are asking and what I would determine in my shoes are where structures sit in reference to floodway, surge, LIMWA zones when looking at a map for higher risk zones.	5/13/2021 9:10 AM
284	The risk changes based on the proximity to the hazard source, and external factors that are related to lessen and or mitigating it.	5/13/2021 9:09 AM
285	Not sure	5/13/2021 9:08 AM
286	none	5/13/2021 9:07 AM
287	An opportunity but also a communication challenge	5/13/2021 9:06 AM
288	What City willing to spend to limit risk	5/13/2021 9:06 AM
289	Measurable risk considerations	5/13/2021 9:05 AM
290	It means that risk increases gradually with things like water depth, velocity, wind/waves, and with the vulnerability of the people or property that are exposed to flooding. I.e., risk would increase with a structure slab on grade, or with a low income person, elderly person, people of color, etc.	5/13/2021 9:04 AM
291	A more complete profile of flood risk information to enable more sound decision making.	5/13/2021 9:04 AM
292	Risk in stages. Misapplied in Flood Risk as we deliberately leave out a majority of the flood risk area by our statistical mean.	5/13/2021 9:02 AM
293	Level of risk	5/13/2021 9:02 AM
294	not in or out	5/13/2021 9:01 AM
295	?	5/13/2021 8:55 AM
296	Relying on a gradient of flood risk rather than a single in-out line	5/13/2021 7:23 AM
297	It means I'll still be trying to explain why someone's neighbor doesn't need to carry flood insurance. I haven't seen examples of what it could mean for mitigation.	5/12/2021 7:19 PM
298	Risks will increase if not addressed or mitigated, managed retreat may be last resort.	5/12/2021 8:37 AM
299	Providing more information related to flood risk. Changing the conversation from being "in" the floodplain or "out" of the floodplain to truly educating residents on flood risk and the fact that everyone can experience flooding to some degree. This also provides more opportunities to discuss avenues to reduce flood risk by making informed decisions on where development occurs in communities. The data is no longer a "line on a map" so to speak.	5/12/2021 6:17 AM
300	categories based on different levels and types of risk	5/12/2021 6:15 AM
301	Probabilistic analysis-not just one number, and taking more into account what actually has happened (Gage data) and what will happen with climate.	5/12/2021 6:14 AM
302	a superior product that unlocks new applications	5/12/2021 6:09 AM
303	having an understanding of the increase in risk level for various flood frequency events and applying that knowledge to target key areas for the most beneficial regulations and actions	5/11/2021 9:38 PM
304	Improving our ability to communicate that "flood-prone" does not mean "one solution fits all". Graduated data will help us make important distinctions in flood hazards and risks within a community, and where higher standards or more customized management/mitigation strategies may be of greatest consequence.	5/11/2021 1:25 PM
305	Providing more of a range of risks instead of binary risks in discreet flood zones.	5/11/2021 1:14 PM
306	Varying levels of risk.	5/11/2021 9:37 AM
307	Regulatory floodway is not correctly mapped in some areas, hopeful that the graduated risk will	5/11/2021 8:58 AM

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	improve mapping.	
308	It means a lot of people who are at very low risk will now be forced to buy flood insurance and will be very unhappy at me for it.	5/11/2021 8:46 AM
309	Flood zones, including 500-year and higher return periods	5/11/2021 6:57 AM
310	A group of structures may be in the floodplain, but some will flood more often than the others.	5/11/2021 6:48 AM
311	Having different levels risk predicted future events.	5/11/2021 6:30 AM
312	Risk identified at individual structure or building through a probabilistic approach	5/11/2021 6:02 AM
313	A graduated risk approach uses probabilistic flood modeling rather than the deterministic method used historically. It takes into account future uncertainty, climate change, and multiple flooding sources.	5/11/2021 5:55 AM
314	A more accurate flood risk assessment based on actual flood elevations and distance from the flood source not just a line on a map where a property is either at high risk or not at high risk of flooding.	5/10/2021 7:05 PM
315	Estimating flood risk based on a scale of potential impacts based on location and proximity to various flood hazards, rather than a binary "in or out" of a flood risk area.	5/10/2021 1:41 PM
316	Risk defined more a more nuanced way than in or out.	5/10/2021 11:26 AM
317	changes in risk over timescales (e.g. sea level rise) or differing risk based on probabilities (e.g. 1% annual chance vs. 0.2% annual chance)	5/10/2021 9:45 AM
318	Varying risk depending on other variables/circumstances. Risk that changes	5/10/2021 8:39 AM
319	Addressing immediate risks while planning for future risk	5/10/2021 7:47 AM
320	Right now risk is characterized in black and white. You are either in a flood zone or you're not. Graduated risk shows the intricacies and nuances of flood risk and that there is plenty of grey area.	5/10/2021 6:26 AM
321	Code of Federal Regulations provides no means of managing infrastructure to graduated risk, or the requirements beyond anything outside the base flood	5/9/2021 3:16 PM
322	Flood risk and mitigation is on a ramp up and down scale in cause and effect.	5/9/2021 9:23 AM
323	There is no "in or out" of a hazard and there is no "safe" from flooding, there is a spectrum of risk that increases with flood depths, velocity, frequency, proximity, construction methods and under insured.	5/8/2021 6:58 AM
324	Developing methods that include dynamics and sustainability and differ from binary models	5/7/2021 4:17 PM
325	elevated risk with increasing SLR and storm return intervals	5/7/2021 2:02 PM
326	Graduated Risk is the inclusion of more advanced data-driven, holistic, risk-based, dynamic models in identifying flood hazards and mitigation measures.	5/7/2021 1:49 PM
327	That their is a higher flood risk associated with living nearer to a source of flooding and that necessary measures must be taken to adequately plan for threats of flooding and other hazards.	5/7/2021 1:17 PM
328	Increased risk over a period of time and how best to communicate that risk in a constantly changing climate	5/7/2021 1:13 PM
329	There are varying degrees of flood risk to property and humans based on the type of structure, the condition of a structure, the location of the structure in proximity (lateral and vertical) to the floodplain (flooding source), and depth of water for various types of flood events (10-year, 25-year, 100-year, etc.) at the structure.	5/7/2021 1:10 PM
330	it's not a question of in/out of a flood risk zone, but more of an overall susceptibility to risk levels and frequencies	5/7/2021 1:08 PM
331	unfamiliar termThi	5/7/2021 1:04 PM
332	Greater the exposure to flooding, the greater the risk.	5/7/2021 12:59 PM

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333	It means that every location has some degree of risk for flooding. It's not simply In/Out or Yes/No. On a graduated scale of 1 - 100, there are properties at every point on the scale.	5/7/2021 12:52 PM
334	Different levels of flooding In community	5/7/2021 12:47 PM
335	a better understanding of the degree of risk at any given location	5/7/2021 12:39 PM
336	a raster or pixelated representation of the probability and consequences/costs of rare flood events distributed over a region.	5/7/2021 12:33 PM
337	Using wider range of events to determine risk	5/7/2021 12:13 PM
338	for regulatory, it has little effect, but for risk management, it helps understand mitigation efforts.	5/7/2021 12:04 PM
339	Structures close to the mapped floodplain could still be at risk as elevation above the base flood is not reflected on the map	5/7/2021 12:01 PM
340	that the risk is real and is happening, just over a long time frame	5/7/2021 11:48 AM
341	Climate change is affecting the risk we are displaying on the maps.	5/7/2021 11:41 AM
342	A range of risk that helps the community to better understand floodplain management through mitigation efforts.	5/7/2021 11:33 AM
343	That all areas of the floodplain do not carry the same risk. That we will have a tool to help people understand that just because they are a few feet beyond the boundary shown on the FIRM does not meant there is no risk.	5/7/2021 11:16 AM
344	A risk that respects and accounts for the spacial context and proximity to all sources of risk.	5/7/2021 11:15 AM
345	An objective means of comparing relative hazard potentials as opposed to a binary choice of high hazard and low hazard.	5/7/2021 11:09 AM
346	The concept that risk varies over space. In a linear sense this could be distance from the flood source. The concept of the 100-year flood lends itself to a black or white sense of risk which is unrealistic. You're either at risk or not at risk. In reality we are all at risk, just different levels of risk relative to the flood source.	5/7/2021 10:47 AM
347	A scale based on % chance of occurrence. Detailed risk data which makes risk personal and readily accessible (depth grids etc.)	5/7/2021 10:46 AM
348	Flood risk is increasing since claymate changes	5/7/2021 10:45 AM
349	Determining the level of management and mitigation based on a risk analysis.	5/7/2021 10:42 AM
350	Applying regulations and requirements intelligently, evaluating cost/benefit to ensure that public health and safety are adequately protected but at reasonable expense.	5/7/2021 10:42 AM
351	Graduated risk means the varying levels of risk a property owner could face depending on proximity to flooding source, land contours, geographics, building elevation and construction type, and how well the property is protected from flooding.	5/7/2021 10:37 AM
352	Increased risk over time	5/7/2021 10:36 AM
353	It would provide more information about the various risk levels, as opposed to a binary "in the floodplain"/"not in the floodplain" classification. It would greatly improve hazard messaging and potential even warnings for flood events.	5/7/2021 10:25 AM

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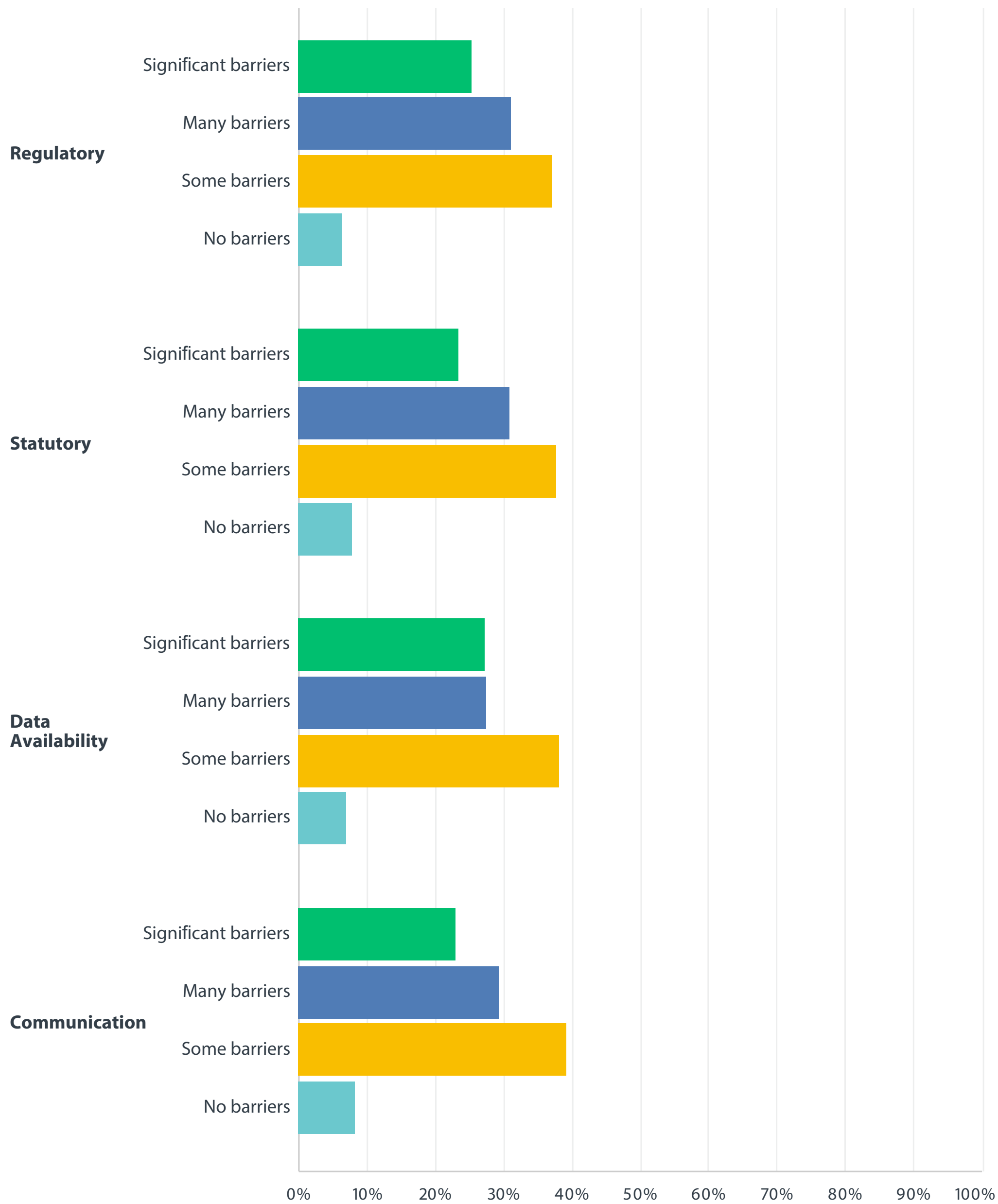
Q11 Select the kinds of obstacles that exist as barriers to using graduated flood hazard and risk information by identifying the magnitude of the barrier.

Answered: 387 Skipped: 44



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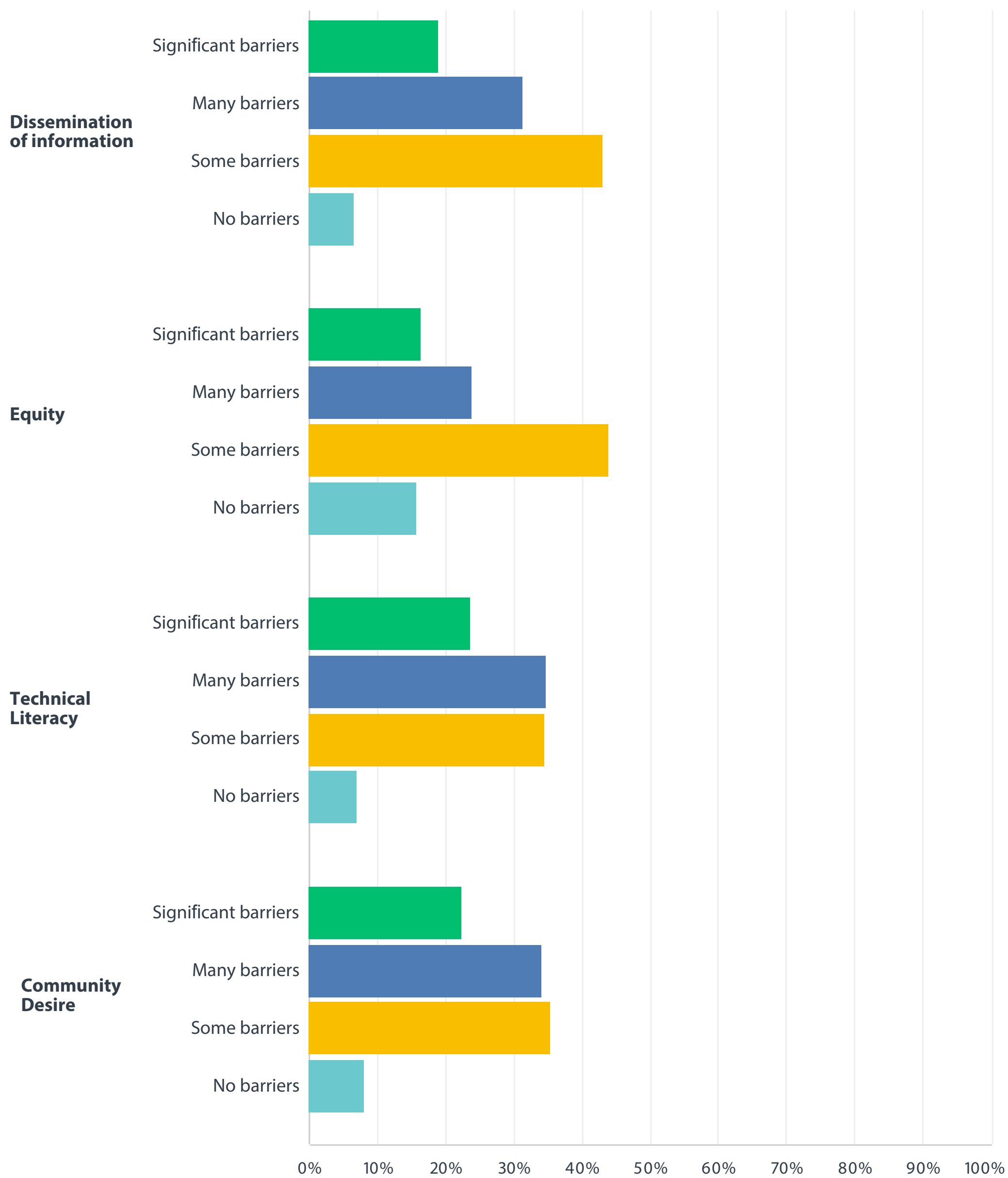
Q11 (continued)



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	SIGNIFICANT BARRIERS	MANY BARRIERS	SOME BARRIERS	NO BARRIERS EXIST	TOTAL	WEIGHTED AVERAGE
Regulatory	25.33% 96	31.13% 118	37.20% 141	6.33% 24	379	2.25
Statutory	23.51% 87	30.81% 114	37.84% 140	7.84% 29	370	2.30
Data Availability	27.27% 105	27.53% 106	38.18% 147	7.01% 27	385	2.25
Communication	23.08% 87	29.44% 111	39.26% 148	8.22% 31	377	2.33
Dissemination of information	19.00% 72	31.40% 119	43.01% 163	6.60% 25	379	2.37
Equity	16.49% 62	23.94% 90	43.88% 165	15.69% 59	376	2.59
Technical literacy	23.68% 90	34.74% 132	34.47% 131	7.11% 27	380	2.25
Community desire	22.43% 85	34.04% 129	35.36% 134	8.18% 31	379	2.29

#	OTHER (PLEASE SPECIFY)	DATE
1	Adequacy of any identifiable, comprehensible menu of mitigation measures to address a multiplicity of magnitudes and sources of flooding.	7/14/2021 2:54 PM
2	Finances to update data	7/14/2021 2:51 PM
3	I'm not sure	7/14/2021 9:42 AM
4	you need to clearly define "graduated risk" before asking this Q	7/14/2021 8:03 AM
5	Don't know what you mean by graduated flood	7/14/2021 7:13 AM
6	I question whether the graduated risk provided to my residents are accurate.	7/13/2021 12:44 PM
7	Availability of depth grid maps or flood risk maps	7/12/2021 7:55 AM
8	FEMAs lack of will to fund prevention activities under CAP and CTP and to get tough with non compliant CRS communities by Region 2 management. Too much emphasis is given to HMP with no resources given to day to day management at the municipal level.	7/10/2021 6:40 AM
9	I cannot respond to this question as I am not familiar with graduated flood hazard risk	6/9/2021 7:48 AM
10	I am still learning all of this, and lost in part of this at this time.	5/28/2021 6:43 AM
11	Cost of Flood Insurance and Mitigation	5/28/2021 6:15 AM
12	Not sure what you are seeking specifically above.	5/28/2021 5:09 AM
13	I cannot adequately answer the above as I am new to this position	5/28/2021 5:06 AM
14	The concept is overdue with respect to the identification of risks, but it is difficult to integrate with ridge local flood-damage control regulations.	5/26/2021 7:47 AM
15	Levees are private and resource agencies create substantial barriers to management.	5/16/2021 11:11 AM
16	Funding or even interest in such programs.	5/14/2021 2:24 PM
17	Unsure	5/14/2021 9:59 AM
18	Community desire is based on community understanding or the lack thereof	5/14/2021 6:46 AM
19	Largest barrier is time. Small communities don't have the personnel to divide duties, thus burdening 1 person beyond what is reasonable to provide accurate coverage.	5/13/2021 1:12 PM

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20	I'm not sure.	5/13/2021 12:00 PM
21	Education and outreach is important as few know what they need to.	5/13/2021 11:49 AM
22	Community capacity and political will.....desire was the wrong question.	5/13/2021 10:52 AM
23	lack of state funding for risk communications	5/13/2021 9:29 AM
24	Communities can not regulate without accurate and transparent information. They have to be able to legally defend their decisions not just say it is a good idea because. They need significant legal adoption process for graduated hazard and risk information.	5/13/2021 9:12 AM
25	Having a 1/10 of the NFIP participating incorporated communities in the NFIP program - staffing needs to administer.	5/13/2021 9:10 AM
26	not applicable	5/13/2021 9:07 AM
27	inertia	5/12/2021 7:19 PM
28	old habits die hard.	5/12/2021 8:37 AM
29	We need better mapping for our diverse coastline.	5/11/2021 1:14 PM
30	Consistency of information portrayal - many barriers	5/7/2021 1:13 PM
31	This does not have meaning at the local level	5/7/2021 1:04 PM

Q12 Do you have specific recommendations for how to enhance the use of graduated flood hazard and risk data?

Answered: 203 Skipped: 228

#	RESPONSES	DATE
1	Explain the process of graduated flood hazard and risk data and its relation to FIRM	8/31/2021 7:40 PM
2	Clear explanation of analysis/resulting data, less reliance on hand-holding of property owners by local officials, accessible mapping technology	8/31/2021 9:58 AM
3	It has to be legal change right? The first street foundation stuff is great so, if possible, maybe just use that? Either give FEMA the resources and ability to be successful or get them out of the business. Don't require mediocrity.	8/16/2021 10:05 AM
4	No.	8/12/2021 6:02 AM
5	Accurate mapping is the primary basis for determinizing the flood impacts. Predicting the amount of damage cannot be performed until accurate mapping is coupled with event simulation of a flood event.	8/4/2021 1:45 PM
6	Change the CFR to increase the regulatory standard	8/2/2021 12:15 PM
7	insurance incentives for voluntary efforts	7/30/2021 7:25 AM
8	Make the process go faster	7/19/2021 11:26 AM
9	History of events	7/19/2021 9:03 AM
10	not at this time	7/19/2021 6:26 AM
11	No.	7/19/2021 6:12 AM
12	N/A	7/17/2021 7:08 AM
13	FEMA would develop a clear definition of the process and share it with all parties concerned, eg; flood administrators, insurance agencies, homeowners. In effect all concerned parties would have the same information base. Currently some FEMA info is for flood administrators, some for insurance agents--but the requirements and needs of each of these is different.	7/16/2021 8:28 AM
14	A focus point to kill as many birds as possible with a sideways dam that runs a Green Energy Water Park, USA!?	7/16/2021 7:56 AM
15	NONE	7/16/2021 7:01 AM
16	none	7/16/2021 6:54 AM
17	Communication and education for elected officials and the public.	7/16/2021 5:50 AM
18	latest technology should be used to gather LIDAR data.	7/15/2021 1:51 PM
19	In Hazard Mitigation Planning, or in the local Flood Management Plan (if appicable),	7/15/2021 10:17 AM
20	Not at this time.	7/15/2021 9:56 AM
21	No	7/15/2021 9:32 AM
22	I would assume community outreach would play a significant part. The same way FEMA went from using the 100- year flood to 1% chance of exceedance, community education on graduated flood hazard would be crucial.	7/15/2021 8:46 AM
23	There needs to be some reasonable balance between increasing the supply of information about different types (sources, magnitudes, probabilities) of flooding and the possible mitigation measures that any party (individuals, communities, states, regional organizations, federal government) could possibly take in response. More information can lead to a failure to focus efforts on solving *any* problems because there is so much information showing that	7/14/2021 2:54 PM

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	there are so many problems--all of them are too serious to be dismissed--yet all competing for attention so that none of them can be addressed.	
24	We are lucky to receive lots of education in our area and have a state coordinator available to answer questions.	7/14/2021 2:51 PM
25	expedite mapping efforts so that risk is more accurate (not outdated by the time it arrives), ensure it's available digitally and in way that is accessible for many users from many different backgrounds	7/14/2021 2:13 PM
26	less focus on the 1% annual chance	7/14/2021 12:23 PM
27	Consistent information - availability and presentation	7/14/2021 12:10 PM
28	no	7/14/2021 11:44 AM
29	Seems like you need to use a formula to calculate individual property risk, including factors like: (in/out 100 year f.p.), proximity to flood source, statistical CLIMATE HISTORY including HURRICANES (why does my riverine community floodplain protected by 3 in-series dams look the same as New Orleans? 0 paid claims on record! Stop using us as a subsidy for SE USA!), statistical history of flooding in community, etc. Remove manmade/highly managed/manipulated agricultural drains from flood maps. They cannot be operated/"administered" in the same manner as a natural river/stream. I cant stress enough - examine climate history! People who live in hurricane areas should have to pay $ for their decision!	7/14/2021 8:03 AM
30	no	7/14/2021 7:13 AM
31	No	7/13/2021 3:21 PM
32	I am the Community Development Director for my city and also serve as the community's floodplain manager (although we contract with an engineer for technical review of no rise certifications). I obtained CFM certification in 2017. I am not familiar with graduated risk.	7/13/2021 3:19 PM
33	Maps/data are the foundation of floodplain management. When they are woefully out of date (our community's FIRM's are dated 1983) the foundation isn't just cracked, it's falling apart. Use of the product will be enhanced if you produce an accurate, user friendly product in a timely fashion. Make it readily available to everyone listed in question #2.	7/13/2021 2:26 PM
34	More Local control and less Federal heavy handed control	7/13/2021 2:00 PM
35	extend the flood hazard studies into areas left out in prior studies and mapping	7/13/2021 1:22 PM
36	FEMA needs to do a better job of modelling flood areas in a more detailed manner. It does not do much good to produce proposed maps with known errors.	7/13/2021 12:44 PM
37	N/A	7/13/2021 11:36 AM
38	Current process is well defined and pretty straight forward to enforce. Graduated process will require that floodplain managers are consistent in their evaluation which will require a considerable amount of training and education. Not all areas have the same information available publicly/readily to be able to evaluate. There should be some default parameters established to assist with evaluation so the system is easier to implement. The more potential there is for someone to challenge an evaluation, the more time required to review and defend the determination. This may lend to floodplain managers avoiding the arguments by placing the risk on the property owner by going with a less significant determination.	7/13/2021 11:14 AM
39	Most small towns struggle with decent mapping programs or integrating the data into their existing mapping system. Any assistance with either of those would be fantastic.	7/13/2021 9:16 AM
40	No	7/13/2021 7:00 AM
41	The information needs to be in a wording that is easily understandable. Sometimes, it is way over a regular persons vocbulary	7/13/2021 6:13 AM
42	impose it from the federal level and let it trickle down to the local/site	7/13/2021 6:05 AM
43	Update the non coastal flood zones, the data is old and unreliable.	7/13/2021 4:49 AM
44	Easy-to-use point and click application or address locator.	7/12/2021 10:54 AM

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45	There will be challenges in advising how to develop a structure and a site that is split by the different gradations.	7/12/2021 10:39 AM
46	Make some type of training mandatory for NFIP community officials.... such as so many hours every other year.	7/12/2021 9:45 AM
47	Make them easier to find in the wild	7/12/2021 9:17 AM
48	It needs to be understandable to the policy holder	7/12/2021 8:48 AM
49	SIMPLIFY the terminology for the public	7/12/2021 8:20 AM
50	Our engineers in Nebraska are developing flood risk maps and depth grids. If Nebraska can create these tools then FEMA can do it also. It would far handier for surveyors and developers to be able to click on a digital map to see the percent risk and instantly get an accurate BFE without using charts, string and a slide rule or other tools from the 1950's. When I answer for questions 13 and 14 I expect I can click on the map and get a data box with a value to the 10th of a foot and single percentage point.	7/12/2021 7:55 AM
51	move away from the 1% annual chance flood	7/12/2021 7:12 AM
52	Education, and involve everyone early!	7/12/2021 3:29 AM
53	More funding and emphasis on CTP and CAP activities over HMP that doesn't adequately address future risk and current decision-making at the local level. Relying on HMP and mitigation alone and not on NFIP permitting programs and risk maps that can more directly influence local governments to make equitable decisions. Capacity building is needed to change inadequate current behaviors. HMP is too passive and the plans are ridiculously ineffective when compared to a code coordinated ordinance that incorporates higher standards.	7/10/2021 6:40 AM
54	Concentrate on education of the public	7/9/2021 2:57 PM
55	produce maps with this information	7/9/2021 2:13 PM
56	make it idiot proof for the regular joe shmoe to use or for planners who aren't interested in floodplain management but still want to do the right thing.	7/9/2021 1:42 PM
57	nope	6/9/2021 2:20 PM
58	No	6/7/2021 11:39 AM
59	Make it available for use	6/2/2021 2:48 PM
60	not at this time.	6/2/2021 10:09 AM
61	Communication that everyone's flood risk is unique based upon location, elevation, housing type, availability of storm drains, potential blockages, etc.	6/1/2021 4:17 PM
62	Better communication tools, in multiple languages.	6/1/2021 12:33 PM
63	Subject to privacy and other issues, make as much data as possible accessible to stakeholders	6/1/2021 7:04 AM
64	As Floodplain administrator for my jurisdiction I have not seen a draft regulatory map yet. Link to the information would be great and provide training to the use of it and how it can be integrated into the current adopted ordinance for my county. Ordinance updates might be required. We use slope maps to determine buildable area and there are some waivers available and I wonder if this would also be the case if only a small portion of a structure was in a graduated area. The current binary maps are easier to work with for regulation purposes. In or out but not always best to a property owner.	6/1/2021 6:33 AM
65	N/A	6/1/2021 6:03 AM
66	Not at this time.	6/1/2021 5:57 AM
67	No	5/31/2021 5:20 AM
68	None come to mind.	5/30/2021 10:46 AM
69	Availability of data	5/28/2021 11:57 AM
70	Don't have enough subject knowledge to make a recommendation.	5/28/2021 11:47 AM

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71	Education and more detailed local review.	5/28/2021 11:14 AM
72	Standardize it lik ethe Flood Control Act and the requirements to participate in the NFIP.	5/28/2021 6:20 AM
73	Flood Factor seems to have a good model for explaining the impact of flood issues and cost.	5/28/2021 6:15 AM
74	Education and training for both public and floodplain administrators.	5/28/2021 5:49 AM
75	Make it simpler to understand. Federal and State programs are generally to long and confusing for individuals to understand.	5/28/2021 5:46 AM
76	I think more classes and possible on site instruction would be helpful. I'd like to be a certified Flood Plain Manager but am not quite sure how to become certified.	5/28/2021 5:09 AM
77	I could use some training and education on what my role as a Floodplain Administrator is and what I should be doing	5/28/2021 5:06 AM
78	Education	5/28/2021 4:57 AM
79	Not enough experience to answer this question.	5/28/2021 4:39 AM
80	Better outreach.	5/26/2021 8:39 AM
81	The NFIP's principal programs need an overall (regulatory and FIMA/Ins.); whereby, risks identified within respective programs illustrates good data, but does is not always the best with respect to the implementation of flood-protection regulations. Regulations need to focus on existing and future conditions that reference ASCE and other construction standards (I-Codes or hybrids, Coastal Const. . . .). Risks mapping is an illustration of potential vulnerabilities, thus local communities "are" actually required to adopt standards and codes that are reflective of their risks and known vulnerabilities (future conditions included). The reliance on a single set of analyses is not necessarily furthering the public good and is also imposing legal and other consequences on the respective jurisdiction for not imposing a holistic approach to protecting life and property from various flooding situations (not "just" those illustrated on an insurance map).	5/26/2021 7:47 AM
82	First, explain what the data is. We are talking about more than floodplains here.	5/25/2021 6:30 AM
83	Not really; I need to see what comes out initially and how helpful it is.	5/24/2021 9:04 AM
84	need more accurate map data. too many map errors exist	5/21/2021 1:34 PM
85	no	5/21/2021 4:21 AM
86	No	5/20/2021 6:45 AM
87	Tools at the jurisdiction's level (beyond mapping). Flood insurance policies in-force (NFIP and private), flood losses (NFIP and private), etc.	5/20/2021 5:44 AM
88	community and stakeholder trainings on how to leverage the information to make more sound floodplain management decisions	5/19/2021 10:02 PM
89	No	5/19/2021 1:49 PM
90	Good communication to homeowners and property owners.	5/19/2021 1:42 PM
91	No	5/19/2021 1:25 PM
92	More freedom to allow for wider range of flood protection solutions and more transparency to ensure equity.	5/19/2021 12:06 PM
93	an improved national platform for displaying depth grids better access to elevation information from Base Level Engineering type A through C used for Zone A.	5/19/2021 10:31 AM
94	Define a storm event much large than the "100 year event". Maybe a 1000 year event, then set flood premiums that can be spread across a larger group of homes. Think that essentially everyone is involved with floods, so nearly everyone should pay some amount. Similar to a Stormwater Utility setup.	5/19/2021 9:02 AM
95	Produce detailed engineering studies of sufficient quality to support graduated flood hazard and risk data dissemination. If users do not have confidence in the results of nationwide catastrophic models, they won't have confidence in the graduated flood hazard and risk data derived from them. Each of these tools (detailed modeling, large scale modeling, and use of	5/19/2021 7:48 AM

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	graduated flood hazard and risk data) will need to play a role in helping communities and stakeholders understand their risk. Simply using information from outdated studies but re-presenting it as graduated data will not be enough for most communities.	
96	The data is available in a lot of areas of the US, but the people writing the insurance policies are not engineers knowing how to utilize the data.	5/19/2021 7:37 AM
97	Eliminate Zone A flood zones. Ensure that all flood prone areas have BFEs from FIS products or other free studies conducted by FEMA.	5/19/2021 7:36 AM
98	N/A	5/19/2021 7:36 AM
99	None	5/18/2021 5:32 PM
100	Education	5/18/2021 1:43 PM
101	Make the resources readily available for utilization.	5/18/2021 8:44 AM
102	Remove areas which are never in SFHA but included to increase the premium payees.	5/18/2021 8:04 AM
103	Have an interactive map that incorporates all of the flood data, including local modeling (based on the current stormwater system capacity), sea level rise, a way to look at rainfall amounts vs time. Our current 100 year flood event is based on 10 inches of rain over 24 hours. That is 10 inches averaged over 24 hours. That is not real world here in Florida.	5/18/2021 7:24 AM
104	Education to all stakeholders	5/18/2021 6:26 AM
105	Many local agencies do not have sufficient ability to provide technical support for better mapping or implementation.	5/18/2021 5:09 AM
106	No	5/18/2021 4:44 AM
107	better evaluation of risk on the flood maps. As an example, on the most recent we have areas that now have lower elevation requirements directly on the water when the water level is rising as a base number. There are areas immediately adjacent to a VE-11 that are labeled as AE-5. That does not even make sense. There seems to be no logical approach to setting the zones and we see what should be a risk area that is not even addressed in many cases.	5/18/2021 4:32 AM
108	Data behind maps needs to be accessible, viewable, and searchable through a web map	5/17/2021 7:44 PM
109	Better data. The FIRMS in our rural areas are terrible. making complex decisions based on their data is not a good idea.	5/17/2021 12:16 PM
110	none	5/17/2021 7:10 AM
111	Flood Hazards and Risk largely ignores hazards to Ag lands and/or the role that Ag lands play in mitigating flood risk to urban or residential areas.	5/16/2021 11:11 AM
112	CA developed 200-yr level of protection requirements and its own advisory maps for the deep floodplains (3'+) if its Central Valley Region. The First Street Foundation's tool was useful in displaying different levels of risk, but specifically FEMA needs to talk about how floodplains CHANGE and MOVE under both natural and human influences.	5/14/2021 6:27 PM
113	Augmented reality using modeled data and affected buildings	5/14/2021 5:42 PM
114	It will work best with communities with enough tax base to fund such specialized personnel.	5/14/2021 2:24 PM
115	Amend statutory and regulatory aspects of the NFIP to reflect the approach being used by RR2.0 - eliminate the inherent disconnects between the regulatory and insurance pieces of the NFIP	5/14/2021 11:49 AM
116	Change regulatory requirements	5/14/2021 11:02 AM
117	Unsure	5/14/2021 9:59 AM
118	I haven't seen enough examples to state and opinion on that.	5/14/2021 9:30 AM
119	Use better methodology to assess probabilities using random numbers and move away from historical assessments.	5/14/2021 9:26 AM
120	The closest thing to graduated flood hazard data that currently exists are the non-regulatory/flood risk products and BLE (both where available). They should be made available	5/14/2021 8:20 AM

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	at scale like the NFHL. Currently, statewide analysis is not possible because coverage is limited, but even if there was coverage, they are not available as state or nationwide downloads, and must be downloaded HUC-8 by HUC-8	
121	the development community will always want a line on a map. Ambiguous data does not help in making permitting decisions. Making decision making harder will not accomplish long term FPM goals.	5/14/2021 6:48 AM
122	no	5/14/2021 5:59 AM
123	It is an integral part of the flood risk communication story.	5/14/2021 5:54 AM
124	Not at this time.	5/13/2021 2:42 PM
125	N/A	5/13/2021 2:23 PM
126	Make such data available, but allow principles of cooperative federalism to drive state-based implementation.	5/13/2021 2:11 PM
127	Make statutory and regulatory changes at the state and local level. Barring that, incentivize it.	5/13/2021 1:17 PM
128	Widely available, tied to floodplain management regulations, significant investment in graduated flood risk communication, people don't understand probabilities and they've been hearing about AE/VE zones for so long there is going to be a laundry list of communication challenges	5/13/2021 1:12 PM
129	No	5/13/2021 1:12 PM
130	In my opinion, the best way to assess graduated flood hazard is to keep accurate and comprehensive records of flood or near-flood events	5/13/2021 1:07 PM
131	More public education, but you'll have to use social media these days since people don't look at anything else.	5/13/2021 12:00 PM
132	Creation of informational pamphlet templates for Communities to disseminate program information and risk avoidance, prevention mitigation measures.	5/13/2021 11:49 AM
133	Provide current and expected (future) conditions risks. Future should reflect impacts of varying degrees of land use and climatic change.	5/13/2021 11:32 AM
134	on line map viewer of graduated risks	5/13/2021 11:28 AM
135	Increase the amount of funding for RiskMAP to enable more frequent map updates and more comprehensive data products.	5/13/2021 10:55 AM
136	No.	5/13/2021 10:42 AM
137	Not really	5/13/2021 10:42 AM
138	Nope.	5/13/2021 10:40 AM
139	No	5/13/2021 10:37 AM
140	No, but I am concerned on how this will be applied by local communities. There is already enough "grey" in the regulatory standards, I hate to see more put on local governments.	5/13/2021 10:23 AM
141	Some sort of phased risk consideration, unfortunately I can find no specific information regarding a definition on the FEMA website. Hmmmm.... hard to answer question if you do not define what it is.	5/13/2021 10:17 AM
142	No	5/13/2021 10:14 AM
143	no	5/13/2021 9:53 AM
144	Provide the same Risk Rating 2.0 program available to WYO companies to Floodplain Administrators (FAs); allow FAs to draw API queries of RR 2.0 factors for specific geographic areas. In order to spur mitigation we have to be able to explain to residents how a specific mitigation will financially impact them via their NFIP policy. Without being able to geographically analyze the RR 2.0 risk factors, FAs aren't able to develop geographically based targeted strategies for mitigation outreach.	5/13/2021 9:51 AM
145	Without knowing exactly what the terminology refers to, no. I have no recommendations.	5/13/2021 9:51 AM

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146	Include states and local communities in the process; their support is paramount to the success of this initiative.	5/13/2021 9:42 AM
147	use as plain of language as possible- so to appeal to and be understood by homeowners	5/13/2021 9:36 AM
148	Communities successfully appeal RE studies lower the risk perception which is problematic in communicating risk to homeowners. Some data proprietary. Will congress approve? Will communities back it? A clear consideration message is the key to communication. FACT sheets may not be enough. Graduated map with more transparency to see parcel and building foot prints is ideal.	5/13/2021 9:34 AM
149	The issue is often that communities want a yes or no answer, is the proposed development in or out, is it required to comply or not comply with the floodplain regulations. Graduated risk maps make sense from a risk reduction planning perspective, but local floodplain managers, community planners and political entities often do not want to consider risk in their decisions.	5/13/2021 9:34 AM
150	no	5/13/2021 9:29 AM
151	Present the entirety of flood risks to a region. If there are additional impacts, such as burn scars, hurricanes, monsoons, dam overtoppings, dam breaks, etc., these should be communicated to potential victims of these events.	5/13/2021 9:21 AM
152	Modify the insurance premiums based on the graduated risk. Use the data to identify mitigation efforts based on cost-benefit-risk-safety analysis.	5/13/2021 9:17 AM
153	Revamp Nationwide floodplain regulations to a Regional approach so that the regs reflect reality rather than an "East Coast" only approach.	5/13/2021 9:16 AM
154	nothing specific	5/13/2021 9:12 AM
155	Streamline all the NFIP programs together. Change the mapping requirements to identify and incorporate graduated flood hazard and risk data. Make sure that this information is defensible in the adoption process.	5/13/2021 9:12 AM
156	No	5/13/2021 9:11 AM
157	Talk to the states and locals not just key in on the use of age of maps in the CNMS.	5/13/2021 9:10 AM
158	no	5/13/2021 9:07 AM
159	Need to understand the contents that drive the product. Being able to explain what components make up the end product.	5/13/2021 9:06 AM
160	Significant investment in targeted education on the benefits and future cost savings adopting the use of graduated flood hazard risk geared towards community officials. After successful community adoption, target state level for statutory support and enhanced minimum standards.	5/13/2021 9:04 AM
161	This is the first I have heard of it, so I need to know more first.	5/13/2021 9:02 AM
162	align with regulations	5/13/2021 9:01 AM
163	?	5/13/2021 8:55 AM
164	Lots and lots of visualizations and interactive viewers.	5/13/2021 7:23 AM
165	1. A nationwide (state by state) requirement for homeowners insurance to cover minimum NFIP flood damage. This would make it easier to get past, is my property in or out? 2. Funding to do truly multi-hazard planning that's more than a cursory mention. It seems like between flooding, earthquakes, hail, winter storms and wildfires, there are plenty of hazards to go around. 3. Awards that reach at least social media for elected officials who are doing the right thing to reduce hazards. Would like to see them wanting to prove how proactive they are to their voters!	5/12/2021 7:19 PM
166	Reduce complexity, be able to explain the details, know the outcome desired and why it is important.	5/12/2021 8:37 AM
167	I recommend getting many stakeholders involved in the development of products that would be useful. This is a new way of looking at flood risk data and new products will be required in order for communities to effectively understand and use the data. The information that may be useful to FEMA or a state partner is different than the products that would be useful to a local	5/12/2021 6:17 AM

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	official. Furthermore, the floodplain administrator may need different data than the emergency manager.	
168	It is currently unclear how mitigation projects will be included in RiskRating 2.0. Will communities have to do two processes (traditional maps and the insurance maps) for significant mitigation projects? This is a burden-moving the regulatory environment to graduated risk for consistency would be helpful.	5/12/2021 6:14 AM
169	shift to a digital FIS and drop the FIRM and profiles	5/12/2021 6:09 AM
170	enhancements in digital products will be necessary to show how hazards change at various levels	5/11/2021 9:38 PM
171	Don't underestimate the impact that the lack of a national "viewer" had on the integration and use of the non-regulatory flood risk products across the country at the beginning of Risk MAP. If equity/fairness is a priority, then something with basic functionality should be provided, even if you leave most of the sophisticated options up to industry or to those states that have more robust GIS capabilities.	5/11/2021 1:25 PM
172	The transect based mapping approach doesn't capture the range of topography/bathymetry along our coastline.	5/11/2021 1:14 PM
173	no	5/11/2021 11:50 AM
174	Simplify messaging and products - WSEL and Depth grids.	5/11/2021 9:37 AM
175	No	5/11/2021 8:58 AM
176	You need to first let us know what it is so we can determine if it can be used.	5/11/2021 8:46 AM
177	More accurate mapping including above the 500-year flood	5/11/2021 6:57 AM
178	Current regulations need to be revised to connect all components of the NFIP and the needs to use graduated flood hazard and risk data	5/11/2021 6:02 AM
179	As a state DOT representative, I see the potential for collaboration between FHWA and FEMA to update their 1982 MOU to support this nationally.	5/11/2021 5:55 AM
180	Listening sessions with local floodplain administrators and elected official and listen to what they say are the issues before rolling it out on a larger scale.	5/10/2021 7:05 PM
181	Decision-makers (i.e. elected officials) are more likely to accept the graduated risk approach after a storm strikes. If your community hasn't had a flood in twenty years then it can be difficult to find the political support to increase regulatory measures on something that people may view as theoretical or unlikely. Of course it is better to be proactive, but once that flood hits it is much easier to approach an elected board with increased regulations and a new approach.	5/10/2021 6:26 AM
182	Start using 2D hydraulic analysis as your standard for hydraulic analysis	5/9/2021 3:16 PM
183	Future projections, not just what the risk is today but what about in 5 years or 10. By a home today and if that risk increases in 5 years substantially, that home may not be as affordable as once thought. If this is part of the scenarios being run, make sure that people now that this takes into account future conditions.	5/9/2021 9:23 AM
184	Start by making it available. Our county received a DFIRM in the last five years but less than 1/4 of our hazards have detailed studies and less than 1% of the SFHA has depth grids. Additionally RR2.0 has been discussed for years, is about to roll out and yet there is no opportunity to see FEMA's interpretation of risk as it relates to insurance premiums for properties in our community.	5/8/2021 6:58 AM
185	No	5/7/2021 4:17 PM
186	I recommend utilizing a variety of communication tools with stakeholder groups. The use of visual explanations will be highly beneficial for property owners and elected officials	5/7/2021 1:49 PM
187	Consistent regulations, regular updates to data, and continued stakeholder engagement; incentivize states to apply consistent graduated data	5/7/2021 1:13 PM
188	> Change the federal code to address the differences in graduated flood hazard versus the current binary. > FEMA to provide States with guidance, outreach, and training materials on	5/7/2021 1:10 PM

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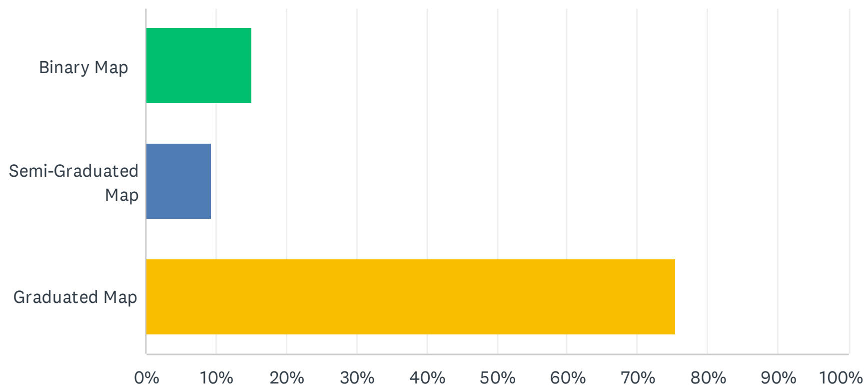
	how to interpret the new hazard maps, how to transition to the new system, and how to manage development and enforce non-compliance. > FEMA will have to change how it rates structures for flood mitigation purposes and how it applies benefit cost analysis in order to get structures approved for mitigation projects.	
189	Eliminate or diminish the link between FEMA LOMA/Rs and insurance; create an entirely new suite of hazard ID/risk assessment products not linked to insurance rating; create an entirely new product based on other natural hazards (all hazard insurance) and mandate it nationally to spread the risk and create equity; incorporate graduated flood hazard and risk data communication into education curriculums.	5/7/2021 1:08 PM
190	All data is helpful in making informed decisions	5/7/2021 1:04 PM
191	This has to be talked about and communicated publicly and often. The populace needs to start hearing about (and therefore thinking about) flood risk as any other risk - not just the historical in-a-flood-zone/not-in-a-flood-zone conversations.	5/7/2021 12:52 PM
192	It seems widely understood that the graduated hazard data is going to be used for insurance rating, but not well understood how it can be updated to represent local mitigation projects.	5/7/2021 12:33 PM
193	none.	5/7/2021 12:04 PM
194	Need digital flood mapping with a topographic layer for all communities	5/7/2021 12:01 PM
195	provide training to local governments and appropriate people as soon as it is available, make it clear and easy to understand, not the traditional scientist language used so often	5/7/2021 11:48 AM
196	No	5/7/2021 11:41 AM
197	We are currently having some challenges with flood mitigation in our narrow valleys that have been mapped. Any floodplain reclamation projects or stream bank stabilization projects create a rise in the map steep valleys.	5/7/2021 11:33 AM
198	Provide the data/maps to local communities so we can talk to developers/builders about Risk Rating 2.0	5/7/2021 11:16 AM
199	Provide a means to improve the accuracy of risk modeling with best available data on a local level, e.g. higher accuracy topography, calibrated runoff coefficients, smaller cell 2D modeling, etc.	5/7/2021 11:15 AM
200	Don't create a whole new regulatory system while retaining the current. Reform current or replace current - DON'T ADD another layer of regulation. A holistic approach is needed.	5/7/2021 11:09 AM
201	Do it well and do it right. The program in this area is seriously compromised by binary maps that are not fit for purpose. I admire the ambition to move to a more rounded concept of risk. Make sure all communities have the tools they need to do the job well.	5/7/2021 10:47 AM
202	Funding for outreach to communities at risk, to include personalized data and community signage.	5/7/2021 10:46 AM
203	Not that come to mind.	5/7/2021 10:42 AM

Q13 Which of the following maps would most help you communicate flood hazards or risk?

Answered: 420 Skipped: 11



ANSWER CHOICES	RESPONSES	
Binary Map	15.24%	64
Semi-Graduated Map	9.29%	39
Graduated Map	75.48%	317
TOTAL		420

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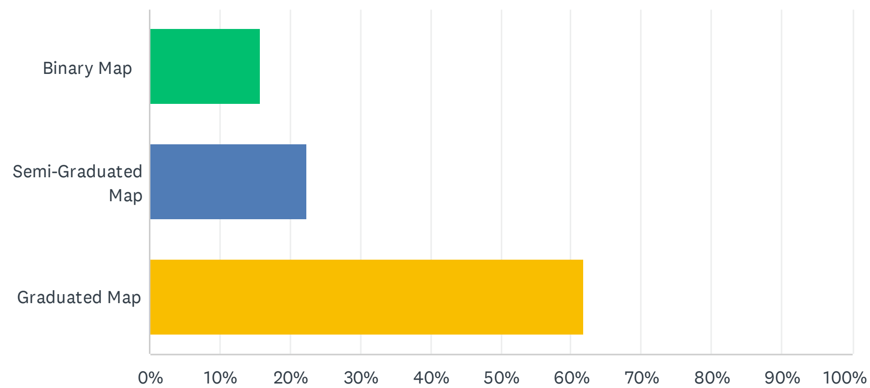
Q14 Which of the following maps would most help you manage flood risk?

Answered: 417 Skipped: 14



ANSWER CHOICES	RESPONSES	
Binary Map	15.83%	66
Semi-Graduated Map	22.30%	93
Graduated Map	61.87%	258
TOTAL		417

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Q15 What would you need to implement a floodplain management strategy capable of leveraging graduated flood hazard and risk data?

Answered: 283 Skipped: 148

#	RESPONSES	DATE
1	Relation	8/31/2021 7:40 PM
2	implementation strategy for public understanding and local authority adoption	8/31/2021 9:58 AM
3	Frequently and modernly updated flood risk maps, on the national scale, with shorter turn around. Also tools and training for local flood managers to incorporate best practices.	8/23/2021 9:51 AM
4	The requirement to use FEMA flood maps for flood insurance is the major barrier.	8/16/2021 10:05 AM
5	Some standardization/regulation or a shift in "way" of doing/presenting flooding risk. No one likes change. We are at the headwaters so not much flooding here.	8/12/2021 6:02 AM
6	Money to hire qualified people. Support from local government that is responsible for enforcing flood regs. (Like having building permits)	8/5/2021 5:18 AM
7	Current digital models based on accurate surveys.	8/4/2021 1:45 PM
8	More training and certifications.	8/3/2021 2:08 PM
9	The map could be used to better explain risk, but statutory changes would be required to use for regulatory purposes.	8/2/2021 12:15 PM
10	larger staff--coordination between flood plain and stormwater reviewers	7/30/2021 7:25 AM
11	better engagement of city council	7/28/2021 10:44 AM
12	The NFIP participation requirements drive floodplain management in my city. Currently it is binary, either you are in or you are out of a flood risk zone.	7/23/2021 3:14 PM
13	training	7/23/2021 8:13 AM
14	Across the board training to those who will be using the map to make regulatory calls.	7/23/2021 7:51 AM
15	Support from elected officials. Ordinances or codes with specific language.	7/22/2021 9:08 AM
16	Very clear data. Historical costs and consequences. Communication strategies.	7/19/2021 1:32 PM
17	more information to be better able to relay the information to my mayor and city council	7/19/2021 12:15 PM
18	Clear guidelines for how different graduations affect development, high quality data to identify the risk grade at any given point.	7/19/2021 9:50 AM
19	Not sure yet	7/19/2021 9:03 AM
20	more info	7/19/2021 6:26 AM
21	Not applicable.	7/19/2021 6:12 AM
22	no	7/17/2021 7:08 AM
23	More individual expert support	7/16/2021 12:36 PM
24	Access to data and resources to cost effectively mitigate hazards. Aggressive governmental management and enhancement of levee integrity and active mitigation of Platte River ice jams.	7/16/2021 11:51 AM
25	information	7/16/2021 11:19 AM
26	As I mentioned in question 12; a common set of data, rating info, available to flood administrators and insurance agents. Also more training of combined groups to include flood administrators and insurance agents.	7/16/2021 8:28 AM

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27	A developed certified blueprint to a sideways dam from an engineer so I can seek bids on the Green Energy Water Park, USA, proposals from local government and private investors, grants!?	7/16/2021 7:56 AM
28	sit down meeting at the local level	7/16/2021 7:48 AM
29	FUNDS	7/16/2021 7:01 AM
30	n	7/16/2021 6:54 AM
31	Coordinate with our County partners who have a CFM on staff.	7/16/2021 5:50 AM
32	Adobe Professional GIS HecRAS 2D training	7/15/2021 1:51 PM
33	Major CRS points/credits, it would take a lot of time to set up and manage, CRS points would be a good incentive	7/15/2021 10:17 AM
34	More information and approval by local codes and regulations.	7/15/2021 9:56 AM
35	Reliable data	7/15/2021 9:32 AM
36	The ability to show the vertical impact of various flood events in order to better demonstrate the need or benefit of various changes or alternatives.	7/15/2021 8:27 AM
37	An interested public comprising individuals capable of understanding the problem and willing to compromise with neighbors and outsiders to find consensus solutions that maximize the interests of all, and then to abide by the agreed solutions. Unlimited funding and staff availability. Support of elected officials.	7/14/2021 2:54 PM
38	unsure	7/14/2021 2:51 PM
39	clear requirements if no longer in or out, where do regulations apply? How does this impact insurance rates?	7/14/2021 2:13 PM
40	better regulations (44 CFR changes)	7/14/2021 12:23 PM
41	updated graduated risk mapping and data availability	7/14/2021 12:10 PM
42	PR needs to updating the effective FIRM from 2009. The Advisory was adopted as emergency state and we need to start working on the new product to island wide.	7/14/2021 9:42 AM
43	Revised GIS maps with all of the necessary metadata. Stop making FPA's toggle between the FIS and maps. No FPA's should have to be utilizing paper - at all! Get the country fully digitized if you're going to implement "graduated risk." Make all of the data and mapping system publicly accessible. Some communities in the NFIP are still using Z-fold, so I'm curious how everyone is going to pivot to "graduated risk" maps.	7/14/2021 8:03 AM
44	It depends on what you want from it.	7/14/2021 7:13 AM
45	Maps that show the risk	7/14/2021 6:48 AM
46	Additional training and materials for public consumption.	7/13/2021 3:21 PM
47	I would need more comprehensive education on how to implement and leverage graduated flood hazard and risk data.	7/13/2021 3:21 PM
48	graduated maps and a scale of risk instead of just a mono tone approach	7/13/2021 3:20 PM
49	An understanding of what the term "graduated risk" means and maps/other supporting documents demonstrating it.	7/13/2021 3:19 PM
50	Updated maps	7/13/2021 2:26 PM
51	updated maps and flood studies. Current maps for our area are up to 46 years old with the average of 38 years old. we have authoritarian regulators enforcing rules that area younger than the maps and information being enforced.	7/13/2021 2:00 PM
52	Appropriate mapping and a clear regulatory scheme.	7/13/2021 1:34 PM
53	More Mapping and flood plane studies	7/13/2021 1:22 PM
54	N/A	7/13/2021 11:36 AM

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55	Training and access to resources.	7/13/2021 11:14 AM
56	Time, man power, and a system what integrates with our current mapping program.	7/13/2021 9:16 AM
57	Maps	7/13/2021 8:54 AM
58	Time	7/13/2021 7:00 AM
59	1. Accurate maps with elevations noted; 2. FIS profiles for locations where no elevation is noted; 3. Zoning ordinance with charging language and administrative procedures	7/13/2021 6:32 AM
60	state supported regulation	7/13/2021 6:14 AM
61	More people in the office	7/13/2021 6:13 AM
62	federal requirement, state tech assistance, high quality GIS mapping data	7/13/2021 6:05 AM
63	community support	7/13/2021 5:44 AM
64	Statute by the state and an ordinance adopted locally.	7/13/2021 5:20 AM
65	LiDAR data/DEMs that match those used to create the FEMA regulatory floodplain.	7/12/2021 10:54 AM
66	Clear education with real world practical application tailored for the end user.	7/12/2021 10:39 AM
67	Support of the community and national policies that encourage its use rather than complicate existing regulatory requirements.	7/12/2021 10:09 AM
68	There needs to be more consequences for NFIP communities not following regulations - easier probation, or other tools. Required training for locals in NFIP communities.	7/12/2021 9:45 AM
69	Likely a new or broader local ordinance.	7/12/2021 9:45 AM
70	Local communities with the expertise and desire to support its use.	7/12/2021 9:17 AM
71	statutory changes to 44 CFR 60.3	7/12/2021 8:48 AM
72	Lots of outreach materials for all skill levels	7/12/2021 8:42 AM
73	SIMPLISTIC IMAGES 7 SIMPLE LANGUAGE	7/12/2021 8:20 AM
74	Still having clear regulations for what development standards apply in which areas.	7/12/2021 8:05 AM
75	Digital % risk maps where we could not only click a spot to find the risk and BFE to the 10th of a foo=t and risk to a single percentage point. It would also be very useful to be able to type in elevations to show the developer how the risk would decrease as the building is elevated at that point.	7/12/2021 7:55 AM
76	General Language and backing from other sources	7/12/2021 7:12 AM
77	Guidance, education.	7/12/2021 3:29 AM
78	Funding. Annual State CAP funding is less than the cost of three house elevations and about the same as two county HMP updates. Capacity building in the CAP and CTP programs inform municipalities about future risks and can result in higher ordinance standards. Also a commitment from regional upper management to enforce significant NFIP noncompliance and a commitment from headquarters to use CRS rating upgrades, downgrades, and removals as a carrot and stick rather than an entitlement and PR program. Note that failure to manage the CRS property is an equity issue for non CRS communities and is an example of systemic FEMA bias towards mostly affluent (and politically powerful) towns.	7/10/2021 6:40 AM
79	Additional staff funding	7/9/2021 2:57 PM
80	Educational products for homeowners, realtors, local government official, and building officials.	7/9/2021 2:46 PM
81	ability to communicate with the individual homeowners/policy holders within each graduated area.	7/9/2021 2:13 PM
82	It would have to come in the form of FEMA policy	7/9/2021 2:13 PM
83	consistency with local codes, a clear permitting process and easily identifiable BFEs that don't require downloading multiple documents. make it user friendly!!!	7/9/2021 1:42 PM

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84	buy-in from the local officials	7/1/2021 9:11 AM
85	the definition of graduated flood hazard and risk data	6/21/2021 7:58 AM
86	an appropriate project	6/9/2021 2:20 PM
87	Data Availability	6/2/2021 2:48 PM
88	I am unable to answer many of the questions in this survey as this is the first time I've heard of graduated risk in floodplain management and the sample maps above are too small to read in order to compare their attributes. However, with any proposed change in the FEMA FIRMs I would need access to the maps and instructions on how to use them, then I would want to notify all floodplain property owners within our jurisdiction and have follow-up public meetings (with local government, IN DNR NFIP & FEMA representatives), an appeals process (with deadline) and later an adoption date of the new maps - just as it was done for the new digital FIRMs in 2015. Information about Risk Rating 2.0 could also be shared with the public.	6/2/2021 2:15 PM
89	new mapping	6/2/2021 10:09 AM
90	mapping, data, and a GOOD MODEL ORDINANCE. Our Model Floodplain Ordinance is required by IDNR, but it is very difficult to understand, not organized well, and does not offer the flexibility for interpretation for situations not specifically spelled out.	6/2/2021 7:50 AM
91	Outreach and Web presence for large data sets	6/1/2021 5:01 PM
92	a large staff and an educated community.	6/1/2021 4:17 PM
93	Better data.	6/1/2021 3:04 PM
94	For issuing building permits, I need a binary map. For flood mitigation projects, I need a graduated map, and a source of funding.	6/1/2021 12:33 PM
95	More data on urban flood risk	6/1/2021 7:45 AM
96	Acceptance by local regulators in the use of data for permitting and mitigation	6/1/2021 7:04 AM
97	A map with that integrates a graduated map into a more binary map with several delineated areas depicting Floodway/1% Floodplain and 0.2% Floodplain much like what we see on FIRMs now but with more accuracy. Ordinance language would need to be updated as well as more education for administrators/engineers/surveyors.	6/1/2021 6:33 AM
98	Data and mapping	6/1/2021 5:57 AM
99	More education and more exact data.	5/31/2021 5:20 AM
100	Our town only has the potential of flooding by a creek and not by a river; thus the threat of major flooding is quite low. While there have been a few rare occasions over the past forty years of some isolated flooding within our Town limits, at this point, I believe that we have sufficiently addressed this potential problem and while the area yet remains within the Town limits, there are no residents there.	5/30/2021 10:46 AM
101	Expertise	5/29/2021 11:34 AM
102	GRADUATED MAPPING	5/28/2021 1:16 PM
103	More time/staff	5/28/2021 11:57 AM
104	More detailed maps as shown. There is not enough fine detail in the current maps and interpretation is time consuming and inaccurate at times.	5/28/2021 11:47 AM
105	Buy in to the benefit of this type of program, funding.	5/28/2021 11:14 AM
106	A quality reason to implement it. Detailed floodways and floodplains are still approximate so the graduated risk would allow people to accept risk that is easily out performed by natural events.	5/28/2021 6:20 AM
107	A specific and detailed strategy to implement the program. ALL entities who deal with development and building need to be involved. This goes from the end user to the local, state, and federal officials who legislate and manage the process. Educational materials would need to be developed that targets each group and frequent communication needs to be directed to each segment to insure on going education on the issues continues.	5/28/2021 6:15 AM

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108	Education and training.	5/28/2021 5:49 AM
109	Time and Money	5/28/2021 5:46 AM
110	I would need more education, and better information for my superiors for starters. Also, a position designation by the former would be helpful also. I don't think the flood risk is really understood well in my area.	5/28/2021 5:09 AM
111	More training	5/28/2021 5:06 AM
112	Accessible data and files	5/28/2021 4:57 AM
113	good mapping with clearly defined boundaries	5/28/2021 4:52 AM
114	Training	5/28/2021 4:39 AM
115	data, modeling, mapping	5/27/2021 4:41 AM
116	Inundation mapping for varying events.	5/26/2021 8:39 AM
117	There needs to be some separation from reliance on maps. Flood protection is far greater than just a review of a map. Look to FEMA's MGT-474 -- Mitigation Hazards with Land Use Planning. There needs to more to 60.3 with respect to implementing flood protection. The sooner it is identified a great deal is required to provide flood protection, the sooner we begin to reduce future floods -- just go ask Houston!	5/26/2021 7:47 AM
118	regulation about how to apply building standards and mandatory purchase in graduated areas	5/25/2021 11:32 AM
119	an ordinance	5/25/2021 7:38 AM
120	Training	5/25/2021 6:30 AM
121	Clear information on the risks for each area and how to regulate the different risk areas.	5/24/2021 10:34 AM
122	An overhauled NFIP; many many many new state and local codes; lawyers!	5/24/2021 9:04 AM
123	Citizen-friendly data and training for staff.	5/24/2021 7:43 AM
124	New updated maps	5/21/2021 7:23 AM
125	Graduated FIRMs and experience. Not a fan of graduated maps for regulatory purposes. I already get a lot of residents who complain that they're barely in a SFHA. If there are different regulations for different graduation levels, this will likely result in more complaints and asking/demanding flexibility from regulatory bodies.	5/20/2021 6:45 AM
126	Explanation of what graduated flood hazard and risk data is compared to binary (and not in those terms exactly for the public).	5/20/2021 5:44 AM
127	the data and the NFIP program to support it.	5/19/2021 7:02 PM
128	Prepared, easy to understand, public service announcements, links, website and facebook posts to pass along.	5/19/2021 6:08 PM
129	None	5/19/2021 1:49 PM
130	updated maps and current data	5/19/2021 1:42 PM
131	Regulatory flexibility and better coordination between stakeholders.	5/19/2021 12:06 PM
132	federal mandates	5/19/2021 11:06 AM
133	strong State NFIP Coordinators who continually reach out to communities and local floodplain managers	5/19/2021 10:31 AM
134	Better outreach of course.	5/19/2021 9:02 AM
135	code & ordinance rewrite, insurance agent training, public outreach, realtor training of actual flood risk	5/19/2021 8:58 AM
136	A crosswalk between the level of graduated risk and the administration of regulation and ordinances. A binary map is easy to point to when communicating a requirement for construction, that will be less clear with a graduated map despite making risk communication easier.	5/19/2021 7:48 AM

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137	Community buy-in.	5/19/2021 7:37 AM
138	Eliminate Zone A flood zones. Ensure that all flood prone areas have BFEs from FIS products or other free studies conducted by FEMA.	5/19/2021 7:36 AM
139	More information	5/19/2021 7:36 AM
140	Clear definition/guidance on what defines each graduated risk level so that can be incorporated into regulations and clearly explained to land owners.	5/19/2021 7:34 AM
141	A Flood Insurance Study and annual flood data.	5/18/2021 5:32 PM
142	Extensive public education for home owners, local officials, and professionals.	5/18/2021 3:52 PM
143	maps with elevation data	5/18/2021 1:43 PM
144	Money, people and product	5/18/2021 9:16 AM
145	Necessary resources and access to graduated maps.	5/18/2021 8:44 AM
146	Arrogance of USCOE using flawed Lake Okeechobee staging data which has never been breached despite hurricanes and multiples canals preventing communities from getting flooded. But no the poor communities have to buy flood insurance because of the flawed model not supported by the data.	5/18/2021 8:04 AM
147	I need more information	5/18/2021 7:41 AM
148	Buy-in from directors and the public.	5/18/2021 7:24 AM
149	Education and deliverables to stakeholders	5/18/2021 6:26 AM
150	CRS stop increasing their compliance requirements, every year communities are less likely to keep or maintain a good class in the CRS. This might be the intent...	5/18/2021 5:53 AM
151	Accurate data and funding to accompany the transition for education, staff, and tools.	5/18/2021 5:53 AM
152	Revised regulations and guidance for application of graduated flood hazard risk data.	5/18/2021 5:19 AM
153	Mapping clarity; raster change in gradients versus wide line. Better understanding of risk and how to communicate with local insurance reps.	5/18/2021 5:09 AM
154	The ability to have regular, real time updates, and stop punishing developers able to fill a site out of the floodplain.	5/18/2021 4:44 AM
155	Support and legislation along with training for staff and outreach events to help get the information in the hands of the public	5/18/2021 4:32 AM
156	guidelines of how to use the data	5/17/2021 7:44 PM
157	Not Sure	5/17/2021 12:53 PM
158	accurate maps that can be updated on a timely basis. A good argument for the high income homeowners who purchase most of the policies in this area.	5/17/2021 12:16 PM
159	Would need to understand the reliability of the maps- will surveys still need to be performed? If so, then I wouldn't bother with the maps. There could be liability concerns.	5/17/2021 8:32 AM
160	Resource Agency desire to address levee maintenance and Public/Private partnerships.	5/16/2021 11:11 AM
161	A nation-wide web portal with both FEMA and non-Federal advisory maps, along with disclaimer language and training for State / local floodplain managers.	5/14/2021 6:27 PM
162	Flood depth datasets using lidar-derived elevations, based on agreed-upon and transparent flood models that take into account climate change	5/14/2021 5:42 PM
163	Exemptions for smaller communities, since they will not be able to fund someone to remain educated in the field, yet only review a few permit applications per year.	5/14/2021 2:24 PM
164	better floodplain literacy at municipal leadership level	5/14/2021 12:15 PM
165	Regulatory and statutory changes along with enhanced products and maps	5/14/2021 11:49 AM
166	Unsure	5/14/2021 9:59 AM

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167	I am a local Emergency Management Director and have been for 14 years. the flooding we get happens in the same area each time. In my opinion, the only long term solution is to get the structures out of the floodplain. I always believe in improving and looking for new solutions but in my case, it's pretty black & white. The structure in the area that flood were built years ago before zoning restrictions. the easily understood Binary Map works for me.	5/14/2021 9:30 AM
168	FEMA needs to reformat its mathematics. Who can even calculate a design flood elevation except a small coterie of civil engineers?	5/14/2021 9:26 AM
169	Carrots. Changes to 44 CFR to incorporate graduated flood hazard data is low-priority, so it seems like states and local governments with land-use authority would be in the best position to implement these practices. For mitigation, we need access to the data driving policy-rating under RR2.0. We will have upward pressure on premiums in many places, which should stimulate demand for mitigation, but without the data, the benefit-cost analysis is extremely difficult for non-SFHA properties. Note for #16: It depends. There's no reason a binary approach couldn't include climate change. Nor is there any reason to think that a graduated approach would. Future-conditions hydrology, whether rainfall or land-use changes, are inputs prior to our decision to display the results as binary or graduated.	5/14/2021 8:20 AM
170	Most property owners want to know if they are in or out of the SFHA . Additional info would be needed to help those locally to understand the new system.	5/14/2021 7:26 AM
171	the greatest barrier is our state legislature -- we currently have higher regulatory standards using current methodologies, and if we have to go to our legislature to update statute, in the current climate we will lose everything, and seriously damage FPM in this state.	5/14/2021 6:48 AM
172	In the graduated map there is a lot of room for interpetration. N	5/14/2021 6:46 AM
173	Don't know at this time	5/14/2021 6:26 AM
174	not sure	5/14/2021 5:59 AM
175	Personnel, time, funding, graduated resources	5/14/2021 5:54 AM
176	It starts with Congress, the NFIP, to require, fund, and roll out enhanced map products.	5/13/2021 2:42 PM
177	Maps	5/13/2021 2:23 PM
178	Federal mandates - there is little chance that our legislature or state government is going to do this willingly.	5/13/2021 2:22 PM
179	Graduated risk data and mapping products together with statutory authority for local government to construct local regulations surrounding higher frequency flood events at its discretion.	5/13/2021 2:11 PM
180	High quality templates for criteria AND process actions for states and communities.	5/13/2021 1:17 PM
181	Sorry, I don't see it working for development regulation purposes.	5/13/2021 1:16 PM
182	better understanding of what graduated flood hazard and risk data are and what they show, understand how this relates to all the other sources of flood hazard/risk information we already have and understand how it is better than those other sources, understand how and why it should be used, tools for communicating this to the public	5/13/2021 1:12 PM
183	I understand this is not the answer sought for this question but it is the foremost answer for my office..... additional personnel.	5/13/2021 1:12 PM
184	More staff. Policy push from above (state and federal). informing residents and the elected officials	5/13/2021 1:07 PM
185	Updated Legal and/or statutory policy to guide work at local level. Trainings to analyze and work with graduated flood hazards and risk data. Suggested updates to local floodplain codes to incorporate graduated risk data.	5/13/2021 1:01 PM
186	A semi-educated and open minded public. My experience tells me they want black/white or a line like the binary map.	5/13/2021 12:00 PM
187	Community Engagement Programs - possibly credits to CRS communities - frequency every 2-3 years?	5/13/2021 11:49 AM
188	the data and maps	5/13/2021 11:34 AM

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189	Guidance for an authoritative authority (FEMA) and their willingness to support state and local floodplain managers.	5/13/2021 11:32 AM
190	There would need to a monetary incentive, reduced insurance premiums, along with understandable regulations that allow for graduated standards to entice communities to adopt a graduated risk management program.	5/13/2021 11:28 AM
191	A complete overhaul of state laws and practices.	5/13/2021 11:21 AM
192	Money of course. Money to spend to create and share data.	5/13/2021 11:17 AM
193	Everything	5/13/2021 11:07 AM
194	GIS layers of the risk data	5/13/2021 10:57 AM
195	Increase the amount of funding for RiskMAP to enable more frequent map updates and more comprehensive data products.	5/13/2021 10:55 AM
196	Better data availability. A better interlocutor who can communicate graduated flood hazards.	5/13/2021 10:42 AM
197	Unsure	5/13/2021 10:42 AM
198	Some hard science on the relationship the incremental measurement to the risk to be ameliorated.	5/13/2021 10:40 AM
199	Not much would change, but I am not too aware of the graduated flood hazard and risk data, so potentially more than I expect. Our town has one large riverine floodway, and its risk seems very binary. Pre-disaster mitigation and property acquisition seems to be our best path forward.	5/13/2021 10:37 AM
200	More support from FEMA and the state EMA, as this puts a huge burden on local goverments	5/13/2021 10:23 AM
201	More information regarding exactly what it is.	5/13/2021 10:17 AM
202	More flexibility in local government.	5/13/2021 10:14 AM
203	We will need support and technical assistance to bring this technology	5/13/2021 9:53 AM
204	Access to all of the data. Data, data, data! Shapefiles, rasters, REST APIs , NFIP claims, policies, elevations, and most importantly, data from elevation certificates.	5/13/2021 9:51 AM
205	More training. Buy in from BOMA.	5/13/2021 9:51 AM
206	Funding and community understanding	5/13/2021 9:50 AM
207	Mapping and data.	5/13/2021 9:47 AM
208	Strong local regulations above the minimum NFIP standards.	5/13/2021 9:42 AM
209	Not sure	5/13/2021 9:42 AM
210	Support from local government.	5/13/2021 9:42 AM
211	flood depth info per structure- per parcel	5/13/2021 9:36 AM
212	PSAs advertising!	5/13/2021 9:34 AM
213	Simplified training materials on ideas on how to utilize this new graduated flood hazard and risk data, how to incorporate it into a community's comprehensive planning process (zoning delineations) and how to interpret the data and how to apply and use the data to guide proposed development.	5/13/2021 9:34 AM
214	better communication infrastructure	5/13/2021 9:29 AM
215	I am a federal engineer, so I'm not in a role to directly implement the strategy. That being said, implementing these at a local level could be groundbreaking for helping levee sponsors and their constituencies understand their vulnerabilities and work with local and state governments to manage these risks.	5/13/2021 9:21 AM
216	community technical literacy	5/13/2021 9:17 AM
217	Clear understanding of the repercussions of the graduated flood hazard data. Who will be affected, what is the purpose, and what measures will the community need to take.	5/13/2021 9:17 AM

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218	FEMA acceptance that one-size-fits all is outdated and not working for all areas in the nation.	5/13/2021 9:16 AM
219	new agency regulations and policy	5/13/2021 9:12 AM
220	Communities are challenged daily - conflicting mapping information weakens the communities ability to adequately and consistently regulate in high risk areas. Information and variables have to be transparent. As mentioned above, The NFIP programs need to be streamlined together. Change the mapping requirements to identify and incorporate graduated flood hazard and risk data. Make sure that this information is defensible in the adoption process.	5/13/2021 9:12 AM
221	Enabling legislation, or some benefit to accepting higher regulatory standards	5/13/2021 9:11 AM
222	Not sure	5/13/2021 9:11 AM
223	folks in the field that can communicate the info to the locals but not in a fashion that confuses them but educates them. Most of the rural communities in farmland USA aren't always thinking of sea level rise like they are on the coasts!	5/13/2021 9:10 AM
224	Regulations would need to change to permit the flexibility of applying graduated risk.	5/13/2021 9:09 AM
225	Regional floodplain manager as the flood hazards are similar across the county	5/13/2021 9:08 AM
226	Hosted data; communication tools	5/13/2021 9:06 AM
227	Time & Staff Resources	5/13/2021 9:06 AM
228	A culture change at my organization; we still tend to use deterministic measurements	5/13/2021 9:04 AM
229	As a state we are poised to do so, it comes down to the community-level understanding and adoption of the graduated flood risk products, which are non-regulatory products. There, so far, has been resistance on a community level to go further than the minimum regulatory products.	5/13/2021 9:04 AM
230	The data	5/13/2021 9:02 AM
231	federal regulations to align with mapping and insurance	5/13/2021 9:01 AM
232	?	5/13/2021 8:55 AM
233	Time/funding for someone to work on this. Like a large scale 2D map that shows graduated flood risk (depths/velocities) that isn't limited to FEMA map boundaries. Cross sections on FEMA maps don't extend far enough to show real risk and 2D is needed to show all the flood paths in my county. People would take maps more seriously if they showed more than just a cartoon (current FEMA maps).	5/12/2021 7:19 PM
234	Good user guidance, easy to use tools, and many examples.	5/12/2021 8:37 AM
235	Time and well-documented expectations from FEMA.	5/12/2021 6:17 AM
236	Other countries have figured this out because their processes are not as historically tied to insurance like ours are in the US-look to the current NAFRA2 effort in the UK, for example. Do we really need to reinvent the wheel?	5/12/2021 6:14 AM
237	An interactive viewer and FEMA to remove or dial back obsolete regulations	5/12/2021 6:09 AM
238	Either a viewer that had pre-processed the graduated data into different products that helped identify where higher standards could be beneficial, or guidance on how to develop those tools/products that leveraged the underlying graduated data.	5/11/2021 1:25 PM
239	It would be helpful if FEMA leveraged other expertise from the USGS to map erosion hazards, as they have a lot of background and expertise with that.	5/11/2021 1:14 PM
240	Nationwide WSEL and Depth grid data and viewers for this.	5/11/2021 9:37 AM
241	funding and education	5/11/2021 8:58 AM
242	lots of money and training	5/11/2021 8:46 AM
243	better maps	5/11/2021 6:57 AM
244	Accurate and consistent parcel data across the whole region	5/11/2021 6:48 AM
245	Tools and guidance	5/11/2021 6:30 AM

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246	Regulatory requirements meaning if 44 CFR as minimum requirements mandate it through incentives programs (grant funding)	5/11/2021 6:02 AM
247	Initiatives and support from FEMA and FHWA, and ultimately statutory and regulatory mandates could help to drive implementation.	5/11/2021 5:55 AM
248	At a minimum, detailed graduated flood hazard and risk data in GIS format, including raster surface data.	5/10/2021 1:41 PM
249	political support and trustworthy data	5/10/2021 9:45 AM
250	More time and informational/educational resources to get the public and other agencies/entities up to date on the changes, new uses of the risk data, etc.	5/10/2021 8:39 AM
251	Regulations	5/10/2021 7:47 AM
252	I would need the support of our elected officials. To get that support, I think it would require a regional or statewide approach where the Board can see that this approach has worked elsewhere.	5/10/2021 6:26 AM
253	Update to the Code of Federal Regulations	5/9/2021 3:16 PM
254	A viewer like FEMA's NFHL but for graduated risk	5/9/2021 9:23 AM
255	the above graduated map that is equitably mapped for my entire community	5/8/2021 6:58 AM
256	More community outreach to regulatory personnel	5/7/2021 4:17 PM
257	?	5/7/2021 1:49 PM
258	Access to high accuracy, routinely updated and reasonably priced LiDAR and aerial imagery.	5/7/2021 1:17 PM
259	Funding and consistent data standards; perhaps a regulatory baseline model	5/7/2021 1:13 PM
260	> Changes in the federal code to address the differences in graduated flood hazard versus the current binary. > Guidance, outreach, and training materials on how to interpret the new hazard maps, how to transition to the new system, and how to manage development and enforce non-compliance. > Change in how structures are rated for flood mitigation purposes and how it applies benefit cost analysis in order to get structures approved for mitigation projects.	5/7/2021 1:10 PM
261	as with 44CFR 60.3, a strategy incorporating performance standards based on graduated hazard/risk data, and incentivized adoption and enforcement measures, along with community technical assistance and monitoring capability. Such a strategy could be implemented gradually as risks change over time	5/7/2021 1:08 PM
262	graduated flood hazard and risk data as illustrated is still based on assumed static risk factors that must be adopted for regulatory and management purposes	5/7/2021 1:04 PM
263	access to modules communicating graduated risk to the community.	5/7/2021 12:59 PM
264	Updated maps	5/7/2021 12:47 PM
265	Regulations that are not based on binary flood risk and design flood elevations for different risk areas	5/7/2021 12:39 PM
266	strengthening and enforcement of flood ordinances.	5/7/2021 12:33 PM
267	$$$$	5/7/2021 12:13 PM
268	all the maps.	5/7/2021 12:04 PM
269	More staff and funding	5/7/2021 12:01 PM
270	proven situations so local elected officials can see it and buy in, plus funding sources to answer their questions.	5/7/2021 11:48 AM
271	GIS tools, implementation strategies will vary depending on the community.	5/7/2021 11:41 AM
272	Training and easy access to the software/program	5/7/2021 11:33 AM
273	Severe Rainfall Flood Risk Mapping	5/7/2021 11:22 AM
274	Access to the data/maps. Regulations that support a graduated system. I can always talk and	5/7/2021 11:16 AM

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	recommend but without the regulations I can't enforce anything.	
275	Accurate FIRMs that correlate with the catastrophe modeling and do not exhibit wild variation between the two.	5/7/2021 11:15 AM
276	Dedicated staff time and good mapping products.	5/7/2021 11:09 AM
277	A matrix that matches relative risk to development standards.	5/7/2021 10:47 AM
278	Increased staffing levels with associated training and certification. Technical backup to use technology as a form of communication.	5/7/2021 10:46 AM
279	I believe that Government need clearly Executive orders and consolidated funding resources to focus on this issue.	5/7/2021 10:45 AM
280	Good maps, hydraulic studies, educational material, and reference material	5/7/2021 10:42 AM
281	I am responsible for complying with floodplain management rather than implementing strategies.	5/7/2021 10:42 AM
282	Maps or other data which clearly show the risk community-wide. Regulations that guide development properly. Elected officials' desire to keep development away from known flooding sources and desire to build to much higher standards in areas where buildings still must be palced (hurricane/tropical storm areas). Money or other incentives from federal/state govt to buy-out/elevate currently high-risk proepties.	5/7/2021 10:37 AM
283	Access to the data Authority to use and disseminate the data	5/7/2021 10:36 AM

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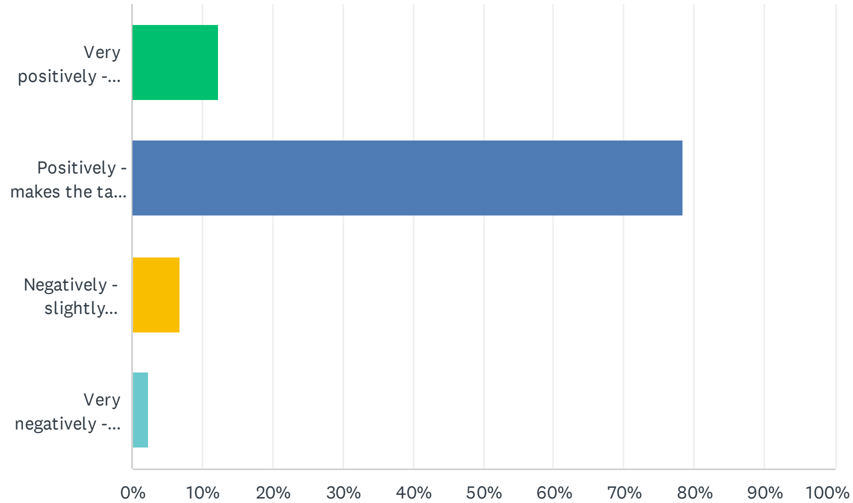
Q16 How would graduated flood hazard and risk data help you prepare for climate change, as compared to the current binary approach?

Answered: 391 Skipped: 40



ANSWER CHOICES	RESPONSES	
Very positively - would not be able to prepare without it.	12.28%	48
Positively - makes the task easier	78.52%	307
Negatively - slightly hinders ability to prepare	6.91%	27
Very negatively - makes preparing much more challenging	2.30%	9
TOTAL		391

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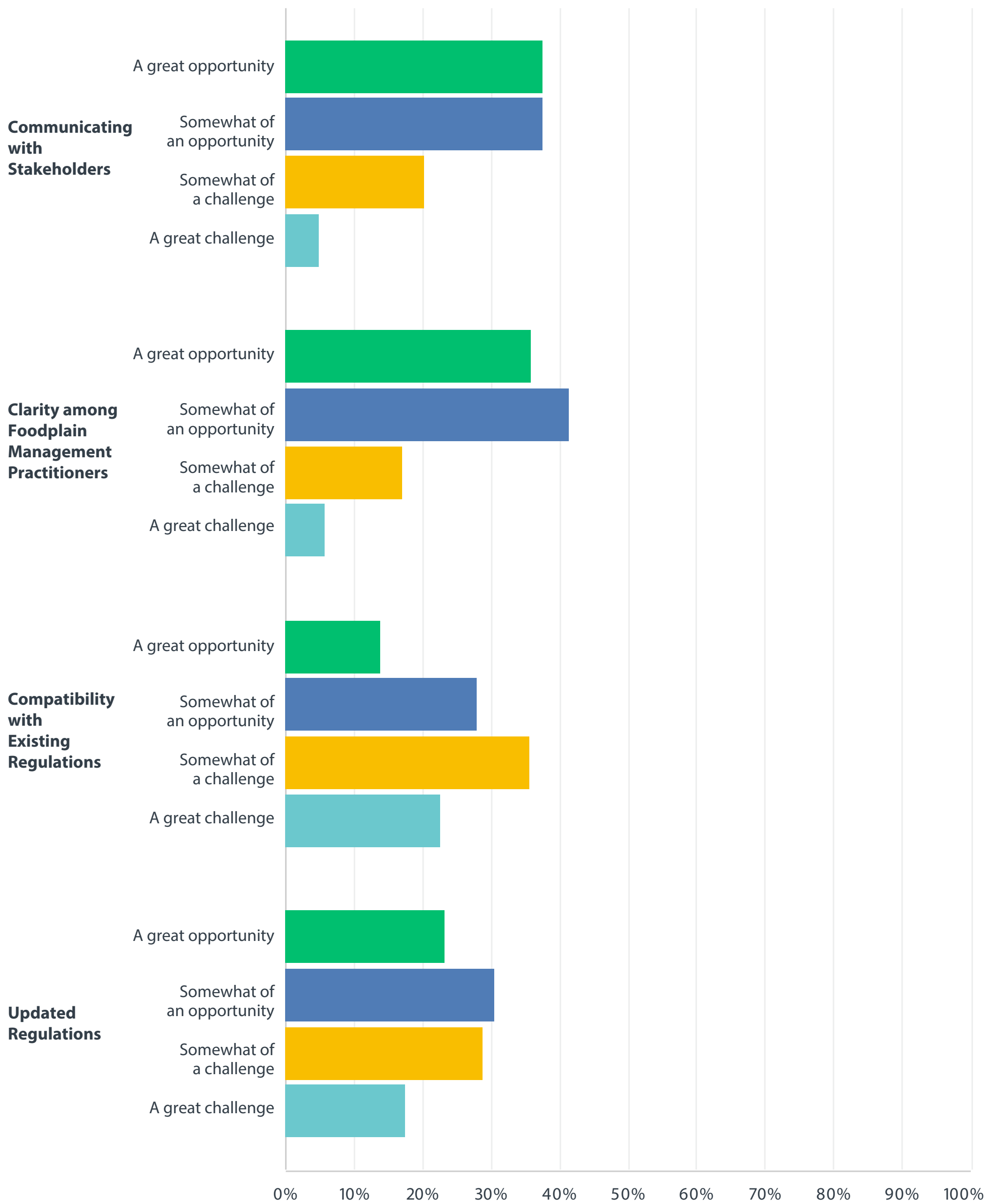
Q17 Graduated flood hazard and risk data present opportunities or challenges as you help your community prepare for climate change in the following areas?

Answered: 392 Skipped: 39



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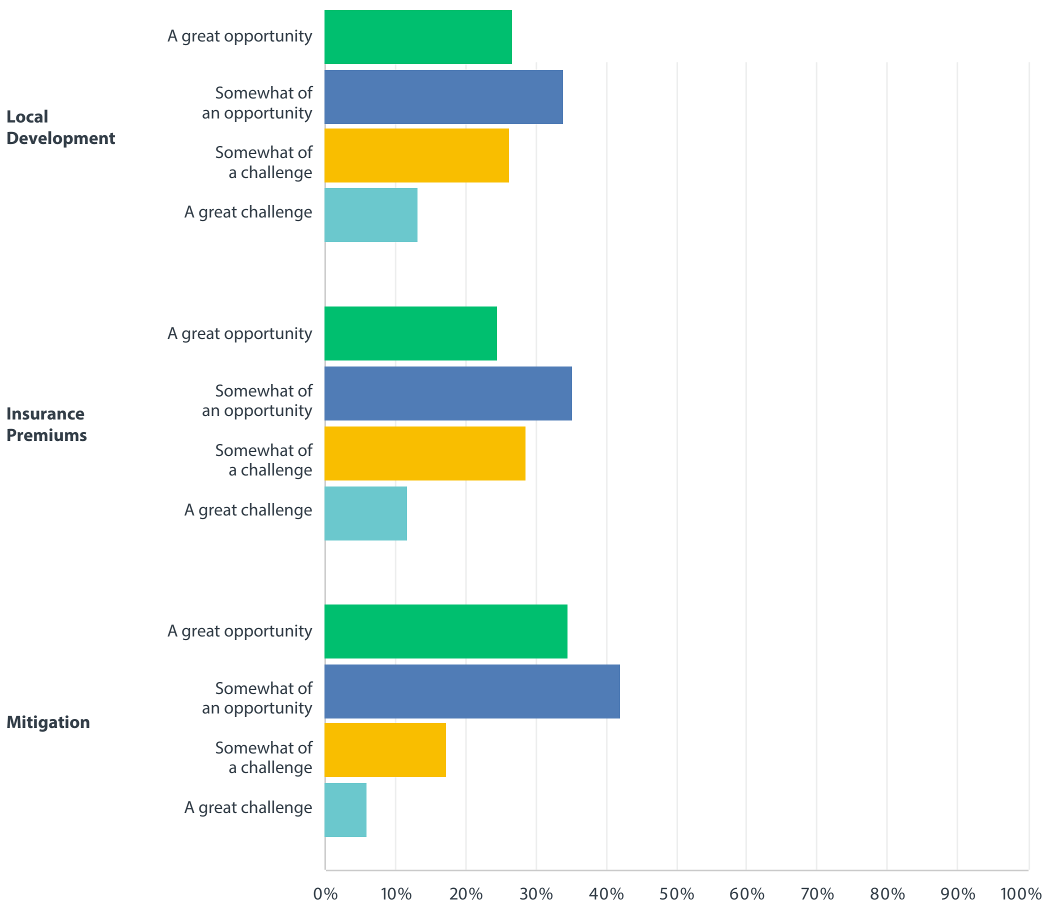
Q17 (continued)



	A GREAT OPPORTUNITY	SOMEWHAT OF AN OPPORTUNITY	SOMEWHAT OF A CHALLENGE	A GREAT CHALLENGE	TOTAL	WEIGHTED AVERAGE
Communicating with stakeholders	37.50% 147	37.50% 147	20.15% 79	4.85% 19	392	1.92
Clarity among floodplain management practitioners	35.84% 138	41.30% 159	17.14% 66	5.71% 22	385	1.93
Compatibility with existing regulations	13.80% 53	27.86% 107	35.68% 137	22.66% 87	384	2.67
Updated regulations	23.14% 87	30.59% 115	28.72% 108	17.55% 66	376	2.41
Local development	26.58% 101	33.95% 129	26.32% 100	13.16% 50	380	2.26
Insurance premiums	24.45% 89	35.16% 128	28.57% 104	11.81% 43	364	2.28
Mitigation	34.47% 131	42.11% 160	17.37% 66	6.05% 23	380	1.95

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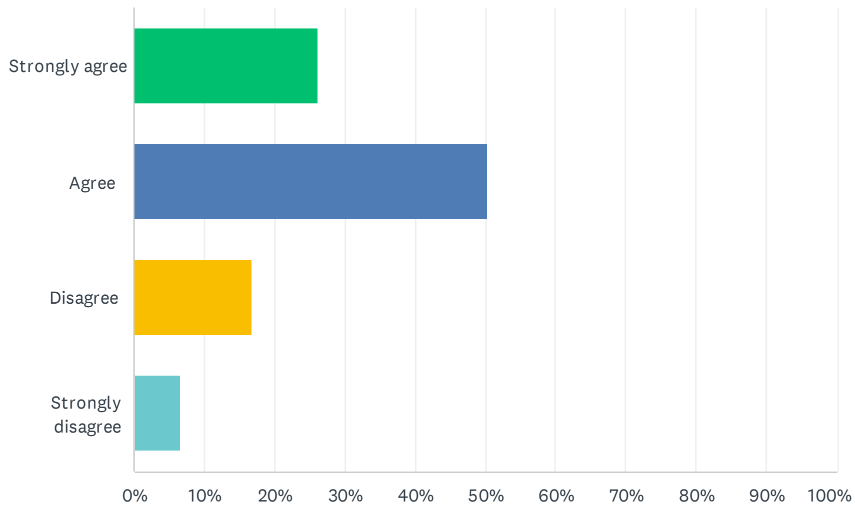
#	OTHER (PLEASE SPECIFY)	DATE
1	Is the failure to provide detailed enough information about flood risk the reason that the original goals of the NFIP (reduce exposure to flood damage and manage the residual exposure) have been so imperfectly realized?	7/14/2021 2:54 PM
2	Many individuals in my community do not agree with concept of climate change	7/14/2021 8:03 AM
3	I have no idea	7/14/2021 7:13 AM
4	I believe increased drainage tiles in farm fields are more of a flooding risk than whatever climate change is this week.	7/13/2021 3:21 PM
5	Unfortunately, none of these maps change mandatory purchase in the 1%AC flood zone	7/10/2021 6:40 AM
6	it's too complicated for non CFMs to understand	7/9/2021 1:42 PM
7	I am not sure about any of these	5/28/2021 5:06 AM
8	See previous comments.	5/26/2021 7:47 AM
9	The issue with these questions is that it provides no option for unknown. Additionally, if I can't understand the impact, how will the public?	5/20/2021 5:44 AM
10	Love the idea... my concern is that the level of detail and granularity of mapping implies accuracy that may not be realistic and cumbersome to manage expectations of development and homeowners when evaluating risks.	5/18/2021 6:43 AM
11	The complexity of risk will drive overall willingness for increased Federal/State investment in mitigation programs ... don't be afraid to move away from dated binary approaches.	5/14/2021 6:27 PM
12	Smaller and rural communities will struggle to administer the floodplain regulations.	5/14/2021 2:24 PM
13	Mitigation is a great opportunity, but will be a challenge until data is being made available (pluvial flooding in particular)	5/14/2021 8:20 AM
14	dont know enough to answer	5/13/2021 9:53 AM
15	no	5/13/2021 9:07 AM
16	Still too many unknowns-esp.precip-about size of the changes & difficult to correctly identify trends for non-coastal communities. You think COVID-19 has a lot of unknowns!	5/12/2021 7:19 PM
17	If AALs can be provided, then we have so much more data	5/12/2021 6:09 AM
18	a great opportunity or great challenge both require significant work on the part of local government to implement, none of this will be easy and FEMA is not even close to showing a product to evaluate (by product I mean full coverage of a community that can be equitably regulated)	5/8/2021 6:58 AM
19	Presenting worst case / long term future scenarios is a challenge even when disguised with 'graduated' data	5/7/2021 1:04 PM
20	Cost benefit is linked to base level flooding	5/7/2021 12:01 PM

Q18 When considering whether the NFIP allows State, Local, Tribal, and Territorial entities (SLTTs) to play a sufficient role in developing flood hazard information, you:

Answered: 411 Skipped: 20



ANSWER CHOICES	RESPONSES	
Strongly agree	26.28%	108
Agree	50.36%	207
Disagree	16.79%	69
Strongly disagree	6.57%	27
TOTAL		411

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Q19 What could communities like yours provide to FEMA to help them develop more localized understanding of flood hazard and flood risk?

Answered: 259 Skipped: 172

#	RESPONSES	DATE
1	Local knowledge and data. Also what is most important to them.	8/31/2021 7:40 PM
2	Participation in the technical process to obtain better understanding that can be passed on to property owners. The FIS does not provide adequate depth of information.	8/31/2021 9:58 AM
3	N/A- however community partners often understand and know flooding problems they face in their communities which are not reflected on FEMA flood maps	8/23/2021 9:51 AM
4	local knowledge, relationships and resources	8/12/2021 8:37 PM
5	Not much very the Council of Governments as begun a climate adaptation and action plan.	8/12/2021 6:02 AM
6	Current aerial mapping GIS	8/5/2021 5:18 AM
7	Base mapping and zoning regulations that tie FIRM standards to the local design standards.	8/4/2021 1:45 PM
8	Actual drainage and water management maps.	8/3/2021 2:08 PM
9	Input into the restudy and remapping process before workmaps generated and study/restudy performed. More input into Scoping and scheduling...	8/2/2021 12:15 PM
10	planning interaction specific to anecdotal and local data outside of the CAV process and the HMP process (ie: interaction this is not connected to regulatory compliance)	7/30/2021 7:25 AM
11	Citizen feedback on flood impacts on them.	7/28/2021 10:44 AM
12	Updated hydraulic and hydrologic studies and historic flow data.	7/23/2021 3:14 PM
13	Past flood level elevations. Man-made drainage ditch hydraulic information.	7/22/2021 9:08 AM
14	The actual flooding that takes place.	7/19/2021 3:43 PM
15	Historical data, some of which is anecdotal but could be supported by hard data.	7/19/2021 1:32 PM
16	The rural aspect of how changing river flow and rain fall amounts effect the water in town	7/19/2021 12:15 PM
17	get FEMA boots to come out and look at things first hand	7/19/2021 6:26 AM
18	Critical Facility locations.	7/19/2021 6:12 AM
19	N/A	7/17/2021 7:08 AM
20	I'm not sure.	7/16/2021 12:36 PM
21	specific details of events	7/16/2021 12:14 PM
22	Historical facts and perspectives. Input to more accurate and detailed information.	7/16/2021 11:51 AM
23	data on flooding in areas	7/16/2021 11:19 AM
24	Current FIRMs with LOMA's, History of flood occurances and related damages or averted damaged, community projects including river bank stabilization , local ordinances that may contain higher standards .	7/16/2021 8:28 AM
25	Past flood elevation data.	7/16/2021 8:23 AM
26	Implementing a sideways dam as a means to achieve many objectives that address the needs and concerns with river flow!? Green Energy Water Parks, USA is not typical flood prevention by design but it can mitigate increased water flow during flooding by shielding developed areas and absorb excess water with minor effect compared to traditional barriers or dams!?	7/16/2021 7:56 AM

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27	clear understand of time frame to get ready, prepare and have no lengthy delays of the officials	7/16/2021 7:48 AM
28	PERSONAL A	7/16/2021 7:01 AM
29	Historical community accounts of recorded events.	7/15/2021 3:22 PM
30	FEMA can use more detail studies done by County and consultants. Most of private studies use field survey which is the best data to use.	7/15/2021 1:51 PM
31	practical knowledge, such as flood nuisance plans	7/15/2021 10:17 AM
32	More detailed flood modeling and more real world data points for calibration of FEMA's models.	7/15/2021 9:56 AM
33	Modeling needs to be in line with actual events.	7/15/2021 9:32 AM
34	Local and current information such as stormdrain networks, design information on large culverts, updated terrain information and some project information that might impact the flooding information either positive or negatively.	7/15/2021 8:46 AM
35	Culvert type and dimensions, perhaps periodic survey of condition (5 year interval).	7/15/2021 8:27 AM
36	Consider some aspect of flood hazards and flood risk other than the technical/engineering matter of probability and magnitude. Seek to understand the psychological, social, economic, historic, political, and religious reasons why people do not see flooding as a "risk" that requires their action, or why they don't see themselves as subjects capable of taking "action" to change the world (like an engineer would). The NFIP is dependent on a specific outlook on the world that is not universally shared and that is becoming less convincing, not more convincing, to more of the population. Providing more information, more facts, more analysis, more "products," will not change that.	7/14/2021 2:54 PM
37	local drainage studies	7/14/2021 2:51 PM
38	n/a	7/14/2021 2:13 PM
39	Local knowledge, historic data and documentation from flood events	7/14/2021 12:10 PM
40	The field and most accurate data of the communities and stakeholders	7/14/2021 9:42 AM
41	(1) Remove manmade/highly managed/manipulated agricultural drains from flood maps. They cannot be operated/"administered" in the same manner as a natural river/stream. They cant be hydrologically monitored or analyzed in the same manner as a natural system. Every time FEMA puts a floodplain/way on an agri drain or canal its forcing a square peg into a round hole and upsets local agencies. Please stop! (2) See item 12 - disparity between flood history & climate and floodplain requirements from community to community.	7/14/2021 8:03 AM
42	I have no idea	7/14/2021 7:13 AM
43	map studies	7/14/2021 6:48 AM
44	Information on infrastructure, flood mitigation practices currently in place, anecdotal data on floods and how they affected landowners.	7/13/2021 3:32 PM
45	Participate in discussion opportunities. Bring FEMA to the field to look at local issues and challenges. Include FEMA in community discussions so they hear from citizens and the public directly. Share positives and negatives for learning.	7/13/2021 3:21 PM
46	Farm tile locations if we have them.	7/13/2021 3:21 PM
47	LiDAR	7/13/2021 2:34 PM
48	Personal experience of events, severity, frequency, historical changes - local knowledge spanning decades.	7/13/2021 2:26 PM
49	Historical background for trouble areas	7/13/2021 2:00 PM
50	Local knowledge, irrigation management contacts.	7/13/2021 1:34 PM
51	On the ground experience	7/13/2021 1:22 PM
52	First- Coordinate all available Federal data prior to publishing proposed maps Second- Do not rely on local governments to check your work Third- Don't allow your subcontractors to use "limited scope" as a reason to do shoddy work	7/13/2021 12:44 PM

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53	Local insight	7/13/2021 11:36 AM
54	information on local rainfall events and corresponding flood elevations at key locations and critical structures.	7/13/2021 11:14 AM
55	Mapping program that shows the state as whole, not just a community or a flood map but end to end on program that can be accessed and zoomed in on.	7/13/2021 9:16 AM
56	Hard to say. I think people rely on memories of recent flood events (or lack of) to decide whether flood hazard and risk data make sense to them. Understanding of probability and uncertainty are hard to communicate.	7/13/2021 7:45 AM
57	local Knowledge	7/13/2021 7:00 AM
58	No idea	7/13/2021 6:53 AM
59	Local experiences, local history of flooding	7/13/2021 6:32 AM
60	More specific areas where flooding occurs to make maps more clear and accurate.	7/13/2021 6:30 AM
61	FEMA is good at remapping areas that have been SFHA for years, and following their specifications. However, FEMA does not generally add new floodplain as risk changes, including at the headwaters (smaller than 1 square mile watershed) and in urban areas that experiences pluvial flooding.	7/12/2021 10:54 AM
62	Not much at this time.	7/12/2021 10:09 AM
63	Nothing, it's all topo and FIRM mapped.	7/12/2021 9:45 AM
64	updated topography, storm sewer mapping/modelling, tiling information, detailed flood studies	7/12/2021 9:17 AM
65	SIMPLE IMAGES, PICTURES, SIMPLE LANGUAGE	7/12/2021 8:20 AM
66	historical flooding context	7/12/2021 8:05 AM
67	Some percent risk maps already created, LiDAR for the state, engineers who understand the soils, rainfall, and landscape of the state.	7/12/2021 7:55 AM
68	Change the message to everyone can flood, know your risk.	7/12/2021 7:12 AM
69	Personal testimony, technical data.	7/12/2021 3:29 AM
70	Higher State standard map areas and State regulated riparian buffers.	7/10/2021 6:40 AM
71	integration of watershed mapping and management with NFIP mapping.	7/9/2021 2:13 PM
72	PR campaign.	7/9/2021 2:13 PM
73	what could FEMA provide to my community is the better question...	7/9/2021 1:42 PM
74	better survey data	6/9/2021 2:20 PM
75	Copies and data from local studies that establish water surface elevations for differing storm events. Data from local river gauges and from local weather stations	6/9/2021 7:48 AM
76	local knowledge as to what floods/ what does not. local knowledge as to how well the dunes protect but lowe bulkheads bay side do not - local knowledge that storm sewers/drains built in 1920 are inadeqaute & are a souce of nuisance flooding	6/3/2021 9:13 AM
77	Where local flooding should occur	6/2/2021 2:48 PM
78	The IN DNR, Division of Water will be submitting their Best Available Flood Hazard Layer to FEMA for review and, if approved, incorporated into the FIRMs.	6/2/2021 2:15 PM
79	Use the information	6/2/2021 10:09 AM
80	maps of storm drainage systems, detention/retention ponds	6/1/2021 4:17 PM
81	information from previous flood events, as well as mitigation measures.	6/1/2021 3:04 PM
82	We tried appealing the latest FIRMs in our community based on alternative calculations. FEMA said no thanks, we like our maps the way we created them. So at this point, I guess FEMA doesn't want our input.	6/1/2021 12:33 PM

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83	Known flood locations - however, many communities lack the capacity to collect and manage this kind of data. Support for local data collection is key.	6/1/2021 7:45 AM
84	Whether there are any locally developed highwater marks and identifying areas subject to flooding that are not currently mapped.	6/1/2021 7:04 AM
85	The Highway Department has information on culverts and bridges crossing waterways which might assist in technical calculations. Some historical aerial data. LiDAR data. Identified critical watersheds for further developmental impacts. Some karst information.	6/1/2021 6:33 AM
86	More local information and definition of area.	6/1/2021 5:57 AM
87	Not sure. During our last remapping data was provided however not all of it was utilized and ended up with only slightly better maps.	5/31/2021 5:20 AM
88	I totally do not know an answer to this question. I cannot find any previous Town Council Member's notes having any input or even any interest in this project. Thus my interest in same.	5/30/2021 10:46 AM
89	Historical information	5/29/2021 11:34 AM
90	FOR FEMA TO RECOGNIZE JURISDICTIONAL AREAS BASED ON OUR MAPPING OR ORDINANCES NOT WHT THEY THINK IT SHOULD BE	5/28/2021 1:16 PM
91	Feedback on actual storm events and flooding observed.	5/28/2021 11:47 AM
92	better data if reporting methods and requirements were improved	5/28/2021 11:14 AM
93	The mission and priorities of the development and zoning commissions.	5/28/2021 6:20 AM
94	Identify history of flooding and impacts to compare with insurance claims.	5/28/2021 6:15 AM
95	Flood studies performed by developers.	5/28/2021 5:52 AM
96	knowledge of flood areas	5/28/2021 5:49 AM
97	FEMA is generally disconnected and not concerned about local officials or owners. FEMA does not have a general understanding of the limits and roles of zoning requirements.	5/28/2021 5:46 AM
98	Generalized areas of local current flooding. Generalized areas of land development forecasting to obtain detailed studies before development.	5/28/2021 5:36 AM
99	I'm not sure what we could provide as I don't know what isn't provided.	5/28/2021 5:09 AM
100	With more training, I am sure we could work very closely to develop a more localized understanding of flood hazard and flood risk	5/28/2021 5:06 AM
101	Date-stamped drone picture/video of flood events	5/28/2021 4:57 AM
102	participation in development, ownership/support of the results	5/28/2021 4:52 AM
103	Not enough experience to answer this question.	5/28/2021 4:39 AM
104	support and data	5/27/2021 4:41 AM
105	N/A	5/26/2021 8:39 AM
106	See previous comments.	5/26/2021 7:47 AM
107	knowledge of localized flooding	5/25/2021 11:32 AM
108	workshops for local floodplain managers	5/25/2021 6:30 AM
109	risk input - many houses fully in the SFHA have never flooded, while others on the fringe or even outside the SHFA have flooded.	5/24/2021 10:34 AM
110	Past and recent studies showing flooding in urban areas, historic waterways, basement pumping records from local DPWs/fire depts...	5/24/2021 9:04 AM
111	Data from local storm events.	5/24/2021 7:43 AM
112	more accurate data	5/21/2021 1:34 PM
113	No comment	5/20/2021 5:44 AM

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114	historical flooding problems and local data	5/19/2021 10:02 PM
115	Historical data. What & where flooding happens in certain rain events.	5/19/2021 6:08 PM
116	Nothing	5/19/2021 1:49 PM
117	acknowledging or approve use of local bfe	5/19/2021 1:42 PM
118	Better coordination and more personal teamwork (brainstorming).	5/19/2021 12:06 PM
119	on the ground knowledge	5/19/2021 11:06 AM
120	outreach to local officials	5/19/2021 10:31 AM
121	The CAP program needs to be expanded. I'm performing CACs now and from what I see we do not contact the local folks nearly enough. Decades go between visits.	5/19/2021 9:02 AM
122	local depressional flooding analysis/historic flood elevations in Zone A areas, river gauge data (flows are often too low)	5/19/2021 8:58 AM
123	Tie mitigation funding to involvement in FEMA flood hazard and flood risk meetings. Few communities participate in the flood hazard and flood risk meetings at early stages and then cause delays to later updates because of their lack of involvement. Incentivizing involvement early in the flood hazard and flood risk process could have a positive cost benefit by keeping projects on budget and on time by addressing community concerns earlier.	5/19/2021 7:48 AM
124	Floodplain maps.	5/19/2021 7:37 AM
125	A simple, electronic way to provide feedback on local maps.	5/19/2021 7:36 AM
126	Understanding areas that need additional study.	5/19/2021 7:36 AM
127	Updated information, but that requires resources.	5/19/2021 7:36 AM
128	More site-specific information on flooding extent at various storm event levels, including unmapped flood hazard areas	5/19/2021 7:34 AM
129	More granular data.	5/18/2021 6:52 PM
130	Flood data.	5/18/2021 5:32 PM
131	local studies	5/18/2021 3:52 PM
132	The large number of A zones	5/18/2021 1:43 PM
133	Human interaction and local products	5/18/2021 9:16 AM
134	Historical events reference of recurring loss properties.	5/18/2021 8:44 AM
135	They don't listen to local Water Management Districts who have collected so much data to prove the models wrong.	5/18/2021 8:04 AM
136	my community has many watershed models that are not currently on the FEMA maps and we started submitting them to FEMA via MT-2 applications. our models seem to change faster than FEMA can process them	5/18/2021 7:41 AM
137	All new development plans showing changes in the ground elevations. Survey elevation of all properties within the community.	5/18/2021 7:24 AM
138	new subdivision plans	5/18/2021 7:11 AM
139	Elevation certificate data	5/18/2021 6:26 AM
140	Storm calculations for projects in the watersheds.	5/18/2021 5:53 AM
141	Stormwater routing data and ICPR data we have. Historical data about king tide elevations.	5/18/2021 5:53 AM
142	Require FEMA mapping contractors to fully communicate while developing information not late in the process eliminating ability to modify due to contract expenses already utilized.	5/18/2021 5:09 AM
143	exact locations of flooding	5/18/2021 4:56 AM
144	historical observations, real time event reporting, actuary risk.	5/18/2021 4:44 AM

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145	Boots on the ground and local knowledge. Open and honest discussions about the maps with the people that are in the know, not just the administrators and bureaucrats	5/18/2021 4:32 AM
146	local known flood issues and locations	5/17/2021 7:44 PM
147	Historical Data	5/17/2021 12:53 PM
148	communication with the locals and smaller towns.	5/17/2021 12:16 PM
149	Focus more on the SRL properties.	5/17/2021 8:32 AM
150	Mountain regions are not the same as flat land. Fema people need to have common sense to work with normal day to day people.	5/17/2021 7:10 AM
151	I don't know.	5/16/2021 11:11 AM
152	Local awareness maps, but also HISTORICAL event specific inundation information. CDWR prepared a CA Flood Future report with an atlas listing the actual high level / county historical flood events. FEMA could host a historical inundation portal to inform risk messaging, complete with layers representing mitigation structural features and layers illustrating some degree of non-structure actions.	5/14/2021 6:27 PM
153	Interactive web sites allowing people to upload pictures, experiences, anecdotes for particular locations	5/14/2021 5:42 PM
154	Common sense information regarding smaller community issues and challenges with administering.	5/14/2021 2:24 PM
155	flash flood or flood outside delineated areas map by community	5/14/2021 12:15 PM
156	My community supplied over 100,000 elevation data points from our digitized EC layer to help supplement the maps - this approach should be utilized nationwide.	5/14/2021 11:49 AM
157	No suggestion	5/14/2021 9:30 AM
158	A Model locality: We are between the Intracoastal Waterway and the Atlantic Ocean and we receive torrential rains on a regular basis.	5/14/2021 9:26 AM
159	Broader perspective. To date, it does not appear that FEMA Mitigation, Floodplain Management & Insurance, and Risk Analysis branches have coordinated their understanding of the implications of RR2.0 (graduated hazard data). For example, the Local and State Hazard Mitigation Planning guides are soon to be released. I am confident that they won't consider pluvial modelling for RR2.0. Similarly for mitigation, upward pressure on premiums is a great opportunity, but HMA staff seems unprepared to leverage RR2.0 resources. Last, but not least, upon the implementation of RR2.0, we will have two "parallel universes" in which LOMCs, the mandatory purchase requirement, the footprints for various Executive Orders, etc, are based on FIRMs, while policy-rating is not. This induces undue complexity, though it is apparent that the issue stems from FEMA's need to act on the NFIP whereas congressional action is needed for other elements of FIRM's use.	5/14/2021 8:20 AM
160	local knowledge and experience, technical expertise (to a degree)	5/14/2021 6:48 AM
161	If money was available, we could better document and mitigate flooding and risks	5/14/2021 6:26 AM
162	historical data. drainage infrastructure improvements	5/14/2021 5:59 AM
163	localized information	5/14/2021 5:54 AM
164	Local benchmarks and historic data of those low-lying areas already affected by sea level rise and King Tides.	5/13/2021 2:42 PM
165	Not sure	5/13/2021 2:23 PM
166	An earful.	5/13/2021 2:11 PM
167	More state and local participation in development of FEMA's flood risk products	5/13/2021 1:17 PM
168	I'm not convinced that a more localized understanding of flood hazard and flood risk will help us make better decisions and become more resilient. There is already SO MUCH information and data out there and we aren't sure how to use what when. Will this new data change the outcomes? Will is make us more resilient? Right now we can't even decide on what decisions need to be made let alone what needs to be done and how we should get there.	5/13/2021 1:12 PM

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169	Not sure at this point	5/13/2021 1:12 PM
170	Local knowledge	5/13/2021 1:07 PM
171	Data on development patterns, visioning documents for priority growth areas, Information on localized flooding and drainage systems, local-specific information on industrial or heavy commercial operations close to Flood Hazard areas.	5/13/2021 1:01 PM
172	Historical flooding events and document high water level.	5/13/2021 12:17 PM
173	Provide data of flooding that is documented after each incident.	5/13/2021 12:16 PM
174	Drainage system maps and/or GIS data.	5/13/2021 12:00 PM
175	information and data related to historic events and flood extents.	5/13/2021 11:49 AM
176	Community input for local flooding that is not part of the floodplain but is still flood prone.	5/13/2021 11:47 AM
177	list of most frequent resident questions	5/13/2021 11:34 AM
178	Review and potential removal of Zone A designations on lakes and streams that were previously adopted by the community. Graduated risk on lakes might be helpful. Some streams have been diverted through large irrigation projects and no longer exist in their historic channels.	5/13/2021 11:28 AM
179	LiDAR, CTP studies, soil studies	5/13/2021 11:17 AM
180	Yes	5/13/2021 11:07 AM
181	Photos and records of flood events.	5/13/2021 10:55 AM
182	Historical evidence, Nuanced reports, Snow and Rainfall levels	5/13/2021 10:42 AM
183	N/A	5/13/2021 10:40 AM
184	None. We have a small community with little impact on flood hazard from development.	5/13/2021 10:37 AM
185	Local knowledge	5/13/2021 10:23 AM
186	Technical assistance and guidance	5/13/2021 9:53 AM
187	knowledge of repetitive flood prone areas	5/13/2021 9:53 AM
188	We have developed proven targeted outreach strategies based on data we had to painfully extrapolate from FEMA/NFIP. Our targeted outreach strategies have resulted in an 80% NFIP up-take rate within Norfolk's Special Flood Hazard Area (national up-take average in the SFHA is 30%), and an equal number of NFIP policies outside our SFHA (over 12,000 policies total). However, we are repeatedly met with ever-increasing obstacles to obtaining the annual NFIP data needed to improve our outreach and to track up-take, coverage and mitigation changes that occur year-over-year. Most recently, we've had to seek counsel from an attorney in order to assist with our request for NFIP data, even though our purposes clearly meet the federal permitted routine uses.	5/13/2021 9:51 AM
189	I need to see our FIRMs updated so that BFEs are made available for all unstudied streams. We have several revised FIRMs (thankfully) but streams still have areas that have not been studied.	5/13/2021 9:51 AM
190	Better understanding of community conditions and local government that play into flood hazards and flood risk.	5/13/2021 9:50 AM
191	LiDAR, high water marks, parcel information.	5/13/2021 9:42 AM
192	Flood mapping	5/13/2021 9:42 AM
193	Maybe some available LIDAR data.	5/13/2021 9:42 AM
194	understand this is not just about data- this is about people's homes and their lives	5/13/2021 9:36 AM
195	Insurance community should agree to allow FEMA to map rep loss areas in CRS communities	5/13/2021 9:34 AM
196	understanding of rural Western residents attitudes	5/13/2021 9:29 AM

197	Levee overtopping risks, dam overtopping risks.	5/13/2021 9:21 AM
198	we provide the reviews of the maps	5/13/2021 9:17 AM
199	Floodplain and flooding studies Local accounts of flooding activities Geospatial data of developed areas	5/13/2021 9:17 AM
200	LiDAR	5/13/2021 9:16 AM
201	Local floodplain management officials need to be directly and actively participating on FEMA HQ Committees and Task Forces because there is a huge reality disconnect between HQ and local communities. FEMA seems uncomfortable having local community on-the-ground expertise on their committees and task forces.	5/13/2021 9:16 AM
202	On site tour	5/13/2021 9:15 AM
203	Work with people who have to administer this program daily. Those who have been to court over and over again could provide the biggest insight on the changes that are being proposed and how the community will be impacted or how they can legally defend their regulations, permitting processes, and mapping information.	5/13/2021 9:12 AM
204	input on regulatory products and insurance rating procedures.	5/13/2021 9:11 AM
205	frequency of flooding should be considered	5/13/2021 9:11 AM
206	Outreach session, story boards that are localized and meeting the folks where they are, not at the most convenient times for FEMA regional staff	5/13/2021 9:10 AM
207	data, public buy-in	5/13/2021 9:09 AM
208	Local storm drainage/creek studies, and updated FIRMs. FIRM updates more regularly.	5/13/2021 9:08 AM
209	N/A	5/13/2021 9:06 AM
210	Communities have knowledge of floodprone ares that are not currently mapped or designated	5/13/2021 9:06 AM
211	n/a	5/13/2021 9:04 AM
212	Good mapping data that ACTUALLY accounts for the flooding coming out of Mexico.	5/13/2021 9:02 AM
213	N/A	5/13/2021 9:01 AM
214	flooding data	5/13/2021 9:00 AM
215	involvement of community stakeholders as much as possible - coordinating meetings, targeted outreach, etc	5/13/2021 7:23 AM
216	We need increased FEMA staffing (not consultants!) to interact with and provide suggestions and knowledge to local communities. Consultants that are here today and gone tomorrow just increases FEMA staff's lack of familiarity with the communities they are supposed to serve. Consultants can't replace our FEMA representatives. A consultant found out they made a mistake by not including one of the cities in their risk map. If they'd looked at a map (instead of GIS) for 2 minutes or were working with FEMA staff who knew something about the watersheds and communities it wouldn't have happened. She wasn't pleased when I pointed it out.	5/12/2021 7:19 PM
217	Ask for their opinion.	5/12/2021 8:37 AM
218	areas of growth, resiliency studies, land slide areas, localized flooding, infrastructure information	5/12/2021 6:15 AM
219	Need to recouple mapping and insurance rating otherwise my LOMR does nothing	5/12/2021 6:09 AM
220	digital/spatial records of flooding issues with notes or areas of concern	5/11/2021 9:38 PM
221	We have more information about storm damages that could be considered in map updates.	5/11/2021 1:14 PM
222	Better topo might be available.	5/11/2021 11:50 AM
223	Anecdotal and documented past flood data.	5/11/2021 9:37 AM
224	That people who live in flat drought stricken areas are not worried about flooding and as floodplain managers in these areas it is hard to convince people to adopt higher standards,	5/11/2021 8:58 AM

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	when they don't see it as a priority.	
225	local information and better imagery	5/11/2021 8:46 AM
226	Statewide LIDAR in NC	5/11/2021 6:57 AM
227	Localized flooding is a big issue in some parts of our region. This is mainly associated with historical streams - we use historical stream and "blue spots" in GIS to pinpoint these areas.	5/11/2021 6:48 AM
228	NCDOT could provide data on historical flooding data on NCDOT structures.	5/11/2021 6:30 AM
229	Localized and specific individual structure or building data that communities collect	5/11/2021 6:02 AM
230	NCDOT has over 100 years of flood history records on highway drainage structures. We also are leveraging technology to develop new tools for early flood warning systems, etc. with our partners at NCEM.	5/11/2021 5:55 AM
231	1. FEMA needs to understand that communities deal with more issues than just flooding, so often the floodplain administrator may spend less that 5% of their time on flood management. The difficulties of enforcement at the local level of zoning rules under sever development pressure.	5/10/2021 7:05 PM
232	More detailed local scale terrain and elevation data.	5/10/2021 1:41 PM
233	Local flood histories	5/10/2021 11:26 AM
234	ask about most recent flood data that we may have (on a regional level); continue to run them by us before they are published	5/10/2021 9:45 AM
235	Anecdotal information. We don't have the resources or capacity to provide much in the way of technical data. Rather we could provide historical knowledge of where past floods have impacted the community.	5/10/2021 6:26 AM
236	2-dimensional hydraulic analysis solutions supporting federal and state infrastructure project delivery	5/9/2021 3:16 PM
237	We are a CTP (previously a CTC) and in the decades of coordinating with the Region and mapping contractors the partnership feels like a one sided affair with us giving information and data but when we have priorities for QC review, implementation and targeted areas we face a wall of bureaucratic limitations, delays and silence. If there was "a better man" we would go find him but we are trapped in this relationship.	5/8/2021 6:58 AM
238	Outreach	5/7/2021 4:17 PM
239	citizen science accounts of actual flooding	5/7/2021 2:02 PM
240	King County already provides sufficient data	5/7/2021 1:49 PM
241	Field data, historic knowledge and anecdotal evidence	5/7/2021 1:17 PM
242	Historical data; boots on the ground analysis/groundtruthing	5/7/2021 1:13 PM
243	Information on flood damages to structures and infrastructure.	5/7/2021 1:10 PM
244	It's a tough sell in my region as many communities, driven by development and political pressure, coupled with the high cost of developing high quality, scientific and technically defensible information, see that as a low priority. In other regions these factors may be different, or their current culture may favor increased investment and value added conceptualization	5/7/2021 1:08 PM
245	Recent FEMA initiated LiMWA LOMR with opportunity to meet with consultants and ask detailed questions was excellent. Flood risk analysis must be more detailed for local urban areas, AND must account for local mitigation projects that reduce risks.	5/7/2021 1:04 PM
246	Updated maps	5/7/2021 12:47 PM
247	adoption of different sources of locally approved flood hazard information to fill in the gaps where FIRMs have no data.	5/7/2021 12:33 PM
248	to be honest, i have no idea	5/7/2021 11:48 AM
249	Depends on the community; convert approximate A to AE, assist in updating maps to reflect	5/7/2021 11:41 AM

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	current development	
250	Several communities in Delaware county, ny have completed local flood analyses plans to identify flood hazard. Fema support and funding would be greatly appreciated in moving the projects that were recommended in the plans.	5/7/2021 11:33 AM
251	not sure, need to think on this one.	5/7/2021 11:16 AM
252	We are preparing updated hydrologist modeling based on Atlas 14 that proves the 30 year-old FIS overstated 1% chance peak flows by 20% and suggests the SFHA could be reduced by as much as 80%.	5/7/2021 11:15 AM
253	Being a small community we have limited resources, but I can tell you where your maps don't look right. We are invested in scrutinizing your products and applying our local knowledge. But not all communities even have a CFM. Don't expect equal contributions from vastly differently resources communities.	5/7/2021 10:47 AM
254	Documentation of hazard events and time to recover. Mapping and detailed Watershed studies.	5/7/2021 10:46 AM
255	All news/TV/YouTube/internet, this is good way to collect feed back as well Reginal planning commissions can help FEMA consolidate all plans into one. Weekly/monthly webinars with interactive functions	5/7/2021 10:45 AM
256	historic flood data, information to better determine risk, LiDAR, hydraulic models, and insight into education efforts	5/7/2021 10:42 AM
257	Any and all data on historic flooding as well as development in the flood zones.	5/7/2021 10:42 AM
258	Historical flood information (water levels, damage done, extent of flooding)	5/7/2021 10:37 AM
259	accurate data from the local area	5/7/2021 10:36 AM

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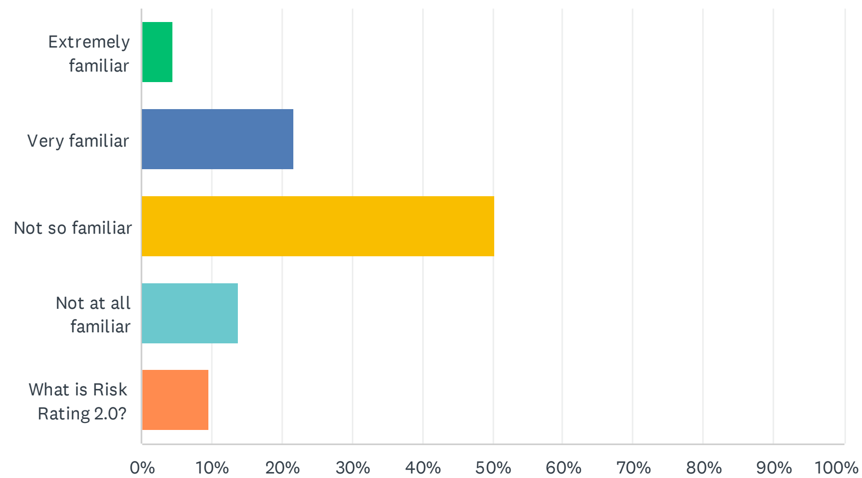
Q20 How well do you feel you understand the approach of FEMA's Risk Rating 2.0?

Answered: 426 Skipped: 5

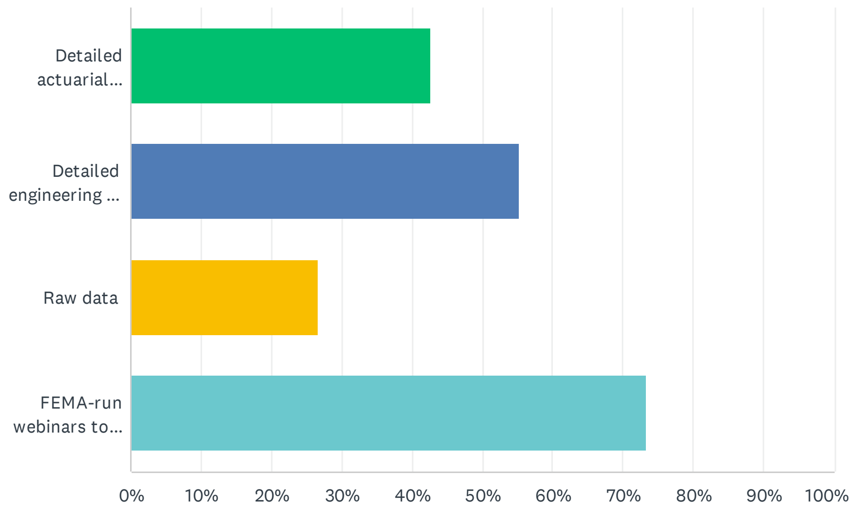


ANSWER CHOICES	RESPONSES	
Extremely familiar	4.46%	19
Very familiar	21.83%	93
Not so familiar	50.23%	214
Not at all familiar	13.85%	59
What is Risk Rating 2.0?	9.62%	41
TOTAL		426

2021 TMAC Stakeholder Engagement Survey

Q21 Is there any additional information you need from FEMA in order for your community to understand Risk Rating 2.0 well enough to communicate the new ratings system to your stakeholders?

Answered: 386 Skipped: 45



ANSWER CHOICES	RESPONSES	
Detailed actuarial rating methodology	42.75%	165
Detailed engineering and mapping methodology	55.18%	213
Raw data	26.68%	103
FEMA-run webinars to explain methods	73.32%	283
Total Respondents: 386		

#	OTHER (PLEASE SPECIFY)	DATE
1	Their message seems to be 'everyone is going to save money' but they haven't answered the question 'will these ratings increase the solvency of the NFIP? Or will the increase the debt of the program?'	8/16/2021 10:05 AM
2	Detailed written guidance for regulators and public	8/2/2021 12:15 PM
3	All of the above	7/19/2021 3:43 PM
4	How Risk Rating 2.0 integrated with Community Rating System, particularly for a community with a relatively small percentage of land in a flood plain.	7/15/2021 8:27 AM
5	Do not conceal any portion of the rating engine from the public behind proprietary rights. Do not obscure the rating methodology behind a cloud of obscurantism. The connection between the potential for flood damage to individual properties and the cost of flood insurance should be conceivable and understandable.	7/14/2021 2:54 PM
6	n/a	7/14/2021 2:13 PM

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7	?	7/14/2021 7:13 AM
8	Please see the answer to the previous question.	7/13/2021 2:34 PM
9	I don't know what it is	7/13/2021 6:53 AM
10	Very little detail has been presented to date. The only information we have is the state-specific information sheets online.	7/12/2021 9:45 AM
11	Pretty much any information beyond "it's a black box" will be additional information.	7/12/2021 9:17 AM
12	trainings (not just webinars) from non-FEMA peeps, but professional educators	7/9/2021 1:42 PM
13	make it as simple as selling car insurance	6/1/2021 4:17 PM
14	Targeted messages for various audiences and levels of understanding of the technology behind the ratings.	5/28/2021 6:15 AM
15	a series of Webinars graduating in understanding	5/28/2021 5:36 AM
16	Training/education	5/28/2021 5:06 AM
17	The differences in the use of the map with "current" regulatory standards in order to participate with the NFIP and CRS.	5/26/2021 7:47 AM
18	There is an unknown element in RR 2.0's "roll out" (among others that I probably am missing). The immediate is how will any stakeholder who decides to even attempt to open the Flood Insurance Manual (which is the only resource for the most part that even attempts to help communities understand NFIP policies) utilize it going forward. ASFPM has done their best (in my personal opinion) to communicate how RR 2.0 will affect communities, but telling us that the insurance industry has "got it from here" is a loaded statement, much like many of these questions. This survey appears like another way where FEMA gets to ask the unknown how we can provide answers about something we don't exactly understand.	5/20/2021 5:44 AM
19	personal outreach followed with webinars on specific topics	5/19/2021 9:02 AM
20	More information - and public information - is better than less	5/19/2021 8:58 AM
21	As long as rates are a 'black box', there is no incentive to begin mitigation projects because a community cannot test cost/benefits without access to the modeling.	5/19/2021 7:48 AM
22	One page handout for flood prone property owners that does more than just tout that 95-100% of people will have lower premiums	5/19/2021 7:36 AM
23	FEMA lately has been going a good job, at least some of the FEMA team -- FEMA's own team needs training on this as well	5/14/2021 6:27 PM
24	Competent and trustworthy personnel to provide instruction.	5/14/2021 2:24 PM
25	How to provide information when something seems off	5/14/2021 11:02 AM
26	General information in written form from FEMA	5/14/2021 9:26 AM
27	it's a black box to us now	5/14/2021 6:48 AM
28	There seems to be a lot of unanswered questions	5/14/2021 6:46 AM
29	More detail and transparency on estimating premiums	5/14/2021 5:54 AM
30	Distillation of actuarial rating, engineering and mapping methodologies that is appropriate for homeowners.	5/13/2021 1:12 PM
31	Better inform local FPMs to assist in management of the FP.	5/13/2021 11:32 AM
32	Cannot answer with no knowledge	5/13/2021 10:55 AM
33	Detailed info on the premium reduction benefits of mitigation measures to help property owners make informed decisions about which investments will provide the greatest return.	5/13/2021 10:55 AM
34	all	5/13/2021 10:37 AM
35	Not sure	5/13/2021 9:42 AM

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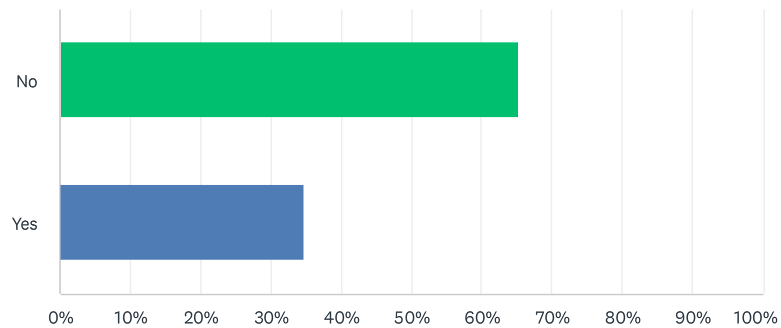
2021 TMAC Stakeholder Engagement Survey

36	Allow insurance agents to do their job. Realtors and floodplain managers should not be quoting. Encourage relationships.	5/13/2021 9:34 AM
37	Why is RR2.0 such a mysterious, non-communicated FEMA product?	5/13/2021 9:16 AM
38	transparency on hidden third party variables, get rid of the conflicting new terminology, and streamline again with the other parts of the NFIP.	5/13/2021 9:12 AM
39	Live time rating tables at outreach sessions - so if I elevate my home to this....what would my policy be	5/13/2021 9:10 AM
40	N/A	5/13/2021 9:06 AM
41	Assumptions that go into the model & how this is sufficiently more more specific than hazus products.	5/12/2021 7:19 PM
42	Cost-benefit analysis	5/12/2021 8:37 AM
43	they need to explain why insurance and mapping are decoupled	5/12/2021 6:09 AM
44	How the heck to I design and premium-rate a building?	5/11/2021 6:57 AM
45	run test rates to the buildings in my community where I know the risk and see if RR2.0 measures up. Demos always look good but the proof is does it work in my community. I have read every public report FEMA has issued on RR2.0 and still do not know if it will be valid in my community	5/8/2021 6:58 AM
46	Mitigation Credit details (Submit for Rates as they apply to Risk Rating 2.0)	5/7/2021 1:49 PM
47	Community specific ratings based on claims history (accounting for mitigation and locally specific factors)	5/7/2021 1:04 PM
48	need a standard map or output of results. Easy to explain and use	5/7/2021 12:13 PM
49	one of my communities has many pre FIRM homes with basements that will pay full risk premium under RR2.0. Need mitigation help, but State OEM is reluctant to help.	5/7/2021 11:41 AM
50	Digital maps showing risk	5/7/2021 11:16 AM
51	Assurance that ratings can and will be improved with best available data and/or mitigation.	5/7/2021 11:15 AM
52	Data for Home Owners and Insurance Agents.	5/7/2021 10:46 AM

Q22 Do you include any forecasting of future flood conditions based on future land use, population change, climate change, sea level rise, etc. in any of your management or planning decisions?

Answered: 400 Skipped: 31



ANSWER CHOICES	RESPONSES	
No	65.25%	261
Yes	34.75%	139
TOTAL		400

#	IF YES, WHAT?	DATE
1	as required by CEQA and regulatory agencies	8/31/2021 9:58 AM
2	Often conduct vulnerability assessments for regional area that lack technical capability, using NOAA's Sea Level Rise and coastal inundation data sets, USGCRP Climate Explorer, USGS National Structures Data Set. We also use location specific data (Texas GLO) to inform future flood conditions based on land use, sea level rise and storm surge models	8/23/2021 9:51 AM
3	We will be including future conditions, not only sea level rise but hail and wildfire as well, in our state hazard mitigation plan update.	8/16/2021 10:05 AM
4	Projected future land-use hydrology	8/12/2021 8:37 PM
5	Flood events that occur from increasing impervious surfaces due to development	8/4/2021 1:45 PM
6	historical events	7/23/2021 8:13 AM
7	We use FIRMS and historical data to author ordinances pertaining to land use planning	7/19/2021 1:32 PM
8	"Bond, build, & boogie on" is GEWP, USA motto that has a goal to place a sideways dam up and down every major riverway where it can improve the conditions across the board!? GEWP, USA wants to become apart of the ERM and work hand in hand in solving as many environmental problems surrounding river mitigation!?	7/16/2021 7:56 AM
9	how the land is used, farms housing recreation uses	7/16/2021 7:48 AM
10	Land Use Regulations and Comprehensive Plan	7/16/2021 5:50 AM
11	Consider all relevant information.	7/15/2021 3:22 PM
12	We touch on it in our Hazard Mitigation Plan and our Green Infrastructure Plan	7/15/2021 10:17 AM

2021 TMAC Stakeholder Engagement Survey

13	Flood modeling based on ultimate buildout conditions.	7/15/2021 9:56 AM
14	The community uses ultimate development on local floodplain studies.	7/15/2021 8:46 AM
15	future land use, population change, future conditions	7/14/2021 2:13 PM
16	weather forecasts	7/13/2021 11:36 AM
17	Future land use and rainfall intensity	7/13/2021 11:14 AM
18	the sun dictates climate change not us.	7/13/2021 10:43 AM
19	watershed land use buildout H&H	7/13/2021 6:05 AM
20	Coast Smart Climate Ready Action Boundary (BFE + 3 feet of freeboard)	7/12/2021 10:54 AM
21	sea level rise	7/12/2021 10:39 AM
22	General recognition of more frequent intense storms.	7/12/2021 10:09 AM
23	higher freeboard	7/12/2021 8:48 AM
24	higher regulatory standards for development in the floodplain for climate change	7/12/2021 8:05 AM
25	silting models for upper Missouri River	7/12/2021 7:55 AM
26	There is a current State sea level rise projection that may be incorporated into State Land Use rules.	7/10/2021 6:40 AM
27	Florida Sea Level Impact Projection (SLIP) Tool	7/9/2021 2:13 PM
28	future flood map	6/21/2021 7:58 AM
29	Somewhat based on climate trend changes. We utilize the most restrictive rainfall event data and methodologies in the expectation that runoff will increase	6/9/2021 7:48 AM
30	For larger developments, we require an additional 2 feet of freeboard to account for sea level rise.	6/1/2021 12:33 PM
31	Future land use	6/1/2021 7:04 AM
32	Population change, climate change,Land use.	6/1/2021 5:57 AM
33	- Breach Inundation flood studies for High Hazard dams	5/28/2021 7:26 AM
34	Flood Factor	5/28/2021 6:15 AM
35	Flooding response by prioritizing roads affected by flooding	5/28/2021 4:37 AM
36	However, communities are stuck since their regulations usually only allow the implementation of regulations based upon existing conditions.	5/26/2021 7:47 AM
37	Predictive sea level rise	5/24/2021 5:38 PM
38	Our state has a variety of tools we have developed recently to help with claimate adaptation design standards, and coastal flood risk modeling tools	5/24/2021 9:04 AM
39	More detention than floodplain regulations. Typically size detention basins on maximum zoning lot coverage requirements to avoid future stormwater deficiencies.	5/20/2021 6:45 AM
40	Not much, just freeboard requirements that takes this into account somewhat.	5/19/2021 12:06 PM
41	development intensity	5/19/2021 11:06 AM
42	Developers will sue you on future land use and win. I like the idea, tough to implement. Climate change is fact we need to outreach that	5/19/2021 9:02 AM
43	Land use change, population change, climate change	5/19/2021 7:48 AM
44	We use the floodplain maps to guide development	5/19/2021 7:36 AM
45	sea level rise	5/18/2021 5:32 PM
46	local stormwater improvements	5/18/2021 3:52 PM

2021 TMAC Stakeholder Engagement Survey

47	HAZUS	5/18/2021 9:16 AM
48	This is performed by P+Z Sustainability Coordinator	5/18/2021 8:44 AM
49	Update BFE	5/18/2021 8:04 AM
50	Peril of Flood in our Comprehensive Plan.	5/18/2021 7:24 AM
51	Southeast Florida Climate Compact Sea-Level Rise Perdictions applied to Critical Infrastructure	5/18/2021 4:44 AM
52	Discussions and requests to plan now for the future	5/18/2021 4:32 AM
53	Sea level rise and resiliency are incorporated into Capital Improvements	5/17/2021 5:33 AM
54	I assist clients with stormwater management/	5/16/2021 11:11 AM
55	CA Executive Order requires late century considerations. We have SLR estimates for coastal areas on state led efforts, and develop our own fluvial estimates for riverine flood hazards.	5/14/2021 6:27 PM
56	Digital Coast SLR Viewer and associated datasets; custom models	5/14/2021 5:42 PM
57	future land use, population change, climate change	5/14/2021 2:24 PM
58	SLR, land-use; Working on future-conditions precip and demographics	5/14/2021 8:20 AM
59	Mostly climate change / sea level rise.	5/13/2021 2:42 PM
60	how the development of the area is going to impact the flood areas.	5/13/2021 1:28 PM
61	SLR, land use, pop change	5/13/2021 1:17 PM
62	We look at how future land use and climate change impacts may change flood risk over time.	5/13/2021 1:12 PM
63	Stormwater control and drainage capital projects	5/13/2021 1:07 PM
64	precipitation increases	5/13/2021 12:58 PM
65	Some of the engineering firms are using more recent rainfall statistics.	5/13/2021 12:42 PM
66	sea level rise	5/13/2021 12:25 PM
67	preliminary flood maps	5/13/2021 11:34 AM
68	Expected land use on the planning horizon (2050) and climate data as available.	5/13/2021 11:32 AM
69	Under our law we can consider future conditions up to 20 years	5/13/2021 11:21 AM
70	Mitigation planning and grants	5/13/2021 11:17 AM
71	Sea level rise and precipitation intensity projections.	5/13/2021 10:55 AM
72	ID areas for grants, specific outreach	5/13/2021 10:52 AM
73	We've included policies in our Comprehensive Plan to disincentivize development in vulnerable areas, policies to reduce public expenditures in those areas	5/13/2021 10:42 AM
74	We incorporate sea level rise and higher precipitation forecasts (including joint probability analyses) into all our floodplain planning actions, including our hazard mitigation projects and the Benefit-Cost Analysis calculator for projects, as well our CRS activities and watershed planning activities.	5/13/2021 9:51 AM
75	projected flood levels	5/13/2021 9:36 AM
76	We are building a plan for this. Not right now, but soon	5/13/2021 9:35 AM
77	wish we could	5/13/2021 9:29 AM
78	climate change considerations, enhanced uncertainty info	5/13/2021 9:22 AM
79	Ultimate conditions are studied (land use, developed areas)	5/13/2021 9:17 AM
80	Planning for outreach and training for local communities. Also, to include in community hazard plans - can not use in a regulatory way under floodplain mangement. Some communities have used zoning to identify flood conditions not mapped such as ice jams	5/13/2021 9:12 AM

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81	Ascertain new developments implement stormwater ordinance requirements	5/13/2021 9:11 AM
82	County Hazard Mitigation plans, Recovery Planning, County Comprehensive plans, SWM plans, etc.	5/13/2021 9:10 AM
83	Future land use	5/13/2021 9:10 AM
84	future land use	5/13/2021 9:00 AM
85	hazard mitigation, erosion control, siting of new development.	5/12/2021 8:37 AM
86	but we should	5/12/2021 6:09 AM
87	We use modeling of storms with sea level rise and erosion rates to inform planning and management.	5/11/2021 1:14 PM
88	100-yr plus safety factor and sea level rise	5/11/2021 6:57 AM
89	Levees, floodwalls, and channel modifications are designed and built to accommodate higher flows.	5/11/2021 6:48 AM
90	future land use occasionally	5/11/2021 6:30 AM
91	Comprehensive Plan	5/11/2021 6:02 AM
92	Limited use of 2D modeling, rain-on-grid modeling, coastal surge data, and consideration of climate change model data and SLR projections have been implemented recently on key projects.	5/11/2021 5:55 AM
93	Changes to hydrology and and development	5/10/2021 7:05 PM
94	Not sure	5/10/2021 1:41 PM
95	Planning; considering regulations but not there yet	5/10/2021 9:45 AM
96	we are include all of the above in our comprehensive flood planning	5/8/2021 6:58 AM
97	sea level rise	5/7/2021 1:17 PM
98	StreamStats after wildfires helps develop a baseline	5/7/2021 1:13 PM
99	3 foot freeboard, adopted HMP sea level rise policy	5/7/2021 1:04 PM
100	future land use	5/7/2021 12:59 PM
101	Been working on resiliency projects that include mapping flood hazard areas that consider likely scenarios out through 2100.	5/7/2021 12:33 PM
102	Climate Change &Furture landuse	5/7/2021 12:13 PM
103	Do not disagree it is happening, but my clients have a hard enough time with current regulations.	5/7/2021 11:41 AM
104	Sea Level Rise	5/7/2021 11:22 AM
105	in recommending map updates	5/7/2021 11:16 AM
106	All development must model and mitigatge full build-out flows.	5/7/2021 11:15 AM
107	General recognition of more frequent intense storms.	5/7/2021 11:09 AM
108	WE are promoting innovations through advanced assistance	5/7/2021 10:45 AM
109	Mostly messaging of recent trends and extrapolation of potential future rainfall's impact on streaflow.	5/7/2021 10:25 AM

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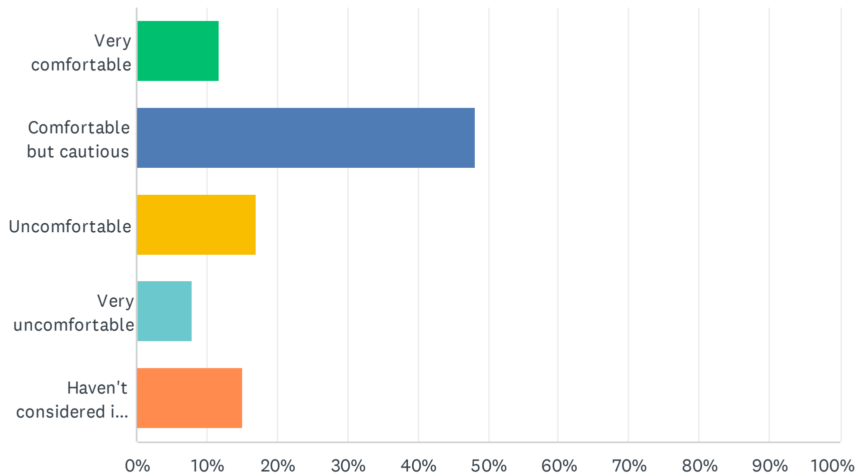
2021 TMAC Stakeholder Engagement Survey

Q23 How comfortable are you integrating information about modeled future flood conditions into your community's flood hazard planning or mitigation activities?

Answered: 407 Skipped: 24

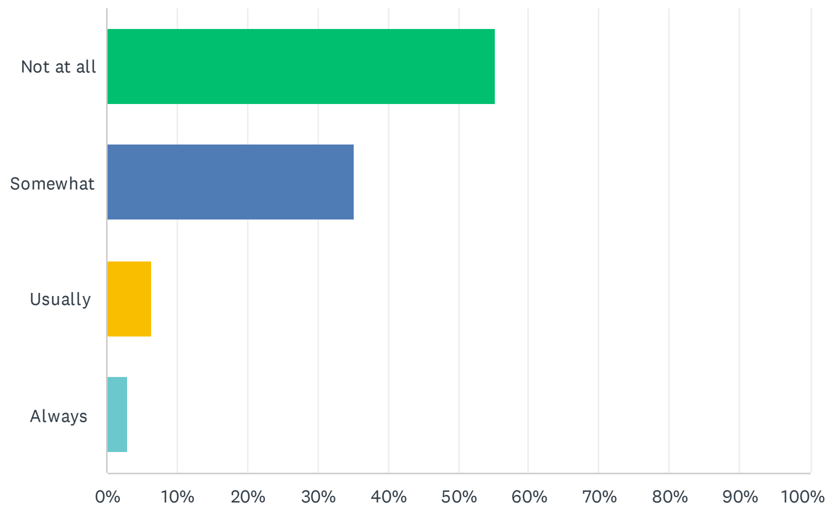


ANSWER CHOICES	RESPONSES	
Very comfortable	11.79%	48
Comfortable but cautious	48.16%	196
Uncomfortable	16.95%	69
Very uncomfortable	7.86%	32
Haven't considered it, but interested in learning more	15.23%	62
TOTAL		407

2021 TMAC Stakeholder Engagement Survey

Q24 Traditional risk management looks at the probability and consequences of an event. Enterprise Risk Management (ERM), on the other hand, is intended to be a broad, comprehensive approach to reducing the impact of uncertainty on the enterprise mission through a continually improving process of identifying, assessing, and managing risk. ERM relies on internal controls to see that the mission objectives are met.To what extent do you employ ERM in your job function as it relates to flood risk management?

Answered: 400 Skipped: 31

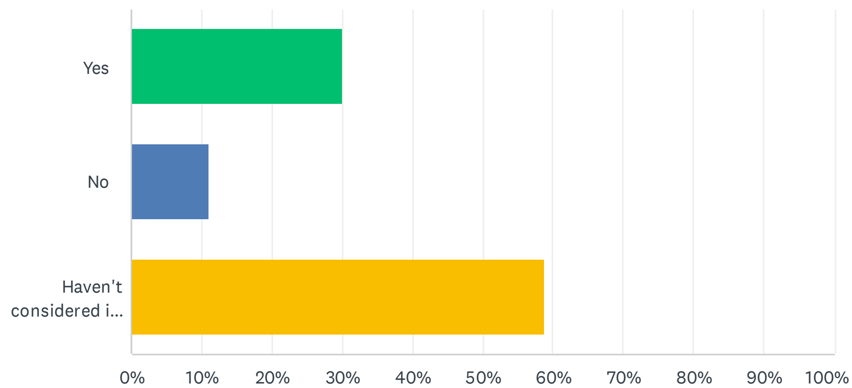


ANSWER CHOICES	RESPONSES	
Not at all	55.25%	221
Somewhat	35.25%	141
Usually	6.50%	26
Always	3.00%	12
TOTAL		400

2021 TMAC Stakeholder Engagement Survey

Q25 Are you interested in increasing your community's use of ERM?

Answered: 399 Skipped: 32



ANSWER CHOICES	RESPONSES	
Yes	30.08%	120
No	11.03%	44
Haven't considered it, but interested in learning more	58.90%	235
TOTAL		399

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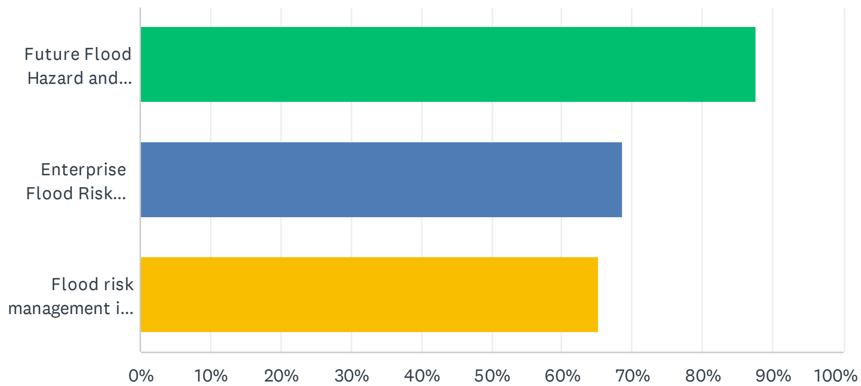
Q26 Are you interested in further engagement opportunities related to any of the following topics? If so, please select all that apply and provide your email address.

Answered: 293 Skipped: 138



ANSWER CHOICES	RESPONSES	
Future Flood Hazard and Flood Risk Conditions	87.71%	257
Enterprise Flood Risk Management	68.60%	201
Flood risk management in underserved communities	65.19%	191
Total Respondents: 293		

#	IF YOU CHECKED ANY OF THE ABOVE, PLEASE PROVIDE YOUR EMAIL ADDRESS.	DATE
1	[redacted]	8/23/2021 9:51 AM
2	[redacted]	8/12/2021 8:37 PM
3	[redacted]	8/5/2021 5:18 AM
4	[redacted]	8/4/2021 1:45 PM
5	[redacted]	8/3/2021 2:08 PM
6	[redacted]	8/2/2021 12:15 PM
7	[redacted]	7/28/2021 10:44 AM
8	[redacted]	7/26/2021 12:53 PM
9	[redacted]	7/23/2021 3:14 PM
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11	[redacted]	7/23/2021 7:51 AM
12	[redacted]	7/21/2021 9:21 AM
13	[redacted]	7/20/2021 8:30 AM

2021 TMAC Stakeholder Engagement Survey

14	[redacted]	7/19/2021 1:32 PM
15	[redacted]	7/19/2021 12:15 PM
16	[redacted]	7/19/2021 9:50 AM
17	[redacted]	7/17/2021 7:08 AM
18	[redacted]	7/16/2021 8:28 AM
19	[redacted]	7/16/2021 5:50 AM
20	[redacted]	7/15/2021 3:22 PM
21	[redacted]	7/15/2021 10:17 AM
22	[redacted]	7/15/2021 9:32 AM
23	[redacted]	7/15/2021 8:46 AM
24	[redacted]	7/15/2021 8:44 AM
25	[redacted]	7/14/2021 4:36 PM
26	[redacted]	7/14/2021 2:54 PM
27	[redacted]	7/14/2021 2:13 PM
28	[redacted]	7/14/2021 11:44 AM
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32	[redacted]	7/13/2021 3:21 PM
33	[redacted]	7/13/2021 3:02 PM
34	[redacted]	7/13/2021 2:36 PM
35	[redacted]	7/13/2021 2:26 PM
36	[redacted]	7/13/2021 2:00 PM
37	[redacted]	7/13/2021 1:15 PM
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42	[redacted]	7/13/2021 6:14 AM
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51	[redacted]	7/10/2021 6:40 AM

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87	[redacted]	5/18/2021 5:32 PM
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95	[redacted]	5/18/2021 5:45 AM
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2021 TMAC Stakeholder Engagement Survey

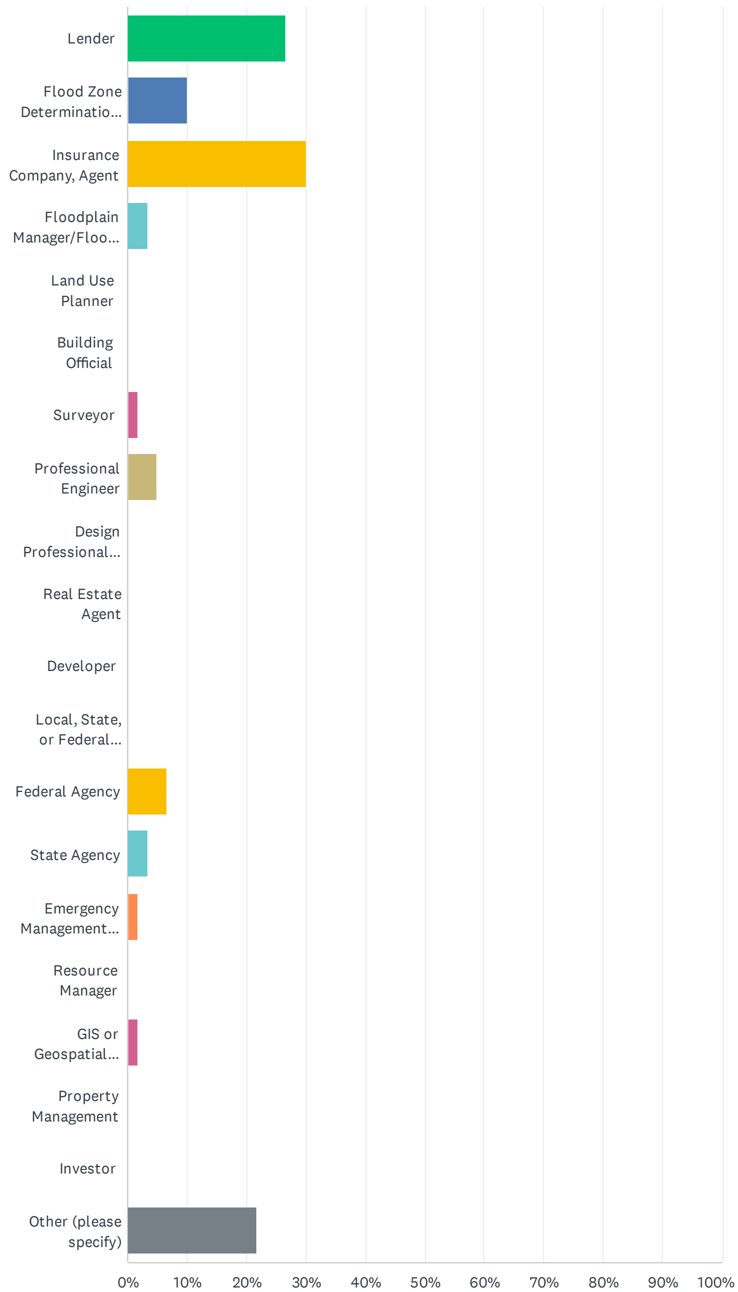
166	[redacted]	5/7/2021 1:49 PM
167	[redacted]	5/7/2021 1:13 PM
168	[redacted]	5/7/2021 1:08 PM
169	[redacted]	5/7/2021 1:04 PM
170	[redacted]	5/7/2021 12:59 PM
171	[redacted]	5/7/2021 12:33 PM
172	[redacted]	5/7/2021 11:48 AM
173	[redacted]	5/7/2021 11:41 AM
174	[redacted]	5/7/2021 11:33 AM
175	[redacted]	5/7/2021 11:22 AM
176	[redacted]	5/7/2021 11:16 AM
177	[redacted]	5/7/2021 11:15 AM
178	[redacted]	5/7/2021 10:47 AM
179	[redacted]	5/7/2021 10:46 AM
180	[redacted]	5/7/2021 10:45 AM
181	[redacted]	5/7/2021 10:42 AM
182	[redacted]	5/7/2021 10:40 AM
183	[redacted]	5/7/2021 10:36 AM

B.4 TMAC FIRST-TIER FLOOD CONFERENCE SURVEY AND RESPONSES

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q1 What is your primary job function?

Answered: 60 Skipped: 0



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Flood Conference June 2021 TMAC Stakeholder Engagement Survey

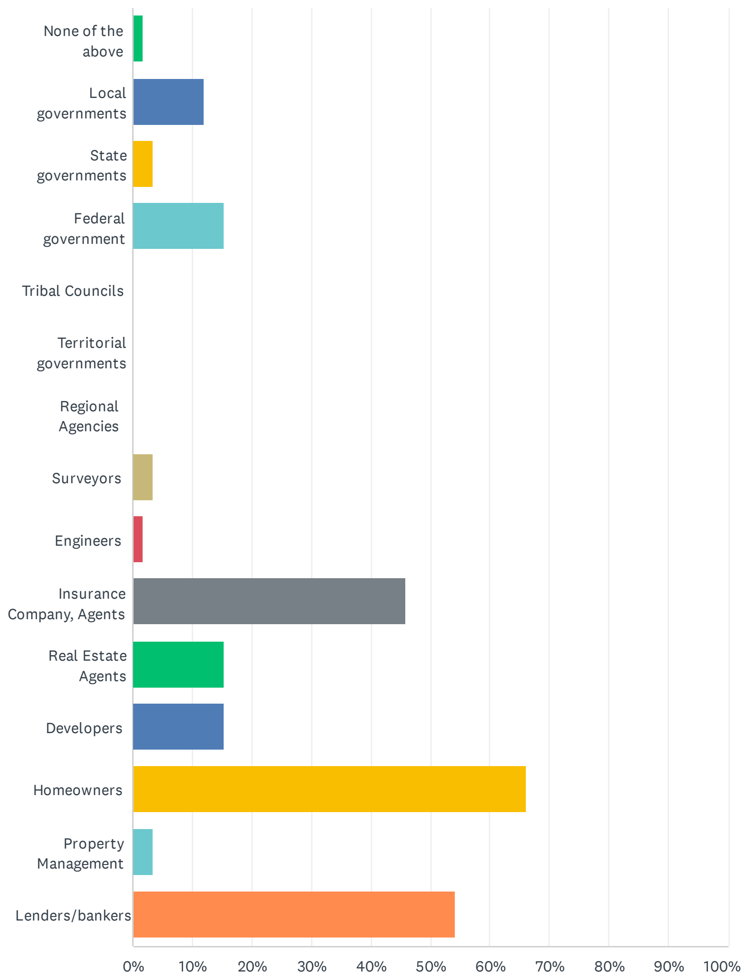
ANSWER CHOICES	RESPONSES	
Lender	26.67%	16
Flood Zone Determination Company	10.00%	6
Insurance Company, Agent	30.00%	18
Floodplain Manager/Floodplain Administrator	3.33%	2
Land Use Planner	0.00%	0
Building Official	0.00%	0
Surveyor	1.67%	1
Professional Engineer	5.00%	3
Design Professional (Engineer, Architect)	0.00%	0
Real Estate Agent	0.00%	0
Developer	0.00%	0
Local, State, or Federal Elected Official	0.00%	0
Federal Agency	6.67%	4
State Agency	3.33%	2
Emergency Management Professional	1.67%	1
Resource Manager	0.00%	0
GIS or Geospatial Specialist	1.67%	1
Property Management	0.00%	0
Investor	0.00%	0
Other (please specify)	21.67%	13
Total Respondents: 60		

#	OTHER (PLEASE SPECIFY)	DATE
1	trade association attorney/lobbyist	7/23/2021 11:02 AM
2	Flood services vendor	7/20/2021 8:39 AM
3	WYO Claims manager	7/20/2021 8:34 AM
4	County Drainage District Engineer	6/30/2021 1:30 PM
5	Financial Institution Compliance Officer	6/29/2021 3:00 PM
6	Compliance Support with a Lender	6/29/2021 2:20 PM
7	Banking Compliance	6/29/2021 12:09 PM
8	Attorney	6/29/2021 12:07 PM
9	Lending compliance Analyst	6/29/2021 12:00 PM
10	Insurance Trainer	6/29/2021 8:05 AM
11	Actuary & Catastrophe Data Scientist	6/29/2021 7:32 AM
12	Adjuster	6/29/2021 7:14 AM
13	Flood Vendor	6/29/2021 7:08 AM

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q2 In your primary job function, who are the top 3 stakeholders you most often provide products or services for/to? (Select 3)

Answered: 59 Skipped: 1



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Flood Conference June 2021 TMAC Stakeholder Engagement Survey

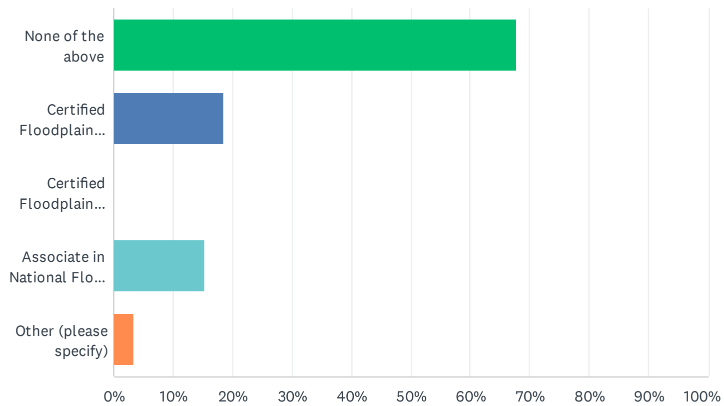
ANSWER CHOICES	RESPONSES	
None of the above	1.69%	1
Local governments	11.86%	7
State governments	3.39%	2
Federal government	15.25%	9
Tribal Councils	0.00%	0
Territorial governments	0.00%	0
Regional Agencies	0.00%	0
Surveyors	3.39%	2
Engineers	1.69%	1
Insurance Company, Agents	45.76%	27
Real Estate Agents	15.25%	9
Developers	15.25%	9
Homeowners	66.10%	39
Property Management	3.39%	2
Lenders/bankers	54.24%	32
Total Respondents: 59		

#	OTHER (PLEASE SPECIFY)	DATE
1	public	7/20/2021 8:24 AM
2	Commercial property owners	6/29/2021 1:32 PM
3	Business Owners (commercial RE loans)	6/29/2021 12:38 PM
4	- review all flood loans prior to closing	6/29/2021 12:00 PM
5	Insurance company, underwriter and Customer Service	6/29/2021 8:05 AM
6	Property Data Vendors; Climatologists; Economists & Actuaries	6/29/2021 7:32 AM

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q3 Do you currently hold any of the following National Flood Insurance Program-supporting designations? (Select all that apply)

Answered: 59 Skipped: 1



ANSWER CHOICES	RESPONSES	
None of the above	67.80%	40
Certified Floodplain Manager (CFM)	18.64%	11
Certified Floodplain Surveyor (CFS)	0.00%	0
Associate in National Flood Insurance (ANFI)	15.25%	9
Other (please specify)	3.39%	2
Total Respondents: 59		

#	OTHER (PLEASE SPECIFY)	DATE
1	CPCU	7/20/2021 8:39 AM
2	Certified Bank auditor	6/29/2021 12:00 PM

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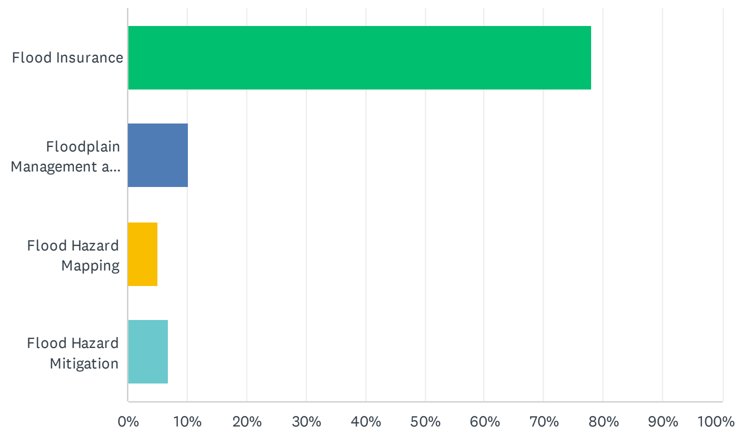
Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q4 Of the four main elements of the National Flood Insurance Program, which element does your professional role most closely align? (Select one)

Answered: 59 Skipped: 1



ANSWER CHOICES	RESPONSES	
Flood Insurance	77.97%	46
Floodplain Management and Regulation	10.17%	6
Flood Hazard Mapping	5.08%	3
Flood Hazard Mitigation	6.78%	4
TOTAL		59

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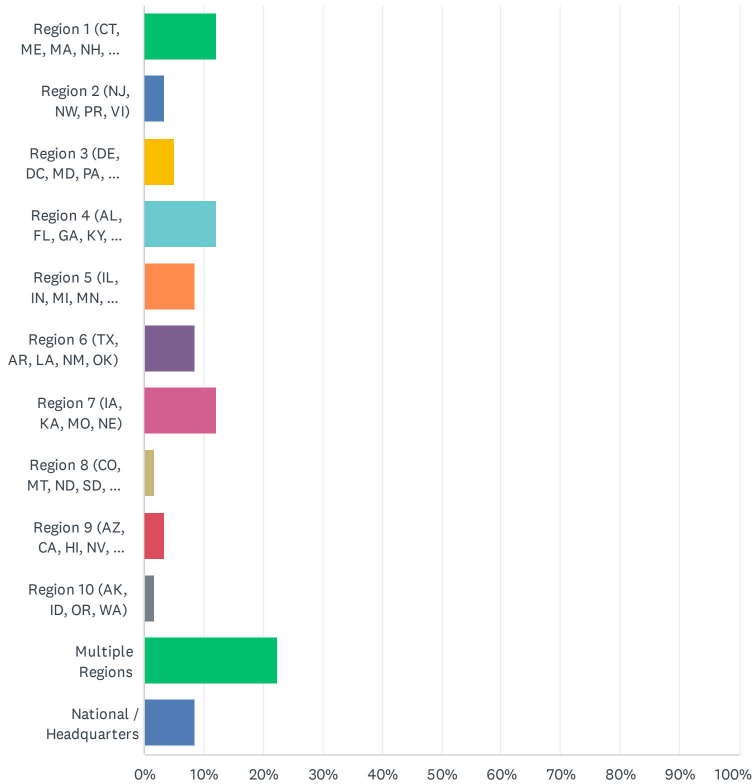
Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q5 Using FEMA regions as a guide, where do you do most of your work?

Answered: 58 Skipped: 2



ANSWER CHOICES	RESPONSES	
Region 1 (CT, ME, MA, NH, RI, VT)	12.07%	7
Region 2 (NJ, NW, PR, VI)	3.45%	2
Region 3 (DE, DC, MD, PA, VA, WV)	5.17%	3
Region 4 (AL, FL, GA, KY, MS, NC, SC, TN)	12.07%	7
Region 5 (IL, IN, MI, MN, OH, WI)	8.62%	5
Region 6 (TX, AR, LA, NM, OK)	8.62%	5
Region 7 (IA, KA, MO, NE)	12.07%	7
Region 8 (CO, MT, ND, SD, UT, WY)	1.72%	1
Region 9 (AZ, CA, HI, NV, GU, AS, MP, MH, FM)	3.45%	2
Region 10 (AK, ID, OR, WA)	1.72%	1
Multiple Regions	22.41%	13
National / Headquarters	8.62%	5
TOTAL		58

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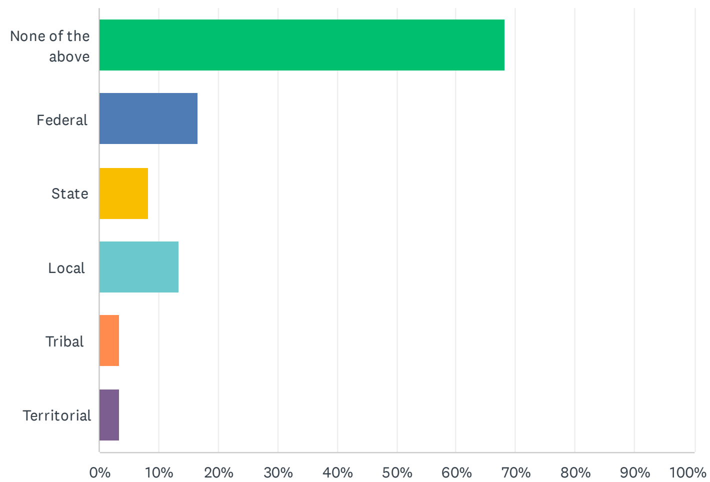
Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q6 Which of the following governmental entities do you support or represent?

Answered: 60 Skipped: 0

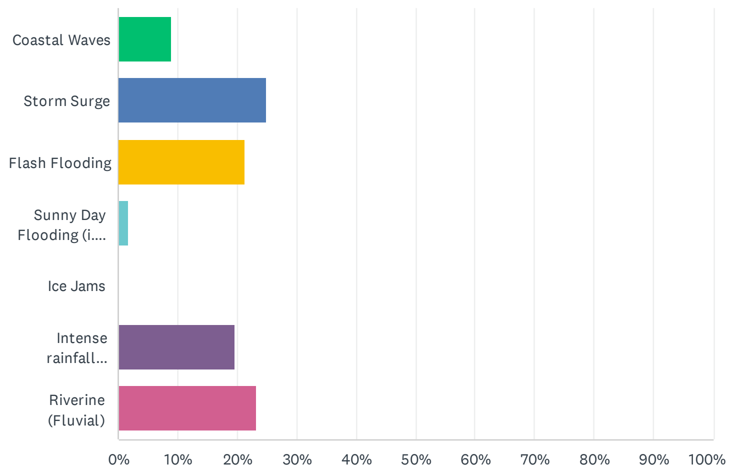


ANSWER CHOICES	RESPONSES	
None of the above	68.33%	41
Federal	16.67%	10
State	8.33%	5
Local	13.33%	8
Tribal	3.33%	2
Territorial	3.33%	2
Total Respondents: 60		

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q7 What would you categorize as the primary source of flood damage that you face in your area?

Answered: 56 Skipped: 4



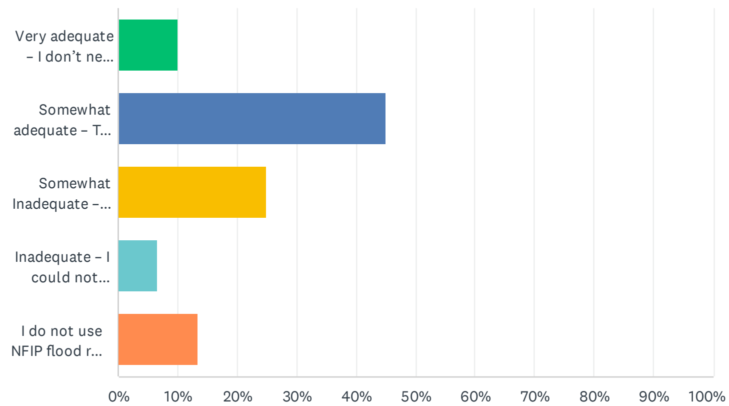
ANSWER CHOICES	RESPONSES	
Coastal Waves	8.93%	5
Storm Surge	25.00%	14
Flash Flooding	21.43%	12
Sunny Day Flooding (i.e., abnormal high tide)	1.79%	1
Ice Jams	0.00%	0
Intense rainfall (Pluvial)	19.64%	11
Riverine (Fluvial)	23.21%	13
TOTAL		56

#	OTHER (PLEASE SPECIFY)	DATE
1	We have loans that are secured by property in 19 states so this could vary depending on the location	6/29/2021 2:20 PM
2	muliple and sometimes in tandem: SLR, Surge, Urban, and precip/riverine	6/29/2021 1:33 PM
3	And pluvial	6/29/2021 1:30 PM
4	Fast snow melt	6/29/2021 12:38 PM
5	Also Snow Melting	6/29/2021 12:35 PM
6	all except ice	6/29/2021 12:33 PM
7	Riverine	6/29/2021 7:11 AM

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q8 How adequate are the NFIP flood risk products (NFHL, FIRMs, FHBMs, etc.) in helping you manage flood risk?

Answered: 60 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very adequate – I don't need or use any other information	10.00%	6
Somewhat adequate – They are my primary source of information but I sometimes supplement them with other information	45.00%	27
Somewhat Inadequate – They are an important source of information for me but I often have to supplement them with other information so I can do my job effectively	25.00%	15
Inadequate – I could not effectively manage flood risk with that data alone	6.67%	4
I do not use NFIP flood risk products	13.33%	8
TOTAL		60

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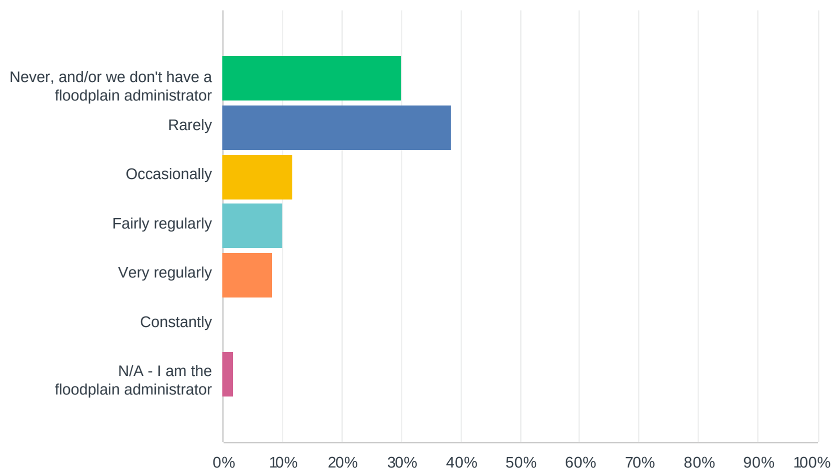
Q9 How frequently to you work with your local floodplain administrator(s) regarding flood insurance and flood mitigation issues?

Answered: 60 Skipped: 0

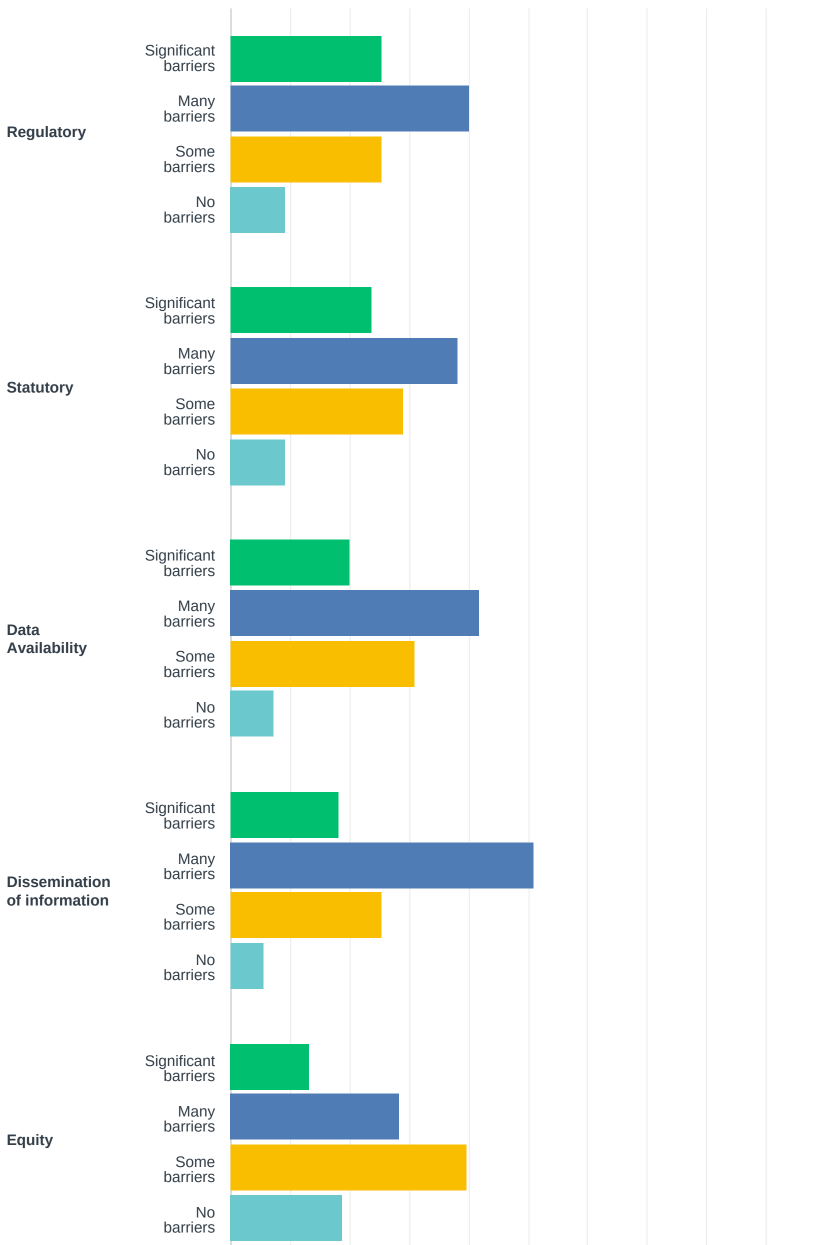


	0 - NEVER, AND/OR WE DON'T HAVE A FLOODPLAIN ADMINISTRATOR	1 - RARELY	2 - OCCASIONALLY	3 - FAIRLY REGULARLY	4 - VERY REGULARLY	5 - CONSTANTLY	N/A - I AM THE FLOODPLAIN ADMINISTRATOR	TOTAL
(no label)	30.00% 18	38.33% 23	11.67% 7	10.00% 6	8.33% 5	0.00% 0	1.67% 1	60

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q10 Currently the NFIP encourages management of flood hazard and risk using a binary approach (in/out). FEMA's future of flood risk data is exploring a graduated depiction of flood hazard and risk where hazard and risk are communicated along a spectrum from "low" to "high".For each of the following areas, indicate the magnitude of difficulty you anticipate as a result of using graduated flood hazard and risk information.

Answered: 56 Skipped: 4



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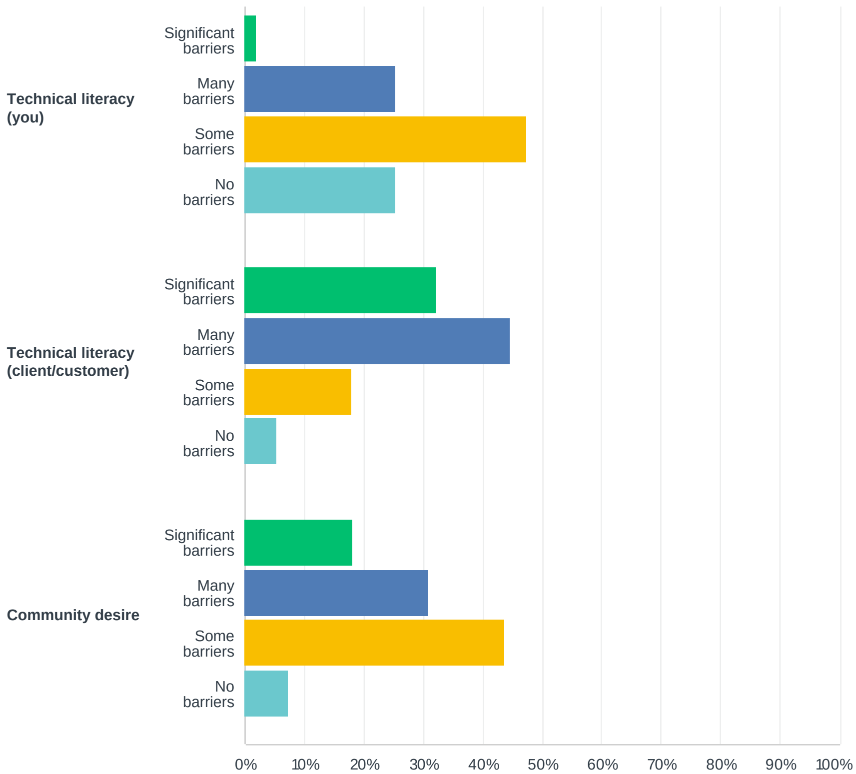
Flood Conference June 2021 TMAC Stakeholder Engagement Survey



	SIGNIFICANT BARRIERS	MANY BARRIERS	SOME BARRIERS	NO BARRIERS EXIST	TOTAL	WEIGHTED AVERAGE
Regulatory	25.45% 14	40.00% 22	25.45% 14	9.09% 5	55	2.18
Statutory	23.64% 13	38.18% 21	29.09% 16	9.09% 5	55	2.24
Data Availability	20.00% 11	41.82% 23	30.91% 17	7.27% 4	55	2.25
Dissemination of information	18.18% 10	50.91% 28	25.45% 14	5.45% 3	55	2.18
Equity	13.21% 7	28.30% 15	39.62% 21	18.87% 10	53	2.64
Technical literacy (you)	1.82% 1	25.45% 14	47.27% 26	25.45% 14	55	2.96
Technical literacy (client/customer)	32.14% 18	44.64% 25	17.86% 10	5.36% 3	56	1.96
Community desire	18.18% 10	30.91% 17	43.64% 24	7.27% 4	55	2.40

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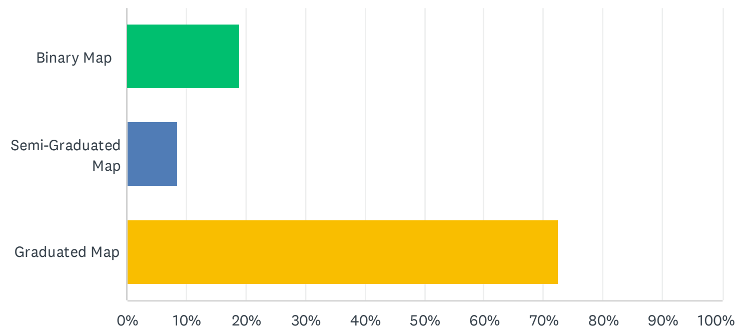
Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q11 Which of the following maps would most help you communicate flood hazards or risk?

Answered: 58 Skipped: 2

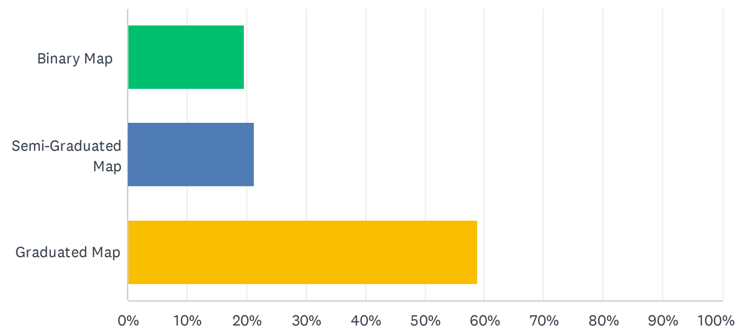


ANSWER CHOICES	RESPONSES	
Binary Map	18.97%	11
Semi-Graduated Map	8.62%	5
Graduated Map	72.41%	42
TOTAL		58

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q12 Which of the following maps would most help you manage flood risk?

Answered: 56 Skipped: 4

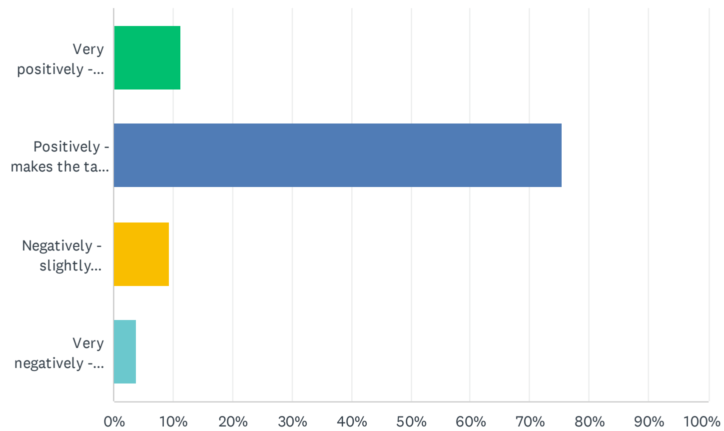


ANSWER CHOICES	RESPONSES	
Binary Map	19.64%	11
Semi-Graduated Map	21.43%	12
Graduated Map	58.93%	33
TOTAL		56

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q13 How would graduated flood hazard and risk data help you prepare for climate change, as compared to the current binary approach?

Answered: 53 Skipped: 7



ANSWER CHOICES	RESPONSES	
Very positively - would not be able to prepare without it.	11.32%	6
Positively - makes the task easier	75.47%	40
Negatively - slightly hinders ability to prepare	9.43%	5
Very negatively - makes preparing much more challenging	3.77%	2
TOTAL		53

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q14 What could communities like yours provide to FEMA to help them develop more localized understanding of flood hazard and flood risk?

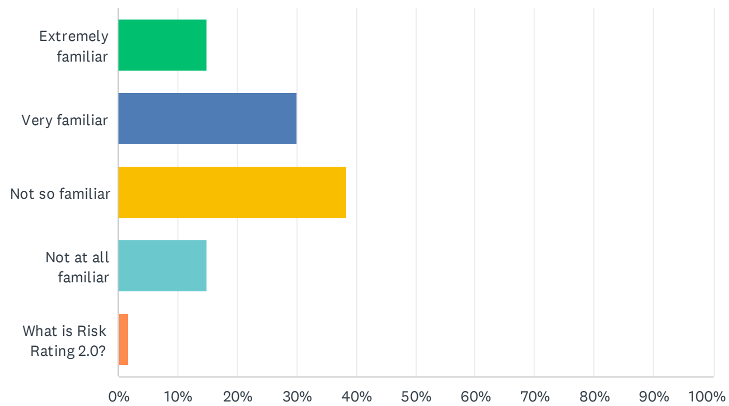
Answered: 20 Skipped: 40

#	RESPONSES	DATE
1	One of the flooding concerns is an inability for local municipalities to drain the canals prior to a tropical event. If they do not have several days to open the locks and drain the canals inland areas will see flooding like they did in Hurricane Irene. Most inland communities think they are immune to flooding.	8/20/2021 6:13 AM
2	Proposed mitigation efforts for future priority. Population control measures in high risk areas (potentially preservation efforts).	7/23/2021 1:28 PM
3	Around us (western ny) many of the maps are antiquated - some as old as 1978. The first thing I would do is update the flood maps in our area.	7/23/2021 12:25 PM
4	projected impact of climate change on territory	7/21/2021 6:26 AM
5	Not sure	7/20/2021 3:26 PM
6	Info from within communities. We have all types of flooding living on an island surrounded by ocean, and also mountains. Each community has different flood experiences.	7/20/2021 11:48 AM
7	Moving away from the "in or out" is critical...everyone has some level of risk and it needs to be identified and recognized.	7/20/2021 8:39 AM
8	Exposure and vulnerability data. FEMA only provides flood hazard data.	6/30/2021 1:35 PM
9	FEMA can't adequately regulate down to a county level. They don't have enough funding, or information.	6/30/2021 1:30 PM
10	Locally Calibrated Modeling and Historical High Watermarks.	6/30/2021 1:13 PM
11	The difference between a lake's high water line and the potential for a river cresting over flood stage.	6/29/2021 3:00 PM
12	SLR, Future storm surge, watershed management plans, some with future conditions flood runs	6/29/2021 1:33 PM
13	If you lack understanding of localized flood hazard and flood risk, then how do you claim the authority to impose regulations, fines, and civil action against "violations" of your rules?	6/29/2021 1:32 PM
14	Outreach. works well in CRS communities	6/29/2021 1:30 PM
15	Don't know	6/29/2021 12:38 PM
16	Have a meeting to inform our borrowers.	6/29/2021 12:35 PM
17	land use studies and building plans	6/29/2021 12:33 PM
18	Dk	6/29/2021 12:08 PM
19	Local H&H data for incorporation into mapping products for floodplain management and mandatory purchase	6/29/2021 12:07 PM
20	The actuarial community, which I've been amidst for 40+ years, can help measure flood risk, project flood risk, & explain flood risk.	6/29/2021 7:32 AM

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q15 How well do you feel you understand the approach of FEMA's Risk Rating 2.0?

Answered: 60 Skipped: 0

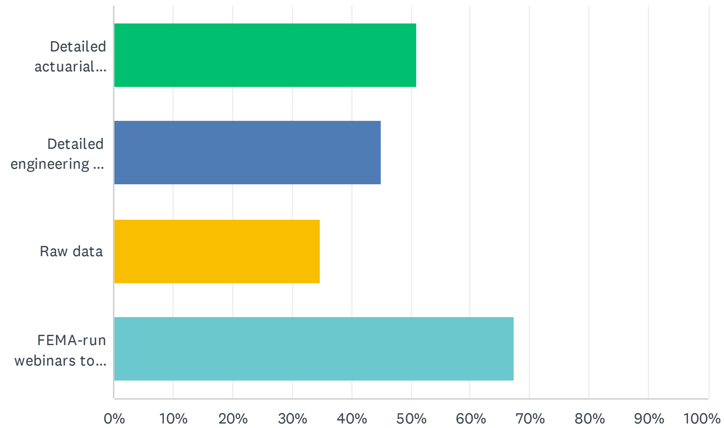


ANSWER CHOICES	RESPONSES	
Extremely familiar	15.00%	9
Very familiar	30.00%	18
Not so familiar	38.33%	23
Not at all familiar	15.00%	9
What is Risk Rating 2.0?	1.67%	1
TOTAL		60

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q16 Is there any additional information you need from FEMA in order for your community to understand Risk Rating 2.0 well enough to communicate the new ratings system to your stakeholders?

Answered: 49 Skipped: 11



ANSWER CHOICES	RESPONSES	
Detailed actuarial rating methodology	51.02%	25
Detailed engineering and mapping methodology	44.90%	22
Raw data	34.69%	17
FEMA-run webinars to explain methods	67.35%	33
Total Respondents: 49		

#	OTHER (PLEASE SPECIFY)	DATE
1	a check list of new information that an agent has to collect from the insured in order to rate and bind a flood policy	8/20/2021 6:13 AM
2	webinars to explain rating engine to insurance agents	7/23/2021 11:02 AM
3	None. I have kept sufficient notes to explain the changes.	7/20/2021 1:17 PM
4	None needed for me individually	7/20/2021 8:39 AM
5	FEMA has yet to release enough data so that communities and residents can review the various factors. This also includes specific data on evaluating levee ratings.	6/30/2021 1:13 PM
6	As much information as possible in order for us to be able to understand well enough to share as well as direct with everyone's best interest. Keeping it simple	6/29/2021 2:20 PM
7	Floodplain mangers will be regulating to outdated Flood INSURANCE RATE Maps, but FEMA will not use them to rate the actual risk, so we will likely build to low and cause high rates.	6/29/2021 1:33 PM
8	Access to quote - insurance agents only	6/29/2021 1:30 PM
9	Need to understand how this works with federal flood laws	6/29/2021 1:15 PM
10	How the community can appeal RR 2.0 rates	6/29/2021 12:07 PM

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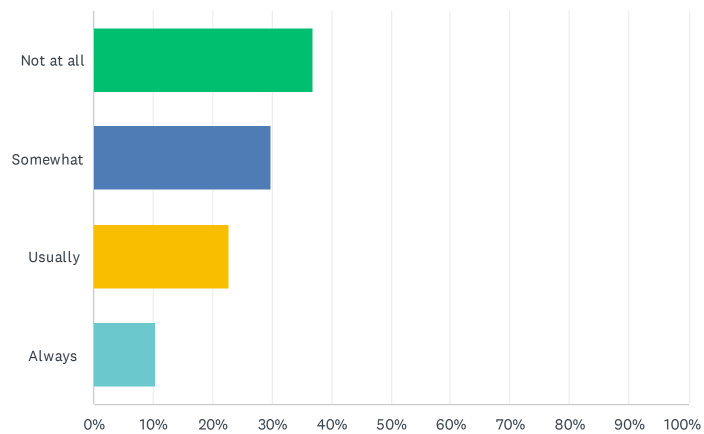
Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q17 Traditional risk management looks at the probability and consequences of an event. Enterprise Risk Management (ERM), on the other hand, is intended to be a broad, comprehensive approach to reducing the impact of uncertainty on the enterprise mission through a continually improving process of identifying, assessing, and managing risk. ERM relies on internal controls to see that the mission objectives are met.To what extent do you employ ERM in your job function as it relates to flood risk management?

Answered: 57 Skipped: 3

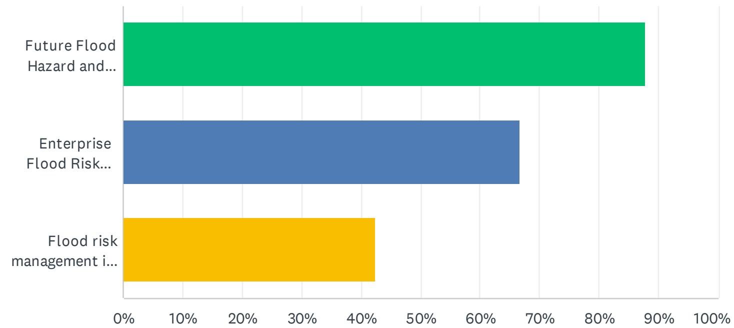


ANSWER CHOICES	RESPONSES	
Not at all	36.84%	21
Somewhat	29.82%	17
Usually	22.81%	13
Always	10.53%	6
TOTAL		57

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

Q18 Are you interested in further engagement opportunities related to any of the following topics? If so, please select all that apply and provide your email address.

Answered: 33 Skipped: 27



ANSWER CHOICES	RESPONSES	
Future Flood Hazard and Flood Risk Conditions	87.88%	29
Enterprise Flood Risk Management	66.67%	22
Flood risk management in underserved communities	42.42%	14
Total Respondents: 33		

#	IF YOU CHECKED ANY OF THE ABOVE, PLEASE PROVIDE YOUR EMAIL ADDRESS.	DATE
1	[redacted]	7/23/2021 1:28 PM
2	[redacted]	7/23/2021 12:25 PM
3	[redacted]	7/23/2021 9:30 AM
4	[redacted]	7/20/2021 3:26 PM
5	[redacted]	7/20/2021 9:59 AM
6	[redacted]	7/20/2021 8:41 AM
7	[redacted]	7/20/2021 8:35 AM
8	[redacted]	7/1/2021 12:23 PM
9	[redacted]	7/1/2021 9:04 AM
10	[redacted]	6/30/2021 1:35 PM
11	[redacted]	6/30/2021 1:13 PM
12	[redacted]	6/30/2021 1:06 PM
13	[redacted]	6/30/2021 7:19 AM
14	[redacted]	6/30/2021 7:06 AM
15	[redacted]	6/29/2021 3:00 PM
16	[redacted]	6/29/2021 2:20 PM
17	[redacted]	6/29/2021 1:33 PM
18	[redacted]	6/29/2021 1:32 PM
19	[redacted]	6/29/2021 1:30 PM
20	[redacted]	6/29/2021 1:15 PM

Flood Conference June 2021 TMAC Stakeholder Engagement Survey

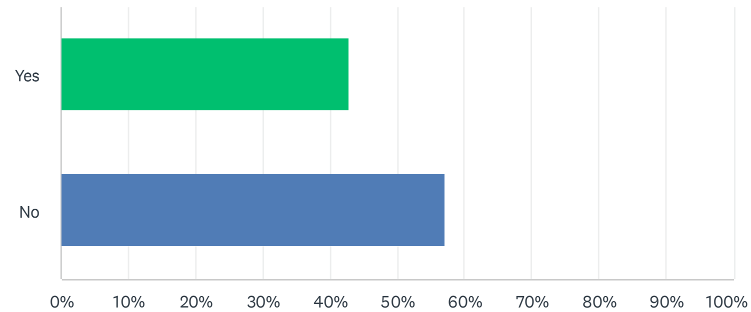
21	[redacted]	6/29/2021 12:38 PM
22	[redacted]	6/29/2021 12:35 PM
23	[redacted]	6/29/2021 12:08 PM
24	[redacted]	6/29/2021 12:07 PM
25	[redacted]	6/29/2021 11:56 AM
26	[redacted]	6/29/2021 7:56 AM
27	[redacted]	6/29/2021 7:32 AM
28	[redacted]	6/29/2021 7:14 AM
29	[redacted]	6/29/2021 7:11 AM

B.5 ERM SURVEY AND RESULTS

TMAC: Enterprise Risk Management (ERM) Survey

Q1 Does your organization have a formal ERM program?

Answered: 7 Skipped: 0

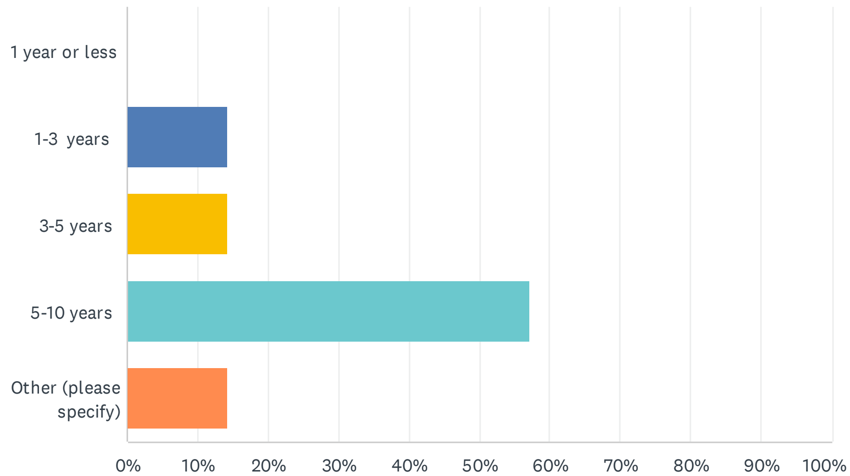


ANSWER CHOICES	RESPONSES	
Yes	42.86%	3
No	57.14%	4
Total Respondents: 7		

TMAC: Enterprise Risk Management (ERM) Survey

Q2 How long has your organization practiced ERM?

Answered: 7 Skipped: 0



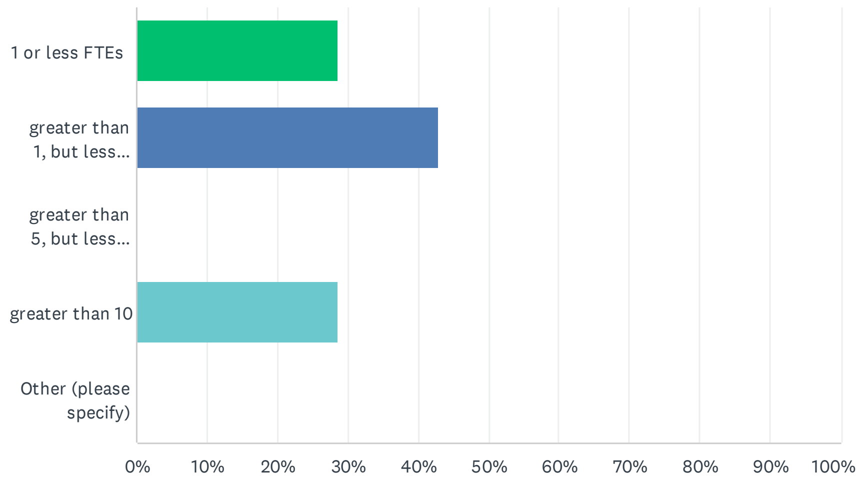
ANSWER CHOICES	RESPONSES	
1 year or less	0.00%	0
1-3 years	14.29%	1
3-5 years	14.29%	1
5-10 years	57.14%	4
Other (please specify)	14.29%	1
TOTAL		7

#	OTHER (PLEASE SPECIFY)	DATE
1	0	8/18/2021 11:01 AM

TMAC: Enterprise Risk Management (ERM) Survey

Q3 How many full-time equivalents (FTEs), including contractor support, are working in the ERM function?

Answered: 7 Skipped: 0



ANSWER CHOICES	RESPONSES	
1 or less FTEs	28.57%	2
greater than 1, but less than 5	42.86%	3
greater than 5, but less than 10	0.00%	0
greater than 10	28.57%	2
Other (please specify)	0.00%	0
TOTAL		7

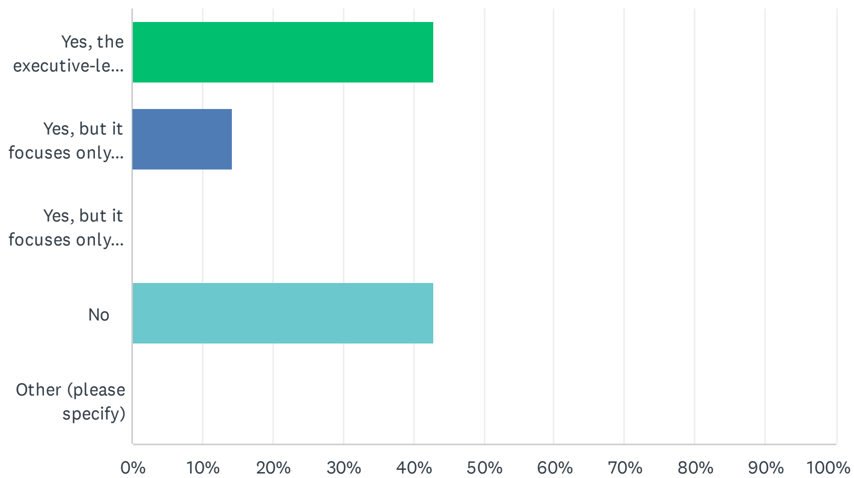
#	OTHER (PLEASE SPECIFY)	DATE
	There are no responses.	

3 / 17

TMAC: Enterprise Risk Management (ERM) Survey

Q4 Do you have an executive-level council that reports and monitors risk as it relates to strategy and performance?

Answered: 7 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes, the executive-level council integrates strategy, risk, and performance decision making	42.86%	3
Yes, but it focuses only on risk and performance	14.29%	1
Yes, but it focuses only on risk	0.00%	0
No	42.86%	3
Other (please specify)	0.00%	0
TOTAL		7

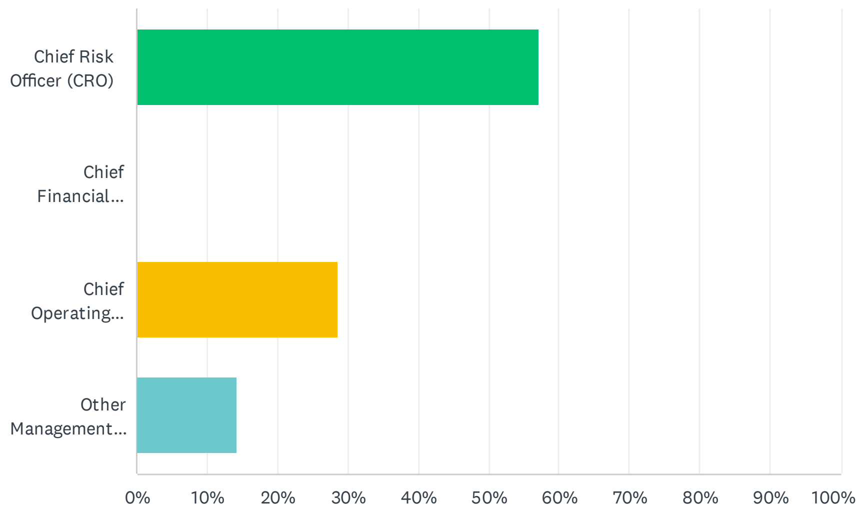
#	OTHER (PLEASE SPECIFY)	DATE
	There are no responses.	

4 / 17

TMAC: Enterprise Risk Management (ERM) Survey

Q5 Which of the following titles best describes the person responsible for your organization's ERM program?

Answered: 7 Skipped: 0



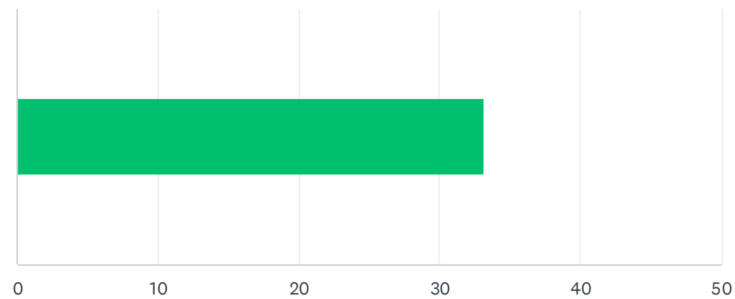
ANSWER CHOICES	RESPONSES	
Chief Risk Officer (CRO)	57.14%	4
Chief Financial Officer (CFO)	0.00%	0
Chief Operating Officer (COO)	28.57%	2
Other Management Level or Function	14.29%	1
TOTAL		7

#	PLEASE SPECIFY:	DATE
1	Environmental Health Officer	8/18/2021 11:01 AM

TMAC: Enterprise Risk Management (ERM) Survey

Q6 What percent of the ERM program leader's time is allocated to the ERM program?

Answered: 7 Skipped: 0



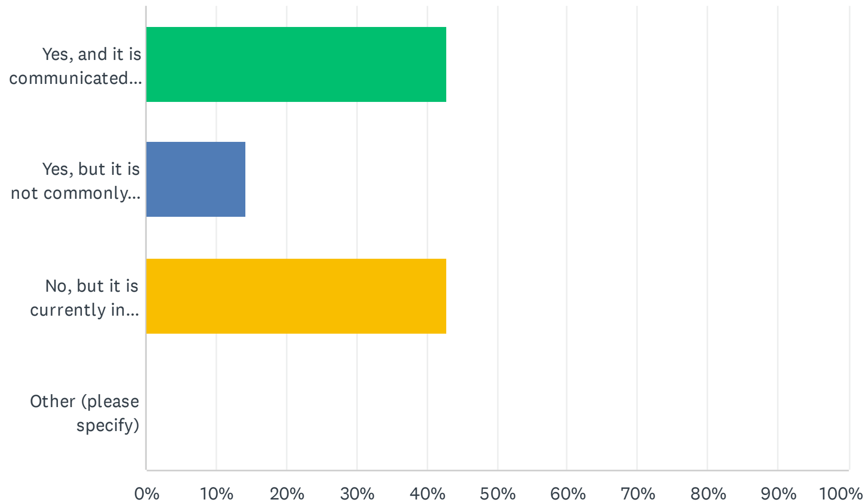
ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	33	232	7
Total Respondents: 7			

#		DATE
1	15	8/28/2021 7:47 AM
2	10	8/27/2021 10:00 AM
3	90	8/27/2021 7:08 AM
4	32	8/27/2021 6:11 AM
5	49	8/27/2021 6:03 AM
6	5	8/18/2021 11:01 AM
7	31	8/17/2021 2:59 PM

TMAC: Enterprise Risk Management (ERM) Survey

Q7 Does your organization have a defined appetite statement?

Answered: 7 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes, and it is communicated throughout the organization and integrated into strategy and decision making	42.86%	3
Yes, but it is not commonly understood or integrated in decision making	14.29%	1
No, but it is currently in development or in draft form	42.86%	3
Other (please specify)	0.00%	0
TOTAL		7

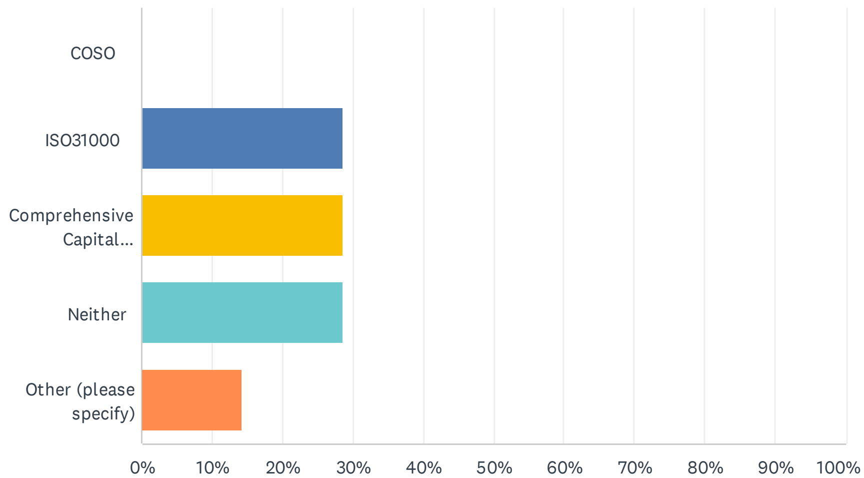
#	OTHER (PLEASE SPECIFY)	DATE
	There are no responses.	

7 / 17

TMAC: Enterprise Risk Management (ERM) Survey

Q8 Which industry standard for ERM does your organization predominantly follow?

Answered: 7 Skipped: 0



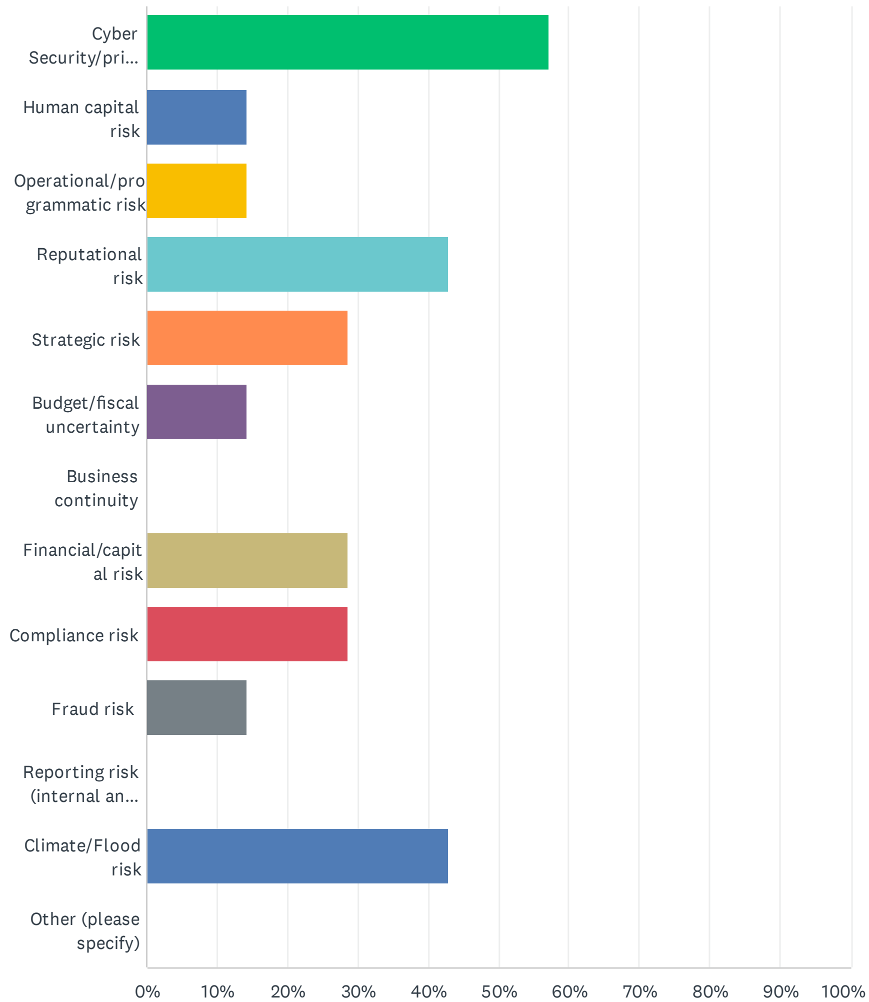
ANSWER CHOICES	RESPONSES	
COSO	0.00%	0
ISO31000	28.57%	2
Comprehensive Capital Analysis and Review (CCAR)	28.57%	2
Neither	28.57%	2
Other (please specify)	14.29%	1
TOTAL		7

#	OTHER (PLEASE SPECIFY)	DATE
1	unknown	8/27/2021 10:00 AM

TMAC: Enterprise Risk Management (ERM) Survey

Q9 What types of risk are currently perceived as the highest to your organization's ability to meet the mission or strategic objectives? Please select up to three.

Answered: 7 Skipped: 0



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TMAC: Enterprise Risk Management (ERM) Survey

ANSWER CHOICES	RESPONSES	
Cyber Security/privacy	57.14%	4
Human capital risk	14.29%	1
Operational/programmatic risk	14.29%	1
Reputational risk	42.86%	3
Strategic risk	28.57%	2
Budget/fiscal uncertainty	14.29%	1
Business continuity	0.00%	0
Financial/capital risk	28.57%	2
Compliance risk	28.57%	2
Fraud risk	14.29%	1
Reporting risk (internal and external)	0.00%	0
Climate/Flood risk	42.86%	3
Other (please specify)	0.00%	0
Total Respondents: 7		

#	OTHER (PLEASE SPECIFY)	DATE
	There are no responses.	

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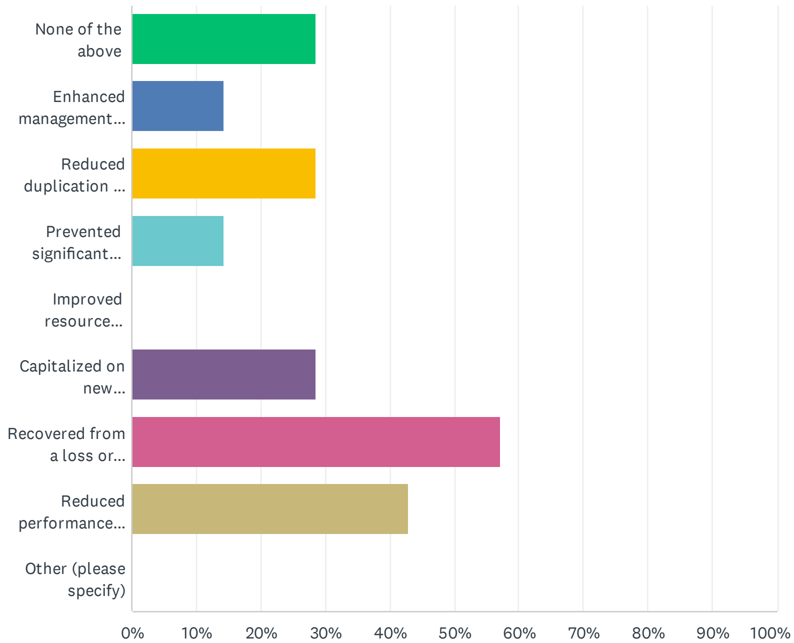
TMAC: Enterprise Risk Management (ERM) Survey

Q10 Since developing an ERM program, which of the following benefits has your organization realized? Please select all that apply.

Answered: 7 Skipped: 0



ANSWER CHOICES	RESPONSES	
None of the above	28.57%	2
Enhanced management decision-making by utilizing data and information produced by the ERM program	14.29%	1
Reduced duplication in risk assessment and/or compliance activities	28.57%	2
Prevented significant negative event from occurring/reduced adverse surprises	14.29%	1
Improved resource deployment	0.00%	0
Capitalized on new opportunities	28.57%	2
Recovered from a loss or outage in less time than it would have taken prior to ERM implementation	57.14%	4
Reduced performance variability	42.86%	3
Other (please specify)	0.00%	0
Total Respondents: 7		

#	OTHER (PLEASE SPECIFY)	DATE

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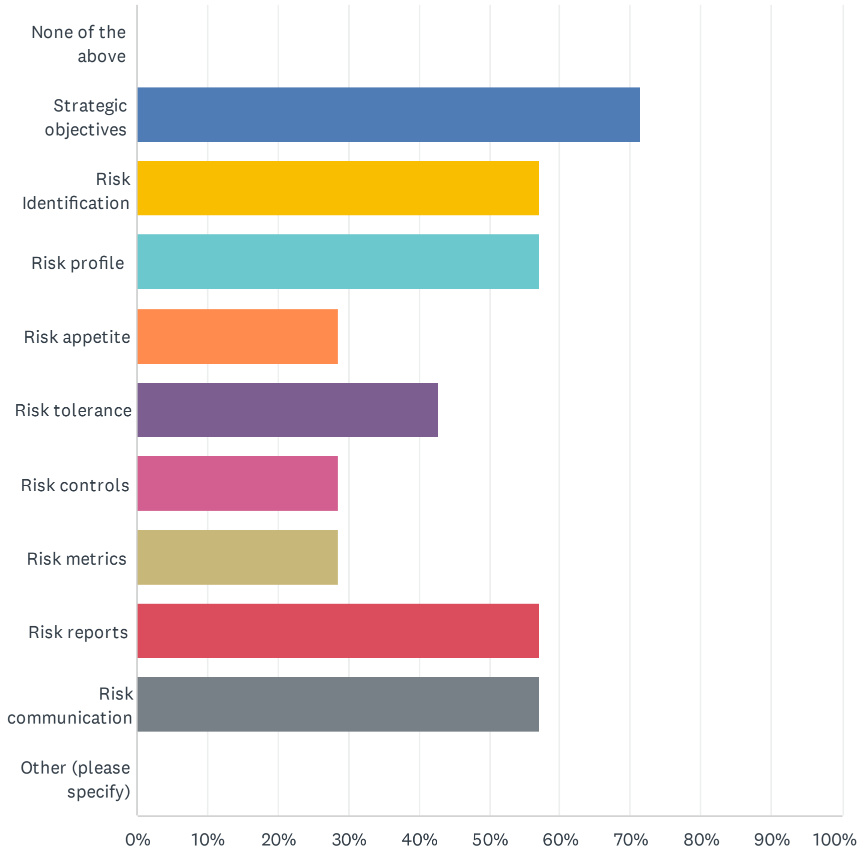
TMAC: Enterprise Risk Management (ERM) Survey

There are no responses.

TMAC: Enterprise Risk Management (ERM) Survey

Q11 Which of these ERM methods and procedures has your plan used? Please select all that apply.

Answered: 7 Skipped: 0



TMAC: Enterprise Risk Management (ERM) Survey

ANSWER CHOICES	RESPONSES	
None of the above	0.00%	0
Strategic objectives	71.43%	5
Risk Identification	57.14%	4
Risk profile	57.14%	4
Risk appetite	28.57%	2
Risk tolerance	42.86%	3
Risk controls	28.57%	2
Risk metrics	28.57%	2
Risk reports	57.14%	4
Risk communication	57.14%	4
Other (please specify)	0.00%	0
Total Respondents: 7		

#	OTHER (PLEASE SPECIFY)	DATE
	There are no responses.	

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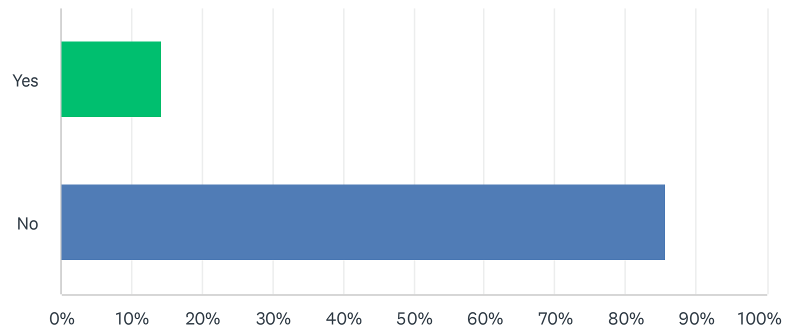
TMAC: Enterprise Risk Management (ERM) Survey

Q12 Would you be willing to share a copy of your ERM plan for confidential review by the TMAC Enterprise Risk Management (ERM) Subcommittee?

Answered: 7 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	14.29%	1
No	85.71%	6
TOTAL		7

TMAC: Enterprise Risk Management (ERM) Survey

Q13 If we have additional questions, we'd like to reach out. If you agree, please provide your contact information, including email address. Thank you.

Answered: 1 Skipped: 6

ANSWER CHOICES	RESPONSES	
Name	100.00%	1
Company	100.00%	1
Address	100.00%	1
Address 2	100.00%	1
City/Town	100.00%	1
State/Province	100.00%	1
ZIP/Postal Code	100.00%	1
Country	0.00%	0
Email Address	100.00%	1
Phone Number	100.00%	1

#	NAME	DATE
1	[redacted]	8/27/2021 7:08 AM
#	COMPANY	DATE
1	[redacted]	8/27/2021 7:08 AM
#	ADDRESS	DATE
1	[redacted]	8/27/2021 7:08 AM
#	ADDRESS 2	DATE
1	[redacted]	8/27/2021 7:08 AM
#	CITY/TOWN	DATE
1	[redacted]	8/27/2021 7:08 AM
#	STATE/PROVINCE	DATE
1	[redacted]	8/27/2021 7:08 AM
#	ZIP/POSTAL CODE	DATE
1	[redacted]	8/27/2021 7:08 AM
#	COUNTRY	DATE
	There are no responses.	
#	EMAIL ADDRESS	DATE
1	[redacted]	8/27/2021 7:08 AM
#	PHONE NUMBER	DATE
1	[redacted]	8/27/2021 7:08 AM

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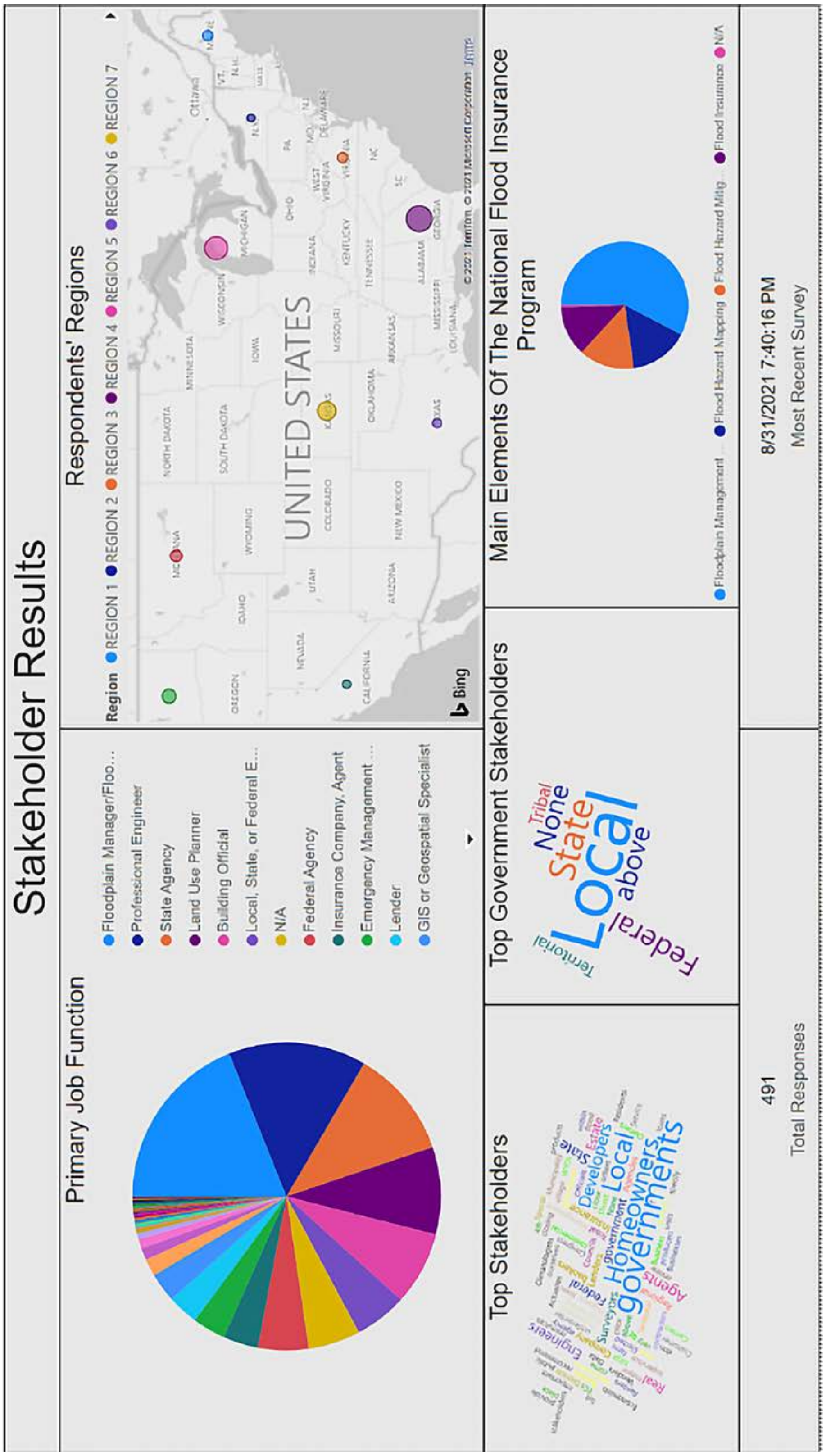
TMAC: Enterprise Risk Management (ERM) Survey

B.6 TMAC DASHBOARD/POWER BI SCREENSHOT



APPENDIX

C

FUTURE CONDITIONS

C.1 REVIEW OF TMAC FUTURE CONDITIONS RECOMMENDATIONS

Chapter 3, Future Conditions, summarizes the Future Conditions recommendations initially defined in the *TMAC 2015 Future Conditions Risk Assessment and Modeling* report (hereafter referred to as 2015 Future Conditions report) (TMAC, 2015a). The information provided in this section is a detailed discussion of each recommendation and provides the basis for the TMAC's response to the 2021 Tasking Letter.

Of the 44 recommendations and subrecommendations identified in the 2015 Future Conditions report (TMAC, 2015a), the TMAC has identified 27 recommendations for which the TMAC believes additional consideration for revision by the Federal Emergency Management Agency (FEMA) is needed. The justification for these revisions is summarized in the following subsections.

C.1.1 2015 FUTURE CONDITIONS RECOMMENDATION FC-1

2015 FUTURE CONDITIONS REPORT TEXT: *Provide future conditions flood risk products, tools, and information for coastal, Great Lakes, and riverine areas. The projected future conditions should use standardized timeframes and methodologies wherever possible to encourage consistency and should be adapted as actionable science evolves.*

2021 REVISED TEXT: *Provide future conditions flood risk products, tools, and information for coastal, Great Lakes, and riverine areas. The projected future conditions should use standardized timeframes and methodologies, wherever possible, to encourage consistency <u>and enable efficient analysis of varying expert-recommended climate change adaptation timeframes and scenarios, which</u> should be <u>adapted</u> as actionable science evolves.*

DISCUSSION/JUSTIFICATION: Over the past several years, FEMA has planned and conducted pilot projects across the country to develop future conditions products, tools, and other relative information. FEMA conducted several studies in the few years prior to the 2015 Future Conditions report (TMAC, 2015a) that looked at the impacts of sea level rise (SLR) and shoreline change. These studies were focused on Puerto Rico (2010), North Carolina (2013), and San Francisco County (2015) (as referenced in FEMA, 2017). Furthermore, FEMA partnered with the National Oceanic and Atmospheric Administration (NOAA), the U.S. Army Corps of Engineers (USACE), and the U.S. Global Change Research Program to develop a future conditions floodplain mapping viewer and the future base flood elevation (BFE) calculator for areas of New York and New Jersey. This work was intended to aid post-Sandy recovery efforts and was completed in 2013.

The TMAC's recommendations in 2015 reinforced the need for nonregulatory future conditions information, which led to additional studies:

- An advisory SLR pilot study for Hillsborough and Pinellas Counties, FL, was completed in July of 2018 (RAMPP, 2018).

- FEMA also supported a shoreline change pilot study in Region 1 (Connecticut to Maine), and a follow-up study focused on future coastal erosion hazard in Nantucket Island (completed in 2019) (Compass PTS JV, 2019).
- Another pilot focused on incorporating climate change into riverine floodplain modeling for the Anacostia River in Washington, DC, and Prince Georges County, MD (Compass PTS JV, 2016).

Section C.1.6 provides additional information and context on the pilot projects FEMA conducted. Despite work on these pilot projects, FEMA has not yet developed consistent future conditions information or standards for identifying future conditions across the United States. As described in other sections of this report, FEMA is developing a probabilistic flood hazard and flood risk analysis capability through its FFRD initiative, which can allow for analysis of multiple climate and land use change scenarios. The TMAC has previously examined the differences between probabilistic and deterministic approaches (i.e., in the 2020 TMAC report) and determined that probabilistic approaches provide a more comprehensive picture of flood risk that may include pluvial, fluvial, and coastal hazard information in the analysis.

According to FEMA briefings to the TMAC, once fully implemented, a probabilistic modeling capability can provide consistent and comprehensive flood risk data across the entire nation. FEMA is already planning to procure national coastal probabilistic flood data but acknowledges that developing the inland methodology is more challenging. FEMA is working with interagency groups such as the Interagency Water Resources Science and Services (IWRSS), which exists as a result of a memorandum of understanding between FEMA, NOAA, the U.S. Geological Survey (USGS), and USACE to address major gaps in methods development.

FEMA has reported that it plans to build a probabilistic capability to both model current flood risk and enable the incorporation of future conditions information using authoritative datasets from other federal agencies. The probabilistic modeling capability will allow FEMA to better provide future conditions flood risk products, tools, and information for the entire country using a consistent framework.

IMPLEMENTATION CONSIDERATIONS: The following describes the TMAC considerations for FEMA's continued implementation of Recommendation FC-1 to accommodate the transition of FEMA's Flood Risk Mapping Program since 2015. During its September 3, 2021, Implementation Status Briefing, FEMA noted that **some progress** has been made towards the completion of Recommendation FC-1.

Establish a Probabilistic Framework as a Foundation for Addressing Recommendation FC-1. In general, most of Recommendation FC-1 and its subrecommendations still apply. The TMAC believes that developing a probabilistic analysis capability will lay the foundation for implementing the recommendation and subrecommendations. This capability is an important precursor to developing guidance and specific products referenced in many of the subrecommendations.

The demand for future conditions flood risk products, tools, and information is increasing, as evidenced by comments and concerns from many FEMA stakeholders. For example, this year's TMAC stakeholder engagement survey showed that climate change is an important consideration of flood risk analysis and that graduated hazard and risk data could be a way to think about the broader range of future conditions impacts. Also, a 2020 petition from Association of State Floodplain Managers (ASFPM) and the Natural Resources Defense Council (NRDC) states the following: "Federally designated flood zones are predicated on an assumption of stationarity of the climate, or that the past is a reasonably accurate predictor for the future. However, the reality today is non-stationarity of climatic factors including rising sea levels and an increasing likelihood of extreme events." The report also notes how climate change and other future conditions are impacting many different parts of the country, including coastal and inland areas.

The TMAC still believes that consistent methodologies should be used whenever possible, and the TMAC believes that a national-scale probabilistic framework will allow FEMA to achieve a standardized methodology. The TMAC still believes that standardized timeframes should be used where possible, as recommended by federal agency experts, and assumes these timeframes may evolve as the science evolves.

SUBRECOMMENDATIONS FC-1.2 AND FC-1.6

2015 FUTURE CONDITIONS REPORT TEXT (FC-1.2): *FEMA should take into account future development (excluding proposed flood control structures for the base condition/ scenario) for future conditions mapping. An additional scenario can be generated that does include future flood control structures.*

2015 FUTURE CONDITIONS REPORT TEXT (FC-1.6): *FEMA should use a scenario approach for future conditions flood hazards calculation and mapping that will allow users to evaluate the robustness of proposed solutions to a range of plausible future conditions, including uncertain land use and climate change impacts.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: Developing a foundational probabilistic analytical capability also directly enables FEMA to more robustly address Subrecommendation FC-1.2, which recommends that FEMA consider future development scenarios with the ability to include future flood control structures. A national-scale probabilistic capability also directly enables FEMA to address Subrecommendation FC-1.6, which recommends that FEMA use a scenario approach for future conditions flood hazard analysis, allowing users to evaluate proposed solutions to a range of potential future conditions scenarios, including varying land use or climate change impacts. As a priority, FEMA should focus on building out the capability to incorporate a wide range of future conditions information into its probabilistic methodologies and provide a consistent methodology for understanding the impact of future conditions scenarios on flood risk to enable these recommendations.

Future conditions flood risk assessments are challenging to develop, in part because of decentralized responsibilities across federal agencies related to developing climate change information and the diverse and sometimes divergent needs of stakeholders related to future conditions information. To maximize the federal government's support to individuals, communities, and entities seeking to build resilience, FEMA should collaborate closely with other federal agencies to identify future conditions datasets and united modeling approaches that can be incorporated in a probabilistic flood risk analysis framework.

FEMA has identified a few specific data needs that require interagency collaboration and that could improve our understanding of future flood risk. One example is a statistical storms database for the interior of the nation that integrates with the databases that FEMA uses for coastal flood analyses. This database would drive an improved understanding of present flood risk from pluvial flooding and also enable the federal family to simulate, in a united manner, future flooding scenario-based recommendations from climate change experts on expected changes to precipitation patterns, frequency, and intensity.

IMPLEMENTATION CONSIDERATIONS: FEMA should continue to work with other federal agencies to identify modeling approaches and datasets that can provide future conditions simulations at a national scale with computational efficiency. During its September 3, 2021, Implementation Status Briefing, FEMA noted that **some progress** has been made towards the completion of Subrecommendations FC-1.2 and FC-1.6.

Apply a Foundational Probabilistic Analysis Capability. State, local, tribal, and territorial (SLTT) partners and private organizations have noted the value of accurate, detailed flood hazard and risk data that can be 'served' to them in formats that they can act on. As a result, many organizations have begun developing data-driven solutions on their own. In the long-term, a consistent, national-scale probabilistic framework could be used at the regional, state, and local level to develop more tailored tools and products that meet stakeholders' specific needs and can incorporate downscaled data and information. Once a nation-wide probabilistic methodology is implemented, FEMA can establish guidance to SLTTs and other stakeholders on how to develop a more tailored analysis using local scenarios, timeframes, or land use plans. The guidance should tie to the most up-do-date science and federal guidelines but recognize that science and federal guidelines are rapidly evolving, and SLTTs may have varying needs. Therefore, the TMAC recommends that FEMA employ flexibility with its guidance and caution to avoid being overly prescriptive in its guidelines.

SUBRECOMMENDATIONS FC-1.1, FC-1.3, FC-1.4, AND FC-1.5

2015 FUTURE CONDITIONS REPORT TEXT (FC-1.1): *FEMA should define a future population metric that uses a standard future population database along with various budget scenarios for keeping the data current to predict the percent of the population covered at various points in the future.*

2015 FUTURE CONDITIONS REPORT TEXT (FC-1.3): *FEMA should use population growth as an indicator of areas with increased potential flood risk.*

2015 FUTURE CONDITIONS REPORT TEXT (FC-1.4): *FEMA should develop guidance for how local zoning and land use planning can be used to identify where and how land use will change in the future, and incorporate that into local hazard and risk modeling.*

2015 FUTURE CONDITIONS REPORT TEXT (FC-1.5): *FEMA should develop a policy and standards on how to consider and determine erosion zones that are outside of the Special Flood Hazard Area (SFHA), as they ultimately affect flooding and environmental conditions within the SFHA.*

2021 REVISED TEXT: *None*

DISCUSSION/JUSTIFICATION: The scenarios and timeframes will be identified by federal agency experts and can be adapted as the science evolves. Once a probabilistic analysis capability is established, FEMA can more effectively identify and incorporate future conditions indicators and metrics into its analysis framework. To summarize, a foundational probabilistic analysis capability can enable the implementation of Subrecommendations FC-1.1, FC-1.3, and FC-1.4, and as a result, the TMAC believes these recommendations still apply.

Finally, the TMAC believes that Subrecommendation FC-1.5 also still applies in the long term. Once a probabilistic framework is implemented, FEMA can develop policy and standards for identifying erosion zones. However, the TMAC recommends a slight revision, by removing the following clause: “that are outside of the Special Flood Hazard Area (SFHA).” FEMA’s planned capabilities will enable flood risk analysis everywhere across the nation—both inside and outside of the SFHA.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA noted that **progress has not yet started** towards the completion of Subrecommendations FC-1.1, 1.3, 1.4, and 1.5. If implemented wisely, these unchanged recommendations will ensure the systematic development of national and locally relevant climate, land use, and geomorphological change and flood-control scenarios and related data that is essential for the creation and effective utilization of a probabilistic-modeling framework while ensuring that modeling and mapping efforts serve areas experiencing population-driven increases in flood risk.

C.1.2 2015 FUTURE CONDITIONS RECOMMENDATION FC-2

2015 FUTURE CONDITIONS REPORT TEXT: *Identify and quantify accuracy and uncertainty of data and analyses used to produce future conditions flood risk products, tools, and information.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: This simple, direct, and unchanged recommendation requiring the quantification/qualification of data and modeling accuracy and uncertainty represents a fundamental prerequisite for widespread acceptance of FEMA's future flood conditions products. The *TMAC 2015 Future Conditions Risk Assessment and Modeling* report recognizes the importance of data accuracy and relevancy in the decision making process of property owners and other affected stakeholders.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA noted that **some progress** has been made towards the completion of Recommendation FC-2. The TMAC recommends keeping Recommendation FC-2 as a vital part of communicating not just forecasts and estimates of future conditions impacting flooding scenarios, but also the confidence and accuracy of that information.

Modeling future conditions and events is based on estimates of several variables and simulations of multiple models. The variables upon which the models are based, and the models themselves, carry some measure of uncertainty that is not uniform across space (Figure C-1). When combined in a geospatial operation (i.e., model), errors in model input layers are propagated to the output layer, contributing to model uncertainty, which varies greatly across the location of interest.

Section C.3.1 broadly describes model uncertainty and the sources of common types of uncertainty. In addition to those discussed in Section C.3.1, the differential spatial distribution of uncertainty in data and model products may also be considered by FEMA, particularly for products derived from integrated products. FEMA should continue to expand the volume and variety of flooding scenarios published, and underlying data, in order to provide maximum flexibility and confidence in stakeholder planning processes. The TMAC further agrees that any data released in conjunction with flood estimates follow FAIR data principles (Findability, Accessibility, Interoperability, and Reusability).

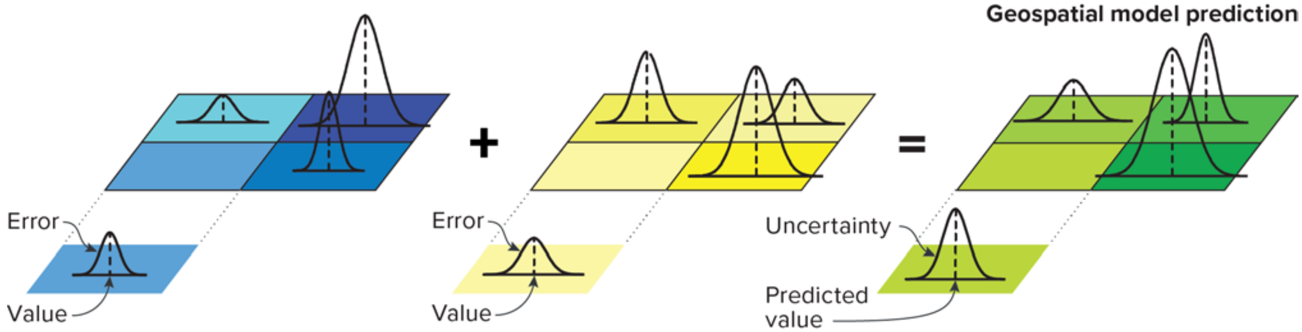


Figure C-1: Model input layers (i.e., variables) have error that is non-uniform across space

Source: https://pubs.usgs.gov/tm/11c3/

The proliferation of earth observation data and understanding of climate variability has increased in the short time since the 2015 Future Conditions report was issued (TMAC, 2015a). This presents new opportunities, and necessity, for improved communication about the data, information, knowledge, and derivates that are being delivered. Action 19 of the Federal Data Strategy also addresses this need across the federal government by requesting that the Federal Committee on Statistical Methodology "Identify best practices for measuring and reporting on the quality of data outputs created from multiple sources or from secondary use of data assets."

In addition, the importance of providing data provenance in metadata and tracking propagation of error in modeled results are recognized as effective and preferred practices. This is codified in the Federal Geographic Data Committee (FGDC) National Strategic Data Infrastructure Strategy as a goal to "Ensure that geospatial data are current, accurate, open, standards-based, findable, accessible, interoperable, and reusable." Producing FAIR data has also become a recent focus of data production and management across the scientific and geospatial community, and should be considered by FEMA. A 2021 FGDC report to the National Climate Task Force detailing the use and efficacy of geospatial data for climate mapping also highlights the need for FAIR data production.

FEMA may wish to consider publishing multiple flood hazard layers, with uncertainty, to allow for more resilient infrastructure engineering and design. The data, modeling, and computing capacity for such data generation should be a minimal barrier to creating additional flood elevation layers, and delivery of the data may hold tremendous value. As more data sources are considered in the modeling and construction of flood hazard layers, the spatial distribution of uncertainty will likely become more heterogenous. Understand not just the global uncertainty associated with a flood elevation layer or other products, but how that uncertainty deviates across the landscape would be informative.

SUBRECOMMENDATIONS FC-2.1 AND FC-2.2

2015 FUTURE CONDITIONS REPORT TEXT (FC-2.1): *FEMA should use future risk assessments to take into account the likelihood of events occurring and their impacts, as well as the associated uncertainties surrounding these estimates.*

2015 FUTURE CONDITIONS REPORT TEXT (FC-2.2): *FEMA should publish multiple future conditions flood elevation layers that incorporate uncertainty so as to provide a basis for building designs that lower flood risk.*

2021 REVISED TEXT: *None*

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA noted that **some progress** has been made towards the completion of Subrecommendations FC-2.1 and FC-2.2. With respect to FC-2.1, FEMA indicated that the use of future risk assessments to account for the likelihood and impacts of flooding events and the associated uncertainties could be addressed in the FFRD initiative, which is also being developed through probabilistic methodologies, according to FEMA. With respect to FC-2.2, FEMA is exploring how best to visualize the future conditions flood elevation layers and is considering their availability from other federal partners in conjunction with FEMA's relevant available flood data.

C.1.3 2015 FUTURE CONDITIONS RECOMMENDATION FC-3

Future Conditions Recommendation FC-3 included the main recommendation and 11 subrecommendations, which are addressed individually in this section. Below is a discussion of the primary Recommendation FC-3.

Since 2015 when the initial TMAC future conditions were developed, the Fourth National Climate Assessment (NCA4) has been conducted with updated actionable science, new interagency SLR projections will be available in February 2022, and newer science will be forthcoming in NCA5, due by 2023. Included in the updated science is a better understanding of relative SLR based on regional influences of oceanographic currents, ice sheet finger printing, and vertical land motion. The result is the availability of updated SLR scenarios that enable a risk management approach to future flood risk at more locally relevant level (at individual tide gauges and as a one degree grid for the entire U.S. Coastline).

In addition, more robust process-based coastal modeling is now available that includes the increase in SLR as part of the dynamic modeling input, thus accounting for non-stationarity/ non-linear responses (for example, wave runup, which impacts Zone V areas). Also, there are better methods for accounting for regional differences in areas such as the Great Lakes and Alaska that can be included in the analysis.

Recommendation 3, and the 11 subrecommendations therein, describes these changes as they relate to the initial recommendations and provides recommended changes and justification for doing so.

- *2015 Future Conditions Report Text: Provide flood hazard products and information for coastal and Great Lakes areas that include the future effects of long-term erosion and sea/ lake level rise.*
- *Provide guidance and standards for the development of future conditions coastal flood risk products.*
- *Incorporate local relative sea/lake level rise scenarios and long-term coastal erosion into coastal flood hazard analyses.*
- *Consider the range of potential future natural and man-made coastal changes, such as inundation and coastal erosion.*

2021 REVISED TEXT:

- *Provide flood hazard products and information for coastal and Great Lakes areas that include the future effects of long-term erosion and sea/ lake level rise.*
- *Provide guidance and standards for the development of future conditions coastal flood risk products.*
- *Incorporate local relative sea/lake level rise scenarios and long-term coastal erosion into coastal flood hazard analyses.*
- *Consider the range of potential future natural and man-made coastal changes, such as ~~inundation and coastal erosion~~ flooding, coastal erosion, and land use.*

DISCUSSION/JUSTIFICATION: FEMA conducted several studies in the few years prior to the TMAC's 2015 Report that looked at the impacts of SLR and shoreline change. These studies were focused on Puerto Rico (2010), North Carolina (2013), and San Francisco County (2015) (as referenced in FEMA, 2017). Furthermore, FEMA partnered with NOAA, USACE, and the U.S. Global Change Research Program to develop a future conditions floodplain mapping viewer and the future BFE calculator for areas of New York and New Jersey. This work was intended to aid post-Sandy recovery efforts and was completed in 2013. The TMAC's 2015 recommendations reinforced the need for nonregulatory future conditions information, which led to additional studies:

- An advisory SLR pilot study for Hillsborough and Pinellas Counties, FL, was completed in 2018 (RAMPP, 2018).
- FEMA also supported a shoreline change pilot study in Region 1 (Connecticut to Maine), and a follow-up study focused on future coastal erosion hazard in Nantucket Island (completed in 2019) (Compass PTS JV, 2019).
- Another pilot focused on incorporating climate change into riverine floodplain modeling for the Anacostia River in Washington, DC, and Prince Georges County, MD (Compass PTS JV, 2016).

The pilot study reports were provided to the TMAC for its review and consideration, including a Summary Report of all coastal pilots and recommendations provided to TMAC in 2015. Additional information and context on the pilot projects FEMA conducted are presented in Section C.1.6 where Future Conditions Recommendation FC-6 is discussed in greater detail.

The overall recommendation FC-3 is still valid besides some small wording changes to include flooding, coastal erosion, and land use. However, the TMAC recommends changes to the subrecommendations based on new data, science, and modeling methods as mentioned above. These changes are summarized below and are discussed in more detail under each subrecommendation subsection.

- Include more specific recommendations for the Great Lakes and Alaska coastlines, including projected water levels, ice conditions, bluff and beach erosion, permafrost thawing, and vertical land motion (VLM) implications, in particular glacial isostatic adjustment (GIA).
- Change subrecommendations to be in line with FEMA's new FFRD products, which do not focus on the traditional Flood Insurance Rate Map (FIRM) and 1% BFE line, but rather a graduated flood risk map.
- Change subrecommendations to include dynamic, compound flood modeling as a preference, and integrate VLM estimates and improved geomorphological modeling of beaches, dunes, and cliffs into the flood projections, such as data-driven models that extract shorelines from the vast satellite record to improve site-specific performance.
- Further, recommend utilizing the most recent regional SLR scenarios, such as the authoritative federal interagency reports (e.g., Sweet et al., 2017) that feed into the National Climate Assessment.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA noted that **some progress** has been made towards the completion of Recommendation FC-3, indicating that FEMA has supported several coastal pilot studies after 2015, including Hillsborough and Pinellas Counties, FL. Implementation actions were identified in the TMAC 2016 Annual report (TMAC, 2016) that recommended FEMA prepare a gap analysis based on completed pilot studies and other future conditions projects or programs nationwide. Also included in the implementation actions were recommendations for how FEMA should proceed with coastal erosion and modeling and mapping standards. Additional details regarding these 2016 implementation actions are provided in Section 3.5, Implementation Considerations.

Suggested next steps relative to Recommendation FC-3 that FEMA should consider because of the work by the TMAC in 2021, and taking into account the 2016 implementation actions, are summarized below:

1. Assess past recommendations from Future Sea Level Rise and Erosion Projection Status Assessment and relevance to current FEMA FFRD methods.
2. Provide summary of lessons learned and recommendations from previous coastal pilots, as well as the state-of-the-science from across academia and federal research agencies.

3. Address the implementation actions as outlined in the TMAC 2016 Annual Report.
4. Report or provide update on status of the TMAC 2017 Annual Report (TMAC, 2017) recommendation for an End User Needs Assessment to identify end users' highest priority needs for future conditions products and services that support FEMA's current flood-related program and its evolution over time (p. iv).
    a. Engage a broad array of stakeholders throughout the planning, execution, and interpretation of the Needs Assessment.
    b. Ensure that the Needs Assessment collects information on users' intended applications and addresses key analytical variables, such as relevant timeframe(s), spatial resolution, level of study, future conditions scenarios (e.g., land use, erosion, SLR), product type, uncertainty, and visualization preferences.
    c. Integrate an ongoing future conditions needs-gathering step as part of the standard flood study process and during other local community engagement touchpoints, and use information gained to adapt.

SUBRECOMMENDATION FC-3.1

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should use a scenario approach when considering shoreline location for the estimation of future conditions flood hazards. At least two scenarios should be evaluated, one in which the shoreline is held at its present location, and another in which the shoreline is eroded according to the best available shoreline erosion data.*

2021 REVISED TEXT: *FEMA should <u>ensure FFRD methods incorporate multiple scenarios for future shoreline position and long-term erosion for the estimation of future conditions flood hazards. Different process-based methods should be evaluated for different shoreline geology/morphology, erosion mechanisms, and vertical land motion, including data-driven approaches that leverage the satellite record.</u> At least two scenarios should be evaluated, one in which the shoreline <u>is restricted from eroding past existing infrastructure (e.g., revetments, sea walls, roads),</u> and another in which the shoreline is eroded <u>assuming no infrastructure restrictions, both</u> according to the best available shoreline erosion data <u>and models</u>.*

DISCUSSION/JUSTIFICATION: This subrecommendation has been revised to reflect the current FFRD methods that will more easily incorporate multiple scenarios for shoreline position and long-term erosion. Taking advantage of the new capabilities that will be afforded by the FFRD initiative, the new recommendation suggests that different process-based methods should be evaluated for different shoreline geology/morphology, erosion mechanisms, and vertical land motion, including data-driven approaches that leverage the satellite record.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-3.1. FEMA has been evaluating an event-based erosion methodology that can support multi-frequency analysis and the development of site-specific risk information. At least two scenarios should be evaluated, one in which the shoreline is restricted from eroding past existing infrastructure (e.g., revetments, sea walls, roads), and another in which the shoreline is eroded assuming no infrastructure restrictions, both according to the best available shoreline erosion data and models.

SUBRECOMMENDATION FC-3.2

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should develop guidance for incorporating future conditions into coastal flooding and wave analyses.*

2021 REVISED TEXT: *FEMA should develop guidance for incorporating future conditions into coastal flooding and wave analyses, including Great Lakes water levels, vertical land motion, and Arctic sea ice conditions for Alaska. Wave analysis should include future scenarios derived from latest Coupled Model Intercomparison Project (CMIP) models.*

DISCUSSION/JUSTIFICATION: This subrecommendation has been revised to consider changing Great Lakes Lake levels, vertical land motion, and Artic Sea ice conditions for Alaska. Wave analyses can be modeled better via ensemble runs for future scenarios derived from the latest CMIP models used for Intergovernmental Panel on Climate Change (IPCC) reports.

IMPLEMENTATION CONSIDERATIONS: The TMAC now recognizes the need to address unique conditions and variables in regions such as Alaska and the Great Lakes, as well as others that have high vertical land motion rates and sea ice or coral reefs that impact wave energy. Better data and methods to account for these differences are available now, so they have been specifically mentioned in the revised recommendation.

SUBRECOMMENDATION FC-3.3

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should develop consistent methods and models for long-term coastal erosion hazard mapping.*

2021 REVISED TEXT: *FEMA should develop consistent methods and models for long-term coastal erosion hazard mapping to inform current and future erosion hazard zones for planning purposes in parallel to the flood hazard zones. The latest federal and academic shoreline modeling approaches should be leveraged.*

DISCUSSION/JUSTIFICATION: This subrecommendation has been kept and extended for clarification. Even if a long-term coastal erosion product is not linked directly to flood risk, it could be used to inform current and future erosion hazard zones for planning purposes in parallel to the flood hazards zones. There have been significant advances in shoreline modeling approaches in recent years from federal (e.g., USGS) and academic research groups (e.g., Scripps) that should be leveraged.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that implementation of Subrecommendation FC-3.3 has **not yet started**. FEMA is still exploring approaches for incorporating long-term erosion scenarios and how best to partner with other federal agencies on this effort. FEMA assumes that consistent methods and guidance could follow the exploratory phases. The TMAC addressed a need to develop current and future erosion hazard zones in addition to flood hazard zones as they are two separate hazard processes both being influenced by sea level change. Given advances in dynamic modeling and new data sets since 2015, FEMA should consult the latest in federal and academic shoreline modeling approaches.

SUBRECOMMENDATION FC-3.4

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should use Parris, et al., 2012, or similar global mean sea level scenarios, adjusted to reflect local conditions, including any regional effects (Local Relative Sea Level) to determine future coastal flood hazard estimates. Communities should be consulted to determine which scenarios and time horizons to map based on risk tolerance and criticality.*

2021 REVISED TEXT: *FEMA should use the latest federal guidance for regionally based sea level scenarios (from the latest National Climate Assessment). Scenarios and time horizons should use a consistent national approach based on risk tolerance and criticality.*

DISCUSSION/JUSTIFICATION: This subrecommendation has been kept and enhanced/changed to remove reference to a specific set of SLR scenarios. Instead, the language has been changed to refer to using the latest federal guidance (guided by the National Climate Assessment) for regionally based SLR scenarios, in particular the authoritative guidance of federal interagency reports (e.g., Sweet et al., 2017) that includes representatives from all the key coastal research and regulatory agencies, including FEMA, USACE, the National Aeronautics and Space Administration (NASA), NOAA, the U.S. Environmental Protection Agency (EPA), and USGS. The part about communities deciding which scenarios to use was removed and new text was added to recommend using a consistent national approach based on risk tolerance and criticality (higher scenario for less risk tolerance).

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-3.4. FEMA is working broadly with other federal agencies to incorporate future conditions information into a probabilistic flood risk framework, which includes working with the USACE to explore how FEMA can incorporate various SLR scenarios. Since 2015, SLR science has advanced and newer long-term projections exist via the NCA reports. The latest interagency-produced scenarios should be used. FEMA should base scenario selection on risk tolerance and criticality.

SUBRECOMMENDATION FC-3.5

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should work with other Federal agencies (ex. NOAA, USACE, USGS), the U.S. Global Change Research Program (USGCRP), and the National Ocean Council to provide a set of regional sea-level rise scenarios, based on the Parris, et al., 2012 scenarios, for the coastal regions of the U.S. out to the year 2100 that can be used for future coastal flood hazard estimation.*

2021 REVISED TEXT: *FEMA should continue to work with interagency working groups (ex. USGCRP, SOST) as part of the National Climate Assessment update process to provide a set of regional sea-level rise scenarios, including using updated historical trends and extrapolations to inform the most likely scenarios for shorter time horizons. Time horizons beyond 2100 should be considered.*

DISCUSSION/JUSTIFICATION: This subrecommendation was revised to be less prescriptive and point to using latest NCA scenarios, informed by the interagency U.S. Global Change Research Program (USGCRP) and Subcommittee on Ocean Science and Technology (SOST) process, specifically the Interagency Working Group on Sea Level Rise and Coastal Flood Hazard Scenarios and Tools (IWG-SLR). Because interagency work groups can change with different administrations, the recommendation was made more general for FEMA to continue to participate and use updated SLR scenarios developed from the NCA update process. This is a 4- to 5-year update process and consideration should be given to include reference to using updated historical trends and extrapolations to inform most likely scenarios for shorter time horizons.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC 3.5. FEMA is working broadly with other federal agencies to incorporate future conditions information into a probabilistic flood risk framework. This includes working with the USACE to explore how FEMA can incorporate various SLR scenarios. FEMA should continue to be part of the U.S. Sea Level Rise and Coastal Flood Hazard Scenarios and Tools Interagency Task Force as it has been since 2015. Because FEMA is a user of new sea level science information, a FEMA representative should continue to consult with the task force on use of future scenarios for flood risk mapping and tools.

SUBRECOMMENDATION FC-3.6

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should prepare data and map layers displaying the location and extent of areas subject to long-term erosion and make the information publicly available. Elements include:*

- *Establishing the minimum standards for long-term erosion mapping that will be used by FEMA that must be met by partners/communities if it is to be incorporated into the FEMA products*
- *Working with Federal, State, and local stakeholders to develop these minimum standards via pilot studies*
- *Securing funding that can support sustained long-term erosion monitoring and mapping by allowing for periodic updates*

2021 REVISED TEXT: *FEMA should prepare map <u>and data</u> layers displaying the location and extent of areas subject to long-term erosion and make the information publicly available. Elements include:*

- *Establishing the minimum national standards for long-term erosion <u>hazard zone</u> mapping <u>that incorporate both a median shoreline projection and a 95% confidence band, and should be produced for both storm conditions (extreme shoreline excursions) and daily conditions</u>*
- *Working with Federal, State, and local stakeholders to develop these minimum standards via pilot studies*
- *<u>Exploring use of non-traditional datasets such as satellite shoreline measurements that can be used at national scale to establish historical rates and to inform models for future projections</u>*
- *Securing funding that can support sustained long-term erosion monitoring and mapping by allowing for periodic updates*

DISCUSSION/JUSTIFICATION: This recommendation was kept with a few additions:

1. Emphasize national consistency in coverage and method.
2. Added content to include more specific guidance on how hazard zones should be produced that incorporate both a median shoreline projection and a 95% confidence band, and should be produced for both storm conditions (extreme shoreline excursions) and daily conditions.
3. Added a bullet to address the use of non-traditional datasets, such as satellite shoreline measurements, that can be used at a national scale to establish historical rates and to inform models for future projections.

This subrecommendation was enhanced to emphasize national consistency, provide specific guidance related to future shoreline projections, and encourage consideration of non-traditional datasets.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC 3.6. FEMA supported several pilots after 2015, including one that looked at coastal erosion in Nantucket. The 2015 Future Conditions report (TMAC, 2015a) recommended FEMA conduct pilot studies to include SLR and long-term coastal erosion. Several pilots have been completed, and the results from all pilots conducted should be used to inform a national approach for mapping long-term erosion hazard areas to inform coastal management decisions.

SUBRECOMMENDATION FC-3.7

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should support additional research to characterize how a changing climate will result in changes in Great Lakes and ocean wave conditions, especially along the Pacific Coast. The relative importance of waves on this coast makes this an important consideration.*

2021 REVISED TEXT: *FEMA should support additional research to characterize how a changing climate will result in changes in Great Lakes and ocean wave conditions, especially in <u>Alaska</u>, Pacific Coast, <u>Pacific Islands and Caribbean Islands, and how changing storm and sea/lake ice patterns may impact future wave conditions. CMIP6 driven wave models that represent the state-of-the-science for projecting future wave conditions should be leveraged.</u>*

DISCUSSION/JUSTIFICATION: This subrecommendation was updated to include specific mention of other coasts, including Alaska, the Great Lakes (sea/lake ice impacts), the Pacific Islands, and the Caribbean Islands, where waves are the dominant component of extreme water levels, and how changing storm patterns may impact future wave conditions. In addition, CMIP6-driven wave models that represent the state-of-the-science for projecting future wave conditions are mentioned.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC 3.7. A FEMA Region 9 SLR pilot study evaluated the feasibility of incorporating SLR and shoreline change into flood hazard mapping on the Pacific Coast near San Francisco, and the report was provided to the TMAC for further consideration.

SUBRECOMMENDATION FC-3.8

2015 FUTURE CONDITIONS REPORT TEXT: *For the Great Lakes, the addition or subtraction of future lake level elevations associated with a changing climate is not recommended at this time due to current uncertainty in projections of future lake levels.*

2021 REVISED TEXT: *For the Great Lakes, <u>FEMA should use a scenario approach for high and low water level modeling and engage in future research efforts to more clearly characterize changing Great Lakes water levels and work on standards for Great Lakes water level projections.</u>*

DISCUSSION/JUSTIFICATION:. The subrecommendation was revised to include future research needs, including a scenario approach for high and low water-level modeling and additional supporting research efforts to more clearly characterize changing Great Lakes water levels and work on standards for Great Lakes water-level projections. Current high-level conditions are resulting in significant bluff failures that represents an excellent research opportunity.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that Subrecommendation FC-3.8 was **completed**, stating in the briefing that it had noted the recommendation. The 2015 Future Conditions Report recommended no action be taken in the Great Lakes (TMAC, 2015a). Considering better data and information about Great Lakes historical and future water levels, FEMA should include high- and low-water scenarios in the modeling and mapping process, similar to SLR scenarios. Great Lakes water levels have been fluctuating more drastically over the last decade, causing significant long-term erosion and coastal flooding. Record water levels were recorded in 2019 in Lake Ontario.

SUBRECOMMENDATION FC-3.9

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should build upon the existing current conditions flood hazard analyses prepared by FEMA for the NFIP to determine future coastal flood hazards.*

2021 REVISED TEXT: *FEMA should build upon the <u>latest FFRD methods for determining current graduated flood risk to determine future flood risk.</u>*

DISCUSSION/JUSTIFICATION: This original subrecommendation assumed future conditions mapping products should be based on the current study methods. Because FEMA is developing new coastal analysis methods based on graduated flood risk mapping (e.g., FFRD), this recommendation was changed to reference the latest FFRD methods. It was revised to sync to the current study process.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-3.9. This approach could be reflected through the FFRD initiative and is being developed through probabilistic methodologies. The 2015 Future Conditions report recommended building the future conditions mapping based on the current coastal flood insurance study methods (TMAC, 2015a). Now that FEMA is developing new methods for developing graduated flood risk with probabilistic information (e.g., FFRD), future conditions should be incorporated into this new probabilistic approach and data and map layers.

SUBRECOMMENDATION FC-3.10

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should incorporate Local Relative Sea Level Rise scenarios into the existing FEMA coastal flood insurance study process in one of the following ways:*

- *Direct Analysis – Incorporate sea level rise directly into process modeling (i.e., surge, wave setup, wave runup, overtopping, and erosion) for regions where additional sea level is determined to impact the Base Flood Elevation non-linearly (for example, where a 1-foot sea level rise equals a two-foot or more increase in the base flood).*
- *Linear Superposition – Add sea level to the final calculated total water level and redefine the Base Flood Elevation for regions where additional sea level is determined to impact the base flood linearly (for example, 1 foot of sea level rise equals a 1-foot increase in the base flood).*
- *Wave effects should be calculated based on the higher Stillwater, including sea level rise.*

2021 REVISED TEXT: *FEMA should incorporate regionally based Sea Level Rise scenarios into the existing FEMA FFRD coastal study process using dynamic modeling (Direct Analysis):*

- *Direct Analysis – Incorporate sea level rise directly into process modeling (i.e., surge, tide, wave setup, wave runup, overtopping, and erosion)*

DISCUSSION/JUSTIFICATION: Much like Subrecommendation 3.9, this recommendation was updated to remove reference to the current FEMA coastal study process. Because FFRD is developing new coastal analysis techniques, the recommendation was modified to refer to it. Numerous studies illustrate that linear superposition is not a viable method, and with computational challenges largely solved, dynamic modeling should be the preferred approach to evaluate coastal flood risk (direct analysis). This also may be included in the FFRD coastal analysis modular design (plug and play) processes.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-3.10. This approach could be reflected through the FFRD initiative and is being developed through probabilistic methodologies, which would ideally allow for the incorporation of more refined, local-scale data inputs. The 2015 Future Conditions report recommended two approaches, including a linear superposition method that assumes a linear response of flooding from SLR (TMAC, 2015a). Since 2015, modeling approaches have improved and computing power has increased, allowing for a direct analysis approach. The linear superposition method is no longer recommended as it does not account for non-linearity in response to rising sea level. For example, wave runup increases more than the amount of SLR in some coastal areas, causing more flooding. A direct modeling approach will account for this.

SUBRECOMMENDATION FC-3.11

2015 FUTURE CONDITIONS REPORT TEXT: *Maps displaying the location and extent of areas subject to long-term coastal erosion and future sea level rise scenarios should be advisory (non-regulatory) for Federal purposes. Individuals and jurisdictions can use the information for decision-making and regulatory purposes if they deem appropriate.*

2021 REVISED TEXT: *Maps and data displaying the location and extent of areas subject to long-term coastal erosion and future sea level rise scenarios should be advisory (non-regulatory) for Federal purposes. Individuals and jurisdictions can use the information for decision-making and regulatory purposes if they deem appropriate.*

DISCUSSION/JUSTIFICATION: This recommendation was extended to recognize that the data from which future conditions maps will be developed may also be used in other ways to facilitate consideration of coastal erosion risks. Generally, it hasn't changed based on the current strategy to include future conditions data and map layers in a non-regulatory product. FEMA had intended to proceed with future conditions data and mapping layers that are non-regulatory. This approach could be reflected through the FFRD initiative and is being developed through probabilistic methodologies.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-3.11. In the TMAC 2015 Annual Report (TMAC, 2015b), the TMAC specifically decided not to recommend future conditions products as regulatory. However, some of the Subcommittee members believe short- and long-term erosion on coasts is an equally important part of flood and coastal hazard risk, especially over longer time periods and should or could have some sort of regulatory product similar to BFEs, etc. FFRD methods may be able to address this issue, but more discussion is needed.

C.1.4 2015 FUTURE CONDITIONS RECOMMENDATION FC-4

2015 FUTURE CONDITIONS REPORT TEXT: *Provide future conditions flood risk products and information for riverine areas that include the impacts of future development, land use change, erosion, and climate change, each of which will have associated uncertainties, as actionable science becomes available. Major elements are:*

- *Provide guidance and standards for the development of future conditions riverine flood risk products.*
- *Future land use change impacts on hydrology and hydraulics can and should be modeled with land use plans and projections, using current science and build upon existing model study methods where data are available and possible.*
- *Future land use should assume built-out floodplain fringe and take into account the decrease of storage and increase in discharge.*
- *No actionable science exists at the current time to address climate change impacts to watershed hydrology and hydraulics. If undertaken, interim efforts to incorporate climate change impacts in flood risk products and information should be based on existing methods, informed by historical trends, and incorporate uncertainty based upon sensitivity analyses.*
- *Where sufficient data and knowledge exist, incorporate future riverine erosion (channel migration) into flood risk products and information.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: Although there are no changes to the major elements of FC-4, the subrecommendations identified in the 2015 Future Conditions report (TMAC, 2015a) have been modified to reflect discussion and deliberation by the TMAC in 2021. Changes to the original text are underlined.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Future Conditions Recommendation FC-4. In 2020, FEMA funded the development of a report, *The Best Available Science: An Implementation Plan for Future-Conditions Flood Hazard Mapping* (STARR II, 2020). This report outlined the current state-of-the-science and existing products, tools, and information pertaining to future condition scenarios from recent efforts by FEMA, other federal agencies, SLTTs, non-profit organizations, academia, and the private sector. FEMA is reviewing this report to identify any potential next steps.

A number of subrecommendations can now be enhanced with updated information and progress since the 2015 Future Conditions report; whereas other activities have a high priority and a near-term timeline that have not been started. Further definition of the scope of these activities will be needed in the next steps so that the report can further expand on its specific recommendations for Recommendation FC-4.

SUBRECOMMENDATION FC-4.1

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should evaluate previously-issued guidance for future conditions land use and hydrology to incorporate best practices and lessons learned from communities that have implemented the guidance since 2001.*

2021 REVISED TEXT: *FEMA should evaluate previously-issued guidance for future conditions land use and hydrology to incorporate best practices and lessons learned from communities that have implemented the guidance <u>since 2015.</u>*

DISCUSSION/JUSTIFICATION: Studies may have been completed and resulted in recommendations regarding approaches, particularly with respect to riverine studies. Briefings by SMEs and recent work by the USGS could provide additional tools for modeling empirical flood data that could be considered.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-4.1. FEMA indicated best practices and lessons learned regarding how the guidance was utilized is influencing the FEMA approach to probabilistic flood risk assessments through the FFRD initiative.

SUBRECOMMENDATION FC-4.2

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should determine long-term riverine erosion hazard areas for areas subject to high erosion and provided to the public in a digital layer.*

2021 REVISED TEXT: *FEMA should <u>support research to identify important mechanisms and factors to help</u> determine long-term riverine erosion hazard areas for areas subject to high erosion and provided to the public in a digital layer.*

JUSTIFICATION: The determination of long-term riverine erosion hazard areas is a more complex problem than was realized in 2015. One reason is that fluvial erosion, in conjunction with bank erosion, might result in bank instabilities. As described in section 3.4, several different approaches to address this additional complexity may be possible but need to be evaluated to identify best practices.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-4.2. FEMA indicated it has scoped and is prioritizing a capability to view such layers, utilizing authoritative data from relevant agencies for these areas and others.

SUBRECOMMENDATION FC-4.3

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should utilize a national standard for riverine erosion zone delineations that reflects geographic variability.*

2021 REVISED TEXT: *FEMA should develop a national standard for riverine erosion zone delineations that reflects important mechanisms and factors.*

DISCUSSION/JUSTIFICATION: National standards for riverine erosion zone delineations remain elusive and geographic variability is not the only factor to consider. Although there are possible approaches to address this subrecommendation, they need to be evaluated to identify best practices.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **progress has not yet started** towards the completion of Subrecommendation FC-4.3. FEMA indicated a national standard is intended to be accounted for in the probabilistic methodology for FFRD.

SUBRECOMMENDATION FC-4.4

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should take the impacts of future development and land use change on future conditions hydrology into account when computing future conditions for riverine areas.*

2021 REVISED TEXT: *None.*

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-4.4. FEMA indicated this approach could be reflected through the FFRD initiative and is being developed through probabilistic methodologies.

SUBRECOMMENDATION FC-4.5

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should implement riverine erosion hazard mapping (channel migration zones), leveraging existing data, models, and approaches that reflect site-specific processes and conditions.*

2021 REVISED TEXT: *FEMA should support research to develop best practices for riverine erosion hazard mapping, leveraging existing data, models, and approaches that reflect site-specific processes and conditions.*

DISCUSSION/JUSTIFICATION: Significant efforts are underway to identify and characterize erosion vulnerability zones; however, these efforts will need to be evaluated to identify best practices.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **progress has not yet started** towards the completion of Subrecommendation FC-4.5. FEMA indicated it is not currently prioritizing this recommendation, as it doesn't align with FEMA's future flood risk modeling paradigm as some of the other recommendations do.

SUBRECOMMENDATION FC-4.6

2015 FUTURE CONDITIONS REPORT TEXT : *FEMA should use observed riverine trends to help estimate what future conditions might look like. In watersheds where floods of interest may decrease in magnitude and frequency, then use existing riverine study results as the basis for flood hazard mapping. In watersheds where floods exhibit an increase in magnitude and (or) frequency, then use best available science to determine future hydrology and flood hazards.*

2021 REVISED TEXT: *FEMA should develop best practices and standards to leverage updated techniques to detect statistically significant changes, patterns, and trends, and attribute and model these nonstationarities continually to reevaluate flood flow frequencies (whether increased or decreased flows).*

DISCUSSION/JUSTIFICATION: Since 2015, new techniques have become available and more widely used to analyze empirical flood data for embedded trends and patterns, identify statistically significant trends, and attribute these nonstationarities and trends to continuing conditions such as climate change. A number of national studies that have applied these techniques to flood series across the United States (Archfield et al., 2016; Hodgkins et al., 2017; Dickinson et al., 2019; Hodgkins et al., 2019; Blum et al., 2020; Ryberg et al., 2020).

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-4.6. FEMA indicated this approach could be reflected through the FFRD initiative and is being developed through probabilistic methodologies.

SUBRECOMMENDATION FC-4.7

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should work with other Federal agencies via the Advisory Committee on Water Information's Subcommittee on Hydrology to produce a new method to estimate future riverine flood flow frequencies. This method should contain ways to consistently estimate future climate-impacted riverine floods and address the appropriate range of flood frequencies needed by the NFIP.*

DISCUSSION/JUSTIFICATION: The Advisory Committee on Water Information's Subcommittee on Hydrology no longer exists. Studies funded by the Federal Highway Administration (Hecht et al., in press; Konrad and Restivo, 2021; Over et al. 2016) and Nuclear Regulatory Committee (Harden et al., 2021) have resulted in improved statistical tools to recognize and attribute causation. These methods, tools, and outcomes can be evaluated for their contribution to implementation of this subrecommendation.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing,

2021 REVISED TEXT: *FEMA should work with other Federal agencies [removed specific reference to Advisory Committee on Water Information Subcommittee on Hydrology] to produce a new method to estimate future riverine flood flow frequencies. This method should contain ways to consistently estimate future climate-impacted riverine floods and address the appropriate range of flood frequencies needed by the NFIP.*

FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-4.7. FEMA indicated this approach could be reflected through the FFRD initiative and is being developed through probabilistic methodologies. In addition, FEMA is working with other federal agencies, as well as through the Integrated Water Resources Science and Services (IWRSS) Memorandum of Understanding, to explore some of these needs.

SUBRECOMMENDATION FC-4.8

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should produce, and should encourage communities to adopt, future conditions products to reduce flood risk.*

2021 REVISED TEXT: *None.*

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **some progress** has been made towards the completion of Subrecommendation FC-4.8. FEMA encourages communities to consider future conditions information and the potential impacts of various scenarios on flood risk.

C.1.5 2015 FUTURE CONDITIONS RECOMMENDATION FC-5

2015 FUTURE CONDITIONS REPORT TEXT: *Generate future conditions data and information such that it may frame and communicate flood risk messages to more accurately reflect the future hazard in ways that are meaningful to and understandable by stakeholders. This should enable users to make better-informed decisions about reducing future flood-related losses.*

2021 REVISED TEXT: *Assess and evaluate future conditions data and information such that it may frame and communicate flood risk messages to more accurately reflect the future hazard in ways that are meaningful to and understandable by stakeholders. This should enable users to make better-informed decisions about reducing future flood-related losses.*

DISCUSSION/JUSTIFICATION: FEMA believes that other federal agencies are in a better position to generate future conditions data that could then be incorporated into a probabilistic flood modeling framework. The TMAC agrees with FEMA that other agencies are in a better position to generate the data, but believes that FEMA should be proactive in evaluating climate change data and incorporating them in its products.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **progress has not yet started** towards the completion of Future Conditions Recommendation FC-5. Risk communication is communication intended to provide an audience with the information they need to make informed, independent judgments about risks to their health, safety, and the environment. It should be meaningful, understandable, and actionable and works best when it is a two-way process where an agency listens to, learns from, and meets the needs of its stakeholders.

The TMAC agrees with FEMA's assessment that other agencies are in a better position to generate future conditions data, models, and scenarios, but recommends that the agency work with other agencies in making sure that the agency's needs are met. Specific actions for FEMA to implement include:

- Assess future conditions data, models, and scenarios based on availability; importance; acceptance from stakeholders and ease of incorporation into FFRD. These assessments should include uncertainty estimates.
- Work with other agencies in developing and evaluating future conditions data, models, and scenarios so that such products support flood risk assessments.
- Identify the best communication methodologies for targeted audiences.
- Plan on stakeholder listening sessions to present both models and scenarios and get feedback.
- Evaluate other agency's communication tools to include, but not be limited to, the following:
  - EPA SALT Framework is based on a process of Strategy, Action, and Learning and is supported by Tools that together provide a research-based approach and best practices for communicating our work to the American people (USEPA, 2021). Available here: https://www.epa.gov/sites/default/files/2021-03/documents/flooded_homes_v9_508.pdf.
  - NOAA Climate Resilience Toolkit (CRT) is a website designed to help people find and use tools, information, and subject matter expertise to build climate resilience. The CRT offers information from across the U.S. federal government in one easy-to-use location. The toolkit promotes a five-step process for building resilience: Identify the Problem, Determine Vulnerabilities, Investigate

Options, Evaluate Risks and Costs, and Take Action. The CRT's five-step process for building resilience is available here: https://toolkit.climate.gov/.

– Climate Data Initiative provides climate-related data that helps inform and prepare America's communities, businesses, and citizens for future environmental conditions. Available here: https://www.data.gov/climate.

SUBRECOMMENDATION FC-5.1

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should frame future risk messages for future conditions data and information such that individuals will pay attention to the future flood risk. Messages may be tailored to different stakeholders as a function of their needs and concerns.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: This unchanged recommendation remains relevant and pivotal. Population growth and urban and suburban expansion alone, even in the absence of potential climate change, will drive unnecessary and insidious increases in future flood damages unless individuals, communities, and the nation understand the risks and take appropriate measures to reduce them. Climate change is expected to drive additional increases.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that **progress has not yet started** towards the completion of Future Conditions Subrecommendation FC-5.1. FEMA will consider messaging approaches as part of its broader FFRD initiative and believes that the development of the full FFRD strategy is an important prerequisite. This may include messaging around both current and future flood risk. The TMAC recognizes that the agency must work with other entities to make sure that FEMA is able to access necessary social-science expertise, build inventories of vulnerable assets at risk, and design messages that reveal expected and possible costs of inaction in the context of the costs of mitigation measures such as flood insurance.

C.1.6 2015 FUTURE CONDITIONS RECOMMENDATION FC-6

Future Conditions Recommendation FC-6 included the main recommendation and three subrecommendations which are discussed below.

2015 FUTURE CONDITIONS REPORT TEXT: *Perform demonstration projects to develop future conditions data for representative coastal and riverine areas across the Nation to evaluate the costs and benefits of different methodologies or identify/address methodological gaps that affect the creation of future conditions data.*

2021 REVISED TEXT: *FEMA should perform additional demonstration projects to further develop and refine future conditions data, modeling efforts, and flood hazard and risk products for representative coastal, riverine, and pluvial areas across the Nation.*

DISCUSSION/JUSTIFICATION: As a result of the 2015 TMAC Future Conditions recommendations, FEMA initiated a series of pilot projects to assess the various implications of future conditions modeling and mapping. The following projects were undertaken as a result of FC-6:

1. California Coastal Analysis and Mapping Project (CCAMP) Open Pacific Coast (OPC) Study
2. North Carolina Sea Level Rise Impact Assessment Study
3. FEMA Region 4 Advisory Sea Level Rise Study: Hillsborough and Pinellas Counties, Florida
4. FEMA SLR Advisory Map Proof of Concept Study, Puerto Rico
5. Incorporating Climate Change into Future Conditions Riverine Floodplain Modeling

The pilot projects, while focusing on varying geographic areas of the nation, were generally targeted in coastal areas and provided a multitude of lessons learned related to potential future flood risks and implementation of future conditions data and products. The pilot projects have been referenced throughout this report's discussion of the 2015 Future Conditions recommendations in various contexts, but a simple fact remains: Additional proof of concept work is needed related to three main components of future conditions-related flood risks: 1) Data inputs for future conditions assessments; 2) Modeling of future conditions scenarios; and 3) Products that communicate future flood hazards and risks. An in-depth synopsis of the goals, outcomes, and lessons learned from the five pilot projects mentioned above is provided in Section C.4.

That is not to say that the pilot projects conducted by FEMA haven't provided considerable value, especially when considering the transition and ultimate implementation of FFRD. The pilot projects already conducted and supported by FEMA indicate a willingness to examine and educate stakeholders about future flood risks. In fact, the probabilistic modeling scenarios that will be a cornerstone of FFRD implementation considers more than just historic events in determining the extents of current and future flood hazards. However, there is considerable work still to be done in order for FEMA to begin implementation, and then continually enhance aspects of FFRD.

IMPLEMENTATION CONSIDERATIONS: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that Future Conditions Recommendation FC-6 was **completed**. Additionally, FEMA has made several references of support to other future conditions-related pilot projects with various stakeholders. However, because of the ever-changing status of future conditions data collection, advancements in modeling methodologies and computing technology, and stakeholders' interest (based on input) in seeing what graduated flood risks that consider future conditions look like, FEMA should continue seeking and supporting various collaborations that develop data inputs (e.g., SLR, coastal and riverine erosion, rainfall indices, hydrographic boundary data), dynamic ways to incorporate datasets and products from partners, and engagement on how FFRD products should look and how they should be communicated.

SUBRECOMMENDATION FC-6.1

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should perform a study to quantify the accuracies, degree of precision, and uncertainties associated with respect to flood studies and mapping products for existing and future conditions. This should include the costs and benefits associated with any recommendation leading to additional requirements for creating flood related products.*

2021 REVISED TEXT: *FEMA should assess and report how FFRD will quantify the accuracies, degree of precision, and uncertainties with respect to flood studies and mapping products for existing and future conditions.*

DISCUSSION/JUSTIFICATION: During its September 3, 2021, Implementation Status Briefing, FEMA indicated that Future Conditions Recommendation FC-6.1 was **completed** through the probabilistic methodology exploration. FEMA indicated the methodology could be used to quantify accuracies, degrees of precision, and uncertainties. Context needs to be provided on how FFRD impacts future flood hazards assessments and product creation. FFRD was not a viable concept when this recommendation was made in 2015; therefore, FEMA should assess and document accuracy, precision, and uncertainties related to future conditions flood studies.

IMPLEMENTATION CONSIDERATIONS: In its implementation briefing to the TMAC, FEMA reported that it has **completed** Subrecommendation FC-6.1. However, the TMAC believes additional consideration (via pilot projects) should be conducted under the auspices of FFRD.

The TMAC finds that FC-6.1 remains relevant but requires minor amendment to clarify references to FFRD and the accuracy, precision, and uncertainties associated with those assessments.

SUBRECOMMENDATION FC-6.2

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should conduct future conditions mapping pilots to continue to refine a process and methods for mapping and calculating future flood hazards and capture and document best practices and lessons learned for each.*

2021 REVISED TEXT: *FEMA should conduct mapping pilots to continue to refine processes and methods for mapping and calculating future flood hazards under FFRD and capture and document best practices and lessons learned for each.*

DISCUSSION/JUSTIFICATION: The original text from 2015 remains relevant and aligns closely with the TMAC's overall recommendation FC-6. However, slight updates were made to Recommendation FC-6.2 to align with FFRD efforts.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA reported it has **completed** Recommendation FC-6.2. However, the TMAC believes additional consideration (via pilot projects) should be conducted under the auspices of FFRD.

The TMAC finds that Recommendation FC-6.2 remains relevant but requires minor amendment to refer to FFRD.

SUBRECOMMENDATION FC-6.3

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should support research for future conditions coastal hazard mapping pilots and case studies using the latest published methods to determine the best means to balance the costs and benefits of increasing accuracy and decreasing uncertainty.*

2021 REVISED TEXT: *FEMA should support research for future conditions coastal, riverine, and pluvial flood hazard mapping pilots and case studies using the most current published methods to determine the best means to balance the costs and benefits of increasing accuracy and precision, and decreasing uncertainty.*

DISCUSSION/JUSTIFICATION: The original text from 2015 remains relevant and aligns closely with the TMAC's overall recommendation FC-6. However, slight updates were made to the recommendation relative to precision and to add riverine and pluvial future flood hazards to align with FFRD efforts.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA reported it has **completed** recommendation FC-6.3. However, the TMAC believes additional consideration (via pilot projects) should be conducted under the auspices of FFRD.

C.1.7 2015 FUTURE CONDITIONS RECOMMENDATION FC-7

Future Conditions Recommendation FC-7 included the main recommendation and six subrecommendations, which are described more fully below.

2015 FUTURE CONDITIONS REPORT TEXT: *Data and analysis used for future conditions flood risk information and products should build on standardized data and analysis used to determine existing conditions flood risks and additional future conditions data, such as climate data, sea level rise information, long-term erosion data; and develop scenarios that consider land use plans, planned restoration projects, and planned civil works projects, as appropriate, that would impact future flood risk.*

2021 REVISED TEXT: *Data and analysis used for future conditions flood risk information and <u>nonregulatory</u> products should build on standardized data and analysis used to determine existing conditions flood risks and additional future conditions data, such as climate data, sea level rise information, long-term erosion data, and develop<u>ment</u> scenarios that consider land use plans, planned restoration projects, and planned civil works projects, as appropriate, that would impact future flood risk.*

DISCUSSION/JUSTIFICATION: FEMA is required to produce maps and mapping products for current flood conditions to meet NFIP statutory requirements. Beyond that, it has flexibility to offer non-regulatory products that provide supplemental information, including descriptions of future flood conditions.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA reported it has **not yet started** to implement FC-7 overall, or Subrecommendations 7.1, 7.3, 7.5, or 7.6. FEMA has made some progress on Subrecommendation 7.2 (based on experimentation with probabilistic modeling and mapping approaches) and Subrecommendation 7.4.

TMAC finds that Recommendation FC-7 remains relevant but requires minor amendment to clarify the reference to future development scenarios and to suggest use of future conditions data in nonregulatory products only. These minor but important recommendations clarify the intent of the recommendation.

SUBRECOMMENDATION FC-7.1

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should support expanded research innovation for water data collection, for example using Doppler radar.*

2021 REVISED TEXT: *FEMA should support expanded research innovation for understanding the frequency and intensity of flood causing events and antecedent conditions and how those factors may change through time and affect future flood conditions.*

DISCUSSION/JUSTIFICATION: Subrecommendation FC-7.1 acknowledges the need to examine more of the causal factors behind flooding. More specifically, different types of precipitation events lead to varying rainfall intensities and flood magnitudes. As discussed in the modeling portion of Section C.3.1, climate change may alter the relative frequency of these events. Differences in storm tracks, seasonality, and durations may also give rise to different flood conditions which might be linked to climate change.

More effectively tagging storm and flood data and studying changes in their distributions may enable better prediction of future floods. Developing a national statistical storms database and a tidal flooding database may provide important tools for such a study. Recording the fundamental aspects of the passage of various storms as only Doppler radar can do may also advance flood productions. But there are other methods and technologies which FEMA might consider. Accordingly, subrecommendation 7.1 was broadened and recasted to suggest a more systematic support for flood research.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA indicated implementation of

Recommendation FC-7.1 had not yet started. FEMA reported it could consider this recommendation in the future through expanded interagency partnerships.

SUBRECOMMENDATION FC-7.2

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should use a scenario approach to evaluate the impacts of future flood control projects on future conditions flood hazards.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: As discussed in the scenarios portion of Section C.3.1, scenario analysis remains the primary strategy for evaluating future greenhouse gasses (GHG) emissions and related climate change induced future flood conditions. In 2020, TMAC explicitly endorsed use of probabilistic approaches for modeling and illustrating current flood conditions. As discussed in the modeling portion of Section C.3.1, with relatively minor tweaks, probabilistic approaches can also be used to sample, model, map, and explore many scenario-predicated future flood conditions including the construction of flood control infrastructure.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA indicated implementation of Recommendation FC-7.2 had **not yet started** due to resource constraints but could be an add-on to a probabilistic modeling framework that it is building. TMAC concurs and believes that rapid progress on Subrecommendation FC-7.2 will occur once the probabilistic modeling capability is developed.

SUBRECOMMENDATION FC-7.3 AND FC-7.4

2015 FUTURE CONDITIONS REPORT TEXT (FC-7.3): *FEMA should support research on future conditions land use effects on future conditions hydrology and hydraulics.*

2015 FUTURE CONDITIONS REPORT TEXT (FC-7.4): *FEMA should develop guidance for evaluating locally developed data from States and communities to determine if it is an improvement over similarly-available National data sets and could be used for future condition flood hazard analyses.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: While the impacts of land use change and basin development is generally well understood and may often exceed in magnitude the impacts of climate change on future conditions flooding, compiling national datasets or modeling and projecting future land use and basin development has received comparably little attention. Recommendations 7.3 and 7.4 address this issue as drafted in 2015. The development or provision of relatively little land use/land cover information lies within the mission domain of FEMA, but the timely delivery of it, particularly land use and developmental information in formats and resolutions applicable to modeling future flood conditions, will likely require that FEMA engage and partner with various other agencies at the federal, state, tribal, and local levels.

National parcel boundary datasets have been compiled by various real-estate services and are available to FEMA, but the data rarely convey hydrologically relevant information. The National Land Cover Database contains current landcover information and proposals to develop a National Building Footprint are being considered, but neither of those datasets alone will support needs for future conditions projections. Indeed, given that land use planning is primarily a local responsibility a broad, multi-governmental level coalition to develop a framework to compile national or regional databases, encourage data sharing, and develop operational land use models with frequent updates is likely needed.

Regionally driven efforts motivated on ecological water-quality concerns, such as those in the Chesapeake Bay have resulted in significant data sharing based on information contributed by a wide diversity of government agencies and interest groups and has led to advances in land use modeling. Similar coalitions with the participation of FEMA regional offices might promote similar progress in other areas of the nation and provide worthwhile targets for pilot projects to develop standards and guidance for application to future conditions floodplain modeling and mapping.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA indicated Subrecommendation FC-7.3, had **not yet started** and that it hasn't pursued this recommendation due to resource constraints. For Subrecommendation FC-7.4, FEMA indicated **some progress** has been made, stating that it recognizes this need and is exploring best practices for state and local partners, though guidance has not yet been initiated.

SUBRECOMMENDATION FC-7.5

2015 FUTURE CONDITIONS REPORT TEXT: *FEMA should develop better flood risk assessment tools to evaluate future risk, both population-driven and climate-driven. Improve integration of hazard and loss estimation models (such as Hazus) with land use planning software designed to analyze and visualize development alternatives, scenarios, and potential impacts to increase use in local land use planning.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: This recommendation has only increased in relevance since 2015. Advancements in tax parcel-level simulations, cloud computing, and land use characterization plus development of efficient regional models have made simulation of future land use conditions more practical, even for larger watersheds. Many modelers now routinely avail themselves of cloud computing resources. Example models that provide simulations at parcel-level resolution and regional scope include FORE-SCE model

(Sohl, et.al., 2017). The availability of national-scale parcel data combined with building footprints (from Microsoft and Oak Ridge Laboratories) enable a more detailed characterization of floodplain risks and vulnerabilities. Moreover, some regions like the Chesapeake Bay and Delaware River watersheds, have developed high-resolution (1-meter) land cover data to provide a more accurate characterization of the developed landscape, particularly when combined with parcel data. Additional work is being done with artificial intelligence integration of dynamic feedbacks and coupling, albeit loosely, between land use models and hydrologic, hydraulic, climate, and other types of models.

Pending updates FEMA's Hazus and the recent release of the 2020 Census data means that flood damage and risk management projects will be more complete and accurate. With the Hazus FAST (Flood Assessment Structure Tool) Tool, users can assess risk for a structure without full Hazus installation. Moreover, Hazus and FAST are hazard data agnostic, meaning that past, present, and/or future hazard data can be ingested and analyzed so long as the data is in a usable raster formats with flood-depth values.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA indicated implementation of Subrecommendation FC-7.5 has **not yet started**. FEMA stated it plans to work to ensure a probabilistic flood hazard modeling framework that can be integrated with loss estimation models such as Hazus. As FEMA looks to this broader integration, it could consider how flood risk assessment tools evaluate future risk.

SUBRECOMMENDATION FC-7.6

2015 FUTURE CONDITIONS REPORT TEXT: *Future flood hazard calculation and mapping methods and standards should be updated periodically as we learn more through observations and modeling of land surface and climate change, and as actionable science evolves.*

2021 REVISED TEXT: *None.*

DISCUSSION/JUSTIFICATION: Subrecommendation FC-7.6 emphasizes the high likelihood that climate science and predictive modeling of future flood conditions and statistical characterization of those flood conditions will continue to advance. It also offers a cautionary note about the need to avoid locking communities into a long-term expectation about future flood conditions. Communities should understand that a FEMA prediction regarding future flood conditions is a best estimate at the time that it is issued, reflecting the best available, but still evolving data, uncertainties, and prediction methods and tools.

Consistent with this outlook, FEMA might emphasize a continuous improvement process focused on establishing an early national set of nonregulatory future flood products with an expectation of frequent refreshes even if those products become rapidly obsolete. Private sector and academic organizations, such as First Street, Inc. have already developed useful products based on this approach, at least at large scales and using approximate methods. Continued exploration of probabilistic approaches for creation of shorter-term nonregulatory future conditions products and engage, where possible and expedient, in partnerships with private and public institutions and agencies who are developing such approaches would likely pay important dividends to creating and using future flood products.

IMPLEMENTATION CONSIDERATIONS: In its briefing to the TMAC, FEMA indicated implementation of Subrecommendation FC-7.6 has **not yet started**. FEMA stated it agreed with the recommendation and would lean heavily on its federal agency partnerships to implement this recommendation in the future.

C.2 NEW TMAC 2021 FUTURE CONDITIONS RECOMMENDATION

In addition to assessing the relevancy of the future conditions defined in the 2015 Future Conditions report (TMAC, 2015a), the TMAC was tasked to identify additional recommendations for addressing future conditions with the graduated approach to flood hazard and flood risk identification. Throughout its 2021 deliberations, the Subcommittee validated the existing recommendations and identified one additional recommendation for FEMA's consideration, which addresses the need for FEMA to incorporate the future conditions recommendations, outcomes, and available tools outlined in this report into the development, deployment, and continued enhancement of the Future of Flood Risk Data (FFRD) initiative. More discussion of the new 2021 Recommendation can be found in Section C.2.1.

C.2.1 NEW 2021 FUTURE CONDITIONS RECOMMENDATION

FEMA's FFRD initiative, the primary elements of which are depicted in Figure C-2, aims to provide a more comprehensive understanding of the nation's flood risk. FEMA is working to develop a framework for probabilistic flood hazard and flood risk analysis that will establish the foundation to comprehensively understand the nation's current and future flood risk. Through the collaborative development of foundational datasets to support this framework, such as a national statistical storms database, FEMA will be able to drive an improved understanding of current flood risk and also enable the federal family to simulate, in a consistent manner, future flooding scenario-based recommendations from climate experts that account for future variables such as expected changes to precipitation patterns, frequency, and intensity. A modular design is inherent in the framework described above and would enable FEMA to use computational advances to dynamically model flood risk.

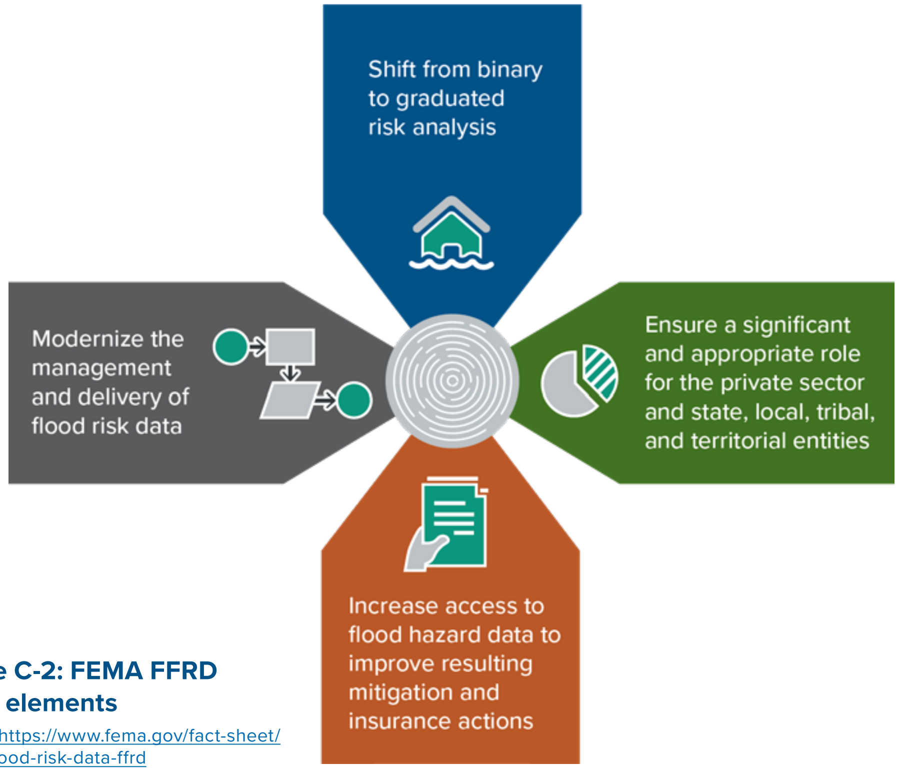


Figure C-2: FEMA FFRD major elements

Source: https://www.fema.gov/fact-sheet/future-flood-risk-data-ffrd

NEW 2021 FUTURE CONDITION RECOMMENDATION TEXT: *FEMA should incorporate the future conditions recommendations outlined in this report into the development, deployment, and continued enhancement of FFRD. This includes supporting existing partnerships to leverage best available climate science and datasets that will support future conditions analyses with an FFRD lens. Future conditions flood hazard and risk analyses should be standard approaches within the probabilistic modeling suite and resultant nonregulatory products that FFRD will employ.*

JUSTIFICATION: As a primary driver for a future, risk-informed NFIP, FFRD will be vital to fulfilling future conditions flood hazard and risk scenarios. The recommendations made by the TMAC in the 2015 Future Conditions report and enhanced in this report will be vital for the implementation of FFRD (TMAC, 2015a). The vision of FFRD is to provide transformational modeling capacity and product output based on significant and appropriate user needs. By incorporating future conditions approaches into the FFRD probabilistic modeling scenarios, FEMA will be able to provide flood hazard and risk products that incorporate current and future flood risk and are dynamic enough to include evolving datasets from geographically varied areas of the nation.

C.3 BACKGROUND INFORMATION AND CONTEXT FOR FUTURE CONDITIONS SUBCOMMITTEE DELIBERATIONS

The identification and availability of future conditions flood hazard and risk information are of utmost importance to the nation's citizens and economy as development and population growth continues in flood-prone areas. The NCA4 states that the climate is clearly changing, will continue to change for the foreseeable future, and that change may accelerate in the future (USGCRP, 2018b). The report goes on to say that these changes are evident in many places and are becoming increasingly disruptive.

Currently, the National Flood Insurance Program (NFIP) does not consider future conditions in the identification of SFHAs on regulatory FIRMs or in the standard Risk Mapping, Assessment, and Planning (Risk MAP) non-regulatory suite of flood hazard and flood risk products. FEMA, Congress, and other stakeholders have recognized the need for incorporating future conditions information into the NFIP and National Flood Mapping Program.

In 2015, the TMAC concluded that the availability of nonregulatory future conditions flood risk products, tools, and information will help communities make more informed development decisions that mitigate the loss of life and property by lessening the impact of future disasters. Risk information supported by future conditions data can save lives; protect property and the environment; and allow for focused, planned recovery when keeping future conditions flood hazards in mind. The recommendations outlined in the 2015 Future Conditions report (TMAC, 2015a) are intended to counsel FEMA on the utilization and incorporation of best available climate science and methodologies to assess possible future flood risk. The report produced seven primary recommendations and 37 subrecommendations supporting these primary recommendations.

Section C.1 summarizes the TMAC's 2021 review and findings regarding the continued relevance of the 2015 recommendations and suggestions for change, along with justifications for the TMAC's 2021 assessments and opinions. Section C.2 presents a new recommendation and the justification for offering it. In addition to these (mostly) brief justifications, Sections C.3.1 and C.3.2 provide contextual definitions and additional background and supplemental information with regard to the ever evolving hydrologic, geospatial, and climate-change sciences relevant to modeling and mapping of future flood conditions and the NFIP. The background information focuses keenly on developments since 2015, that served to broadly guide TMAC deliberations, judgments, and positions.

C.3.1 DEFINING FUTURE CONDITIONS AND FRAMEWORK FACTORS FOR TMAC DELIBERATIONS

Information provided in the following subsections describes various factors that inform the understanding and communication of future conditions flood hazards and risks with a focus on what has changed since 2015. It is important to understand these concepts as they provide background for: (1) the recommendations from the 2015 Future Conditions report (TMAC, 2015a); (2) FEMA's progress on implementing those recommendations; and (3) justifications for updating existing recommendations and identifying new ones. As discussed in Section 3.2, these factors played a key role in the Subcommittee's assessment of each of the TMAC 2015 future conditions recommendations, specifically in determining their relevancy in light of FFRD, advances in climate change and SLR science, and the evolution of other initiatives since the future conditions recommendations were identified in 2015.

C.3.1.1 FLOOD HAZARDS VERSUS FLOOD RISKS

Historically, FEMA has mapped the flood hazards as the expected extent of a the 1-percent-annual-exceedance-probability (1% AEP) flood. In 2015, the TMAC recommended that FEMA transition from merely mapping flood hazards to mapping flood risks. Flood risk is the product of the probability of a flood times the value of the assets threatened by that flood. In 2020, TMAC recommended that FEMA adopt a probabilistic modeling process and display flood risks in a graduated manner over a far greater range of annual exceedances.

C.3.1.2 SCENARIOS

In 2015, the TMAC recommended that FEMA use a scenario approach to create future conditions flood hazard products, tools, and information. Scenarios attempt to link a range of human, societal possibilities to plausible outcomes worthy of assessment and do not imply a likelihood. Overall, the approach recommended by the TMAC uses two types of scenarios: climate change and land use change.

Climate Change: In the context of a changing climate, scenarios describe plausible future conditions with regard to the generation of GHGs, principally carbon dioxide. Various such scenarios have been developed as a result of efforts to develop and compare global climate models and to apply the model outputs to assess the environmental and societal consequences of GHG production. These scenarios and associated climate model outputs have been standardized and published and can be used to drive hydrologic models to simulate future precipitation and flood conditions. Since 2015, new emission scenarios, in combination with the most recent generation of climate or earth system model experimental results (known as the Coupled Model Intercomparison Project or CMIP6) have been developed and used in the Sixth

Assessment Report of the IPCC (IPCC, 2021) and will form the core set of scenarios used in the NCA5, due by 2023. In addition, since 2015, new regional SLR scenarios have been developed that should be available by February 2022. Included in the updated science is a better understanding of relative SLR based on regional influences of oceanographic currents, ice sheet finger printing, and vertical land motion. The result is the availability of updated SLR scenarios that enable a risk management approach to future flood risk at more locally relevant levels (at individual tide gauges and as a one degree grid for the entire U.S. Coastline). The availability of these new SLR scenarios forms the basis for some changes to Recommendation FC-3 concerning mapping of future flood conditions for coastal areas.

Land Use: Land use scenarios reveal possible urban and agricultural lands, forests, and wetlands and can be indexed to land use plans and zoning ordinances of individual communities. They may be based on historical data or land use models that utilize economic and population trends to simulate future conditions. Information about local zoning and future land use change can be incorporated into probabilistic models to illustrate the impacts of various land-use scenarios and is an important consideration as FEMA begins implementing the FFRD into local hazard and risk models. Since 2015, the availability of parcel-level tax information, land use characterizations through widely available remote sensing imagery, and cloud computing have made regional-scale simulations far easier and more informative, potentially permitting their inclusion in future flood conditions mapping as recommended in 2015 Subrecommendations FC-1.6, FC-1.4, FC-4.4, and FC-7.2.

C.3.1.3 MODELS

Models differ widely in terms of their fundamental design and approach, the algorithms that control and modulate them, the nature, volume, and resolution of the data that drives them, and the fidelity of the simulations they produce. Different models and modeling strategies are used to estimate current flood conditions and may have different uses in predicting future flood conditions. Since 2015, new and more refined models and modeling approaches have been developed that have improved our ability to predict and map future flood conditions and that enhance the impact, approach, and feasibility of implementing many of the 2015 TMAC recommendations. The most important changes are the increased adoption of probabilistic modeling methods, new statistical distribution models, and the development and application of continental, high-resolution hydrologic and hydraulic models, all of which were anticipated broadly by TMAC 2015 Subrecommendation FC-7.6 with respect to periodic updates to FEMA methods.

Probabilistic Versus Deterministic Modeling: Historically, FEMA has focused on a deterministic modeling approach that assesses less than 10 flood recurrence intervals (or annual exceedance probabilities, also referred to as AEPs) based on historical data. The new FFRD initiative incorporates a probabilistic modeling approach that may result in assessing thousands of probability-linked input datasets over the full range of AEPs. In 2020, the TMAC endorsed use of probabilistic modeling as a central element in the FFRD and as a preferred tool to illustrate flood risk in a graduated manner. The simulation components of probabilistic modeling can also be applied to evaluate land use and climate change scenarios, but the lack of a probability basis for the scenarios prevents the expression of the simulations in probabilistic terms. However, it does permit the objective assessment of the robustness a community zoning or building code ordinance to the potential stresses of different scenarios as directed by TMAC 2015 Subrecommendation FC-7.5.

Distributional Models: Distributional models use observed, gaged data to fit flood-frequency distributions. As anticipated in 2015, new federal guidelines for computing riverine flood-frequencies have been formulated. In 2019, Bulletin 17C (England, et.al., 2019), the recommended federal guidelines, prescribed use of the Expected Moments Algorithm (Cohn, 1997) to fit a log-Pearson Type III distribution to observed flood data. The Expected Moments Algorithm is an example of a distributional model that permits incorporation of relative (non-precise) flood observations and documented community experience in flood-frequency analysis. These models assume that all of the data come from a single population with a stationary mean, standard deviation, and skew. However, both climate and land use change create new hydrologic conditions and may shift one or more of these statistics through time. In many cases, large or persistent trends may be detected and related to underlying changes such as the expansion of impervious area within a basin. Since publication of the 2015 Future Conditions report (TMAC, 2015a), flood trends detention, modeling, and attribution methods have received more attention and could be important contributors to FFRD development and should be considered in future floodplain mapping procedures as directed by TMAC 2015 Subrecommendation FC-7.5.

Although distributional models assume that the data are drawn from a single, stationary population, most flood datasets are produced by distinctively different storm types or hydrologic conditions that occur over the period of record and comprise “mixed populations.” Rain on snow events, convective thunderstorms, and hurricane-driven floods, for example, are often important contributors to flood datasets collected at individual locations, each representing a potential distinct flood population with unique distributional characteristics. Importantly, there is no substantial reason to expect that climate change will affect each of these or other flood-producing mechanisms in the same way or to the same degree. Thus, there is some need to study and model flood trends with respect to each storm type. The launch of the National Weather Service (NWS) National Water Model in 2017 and completion of 40-year hydrologic retrospectives by the NWS and the USGS, plus study of stream gage records, could help tease out changes in the frequency and characteristics of various storm types. This need motivates the revision and generalization of TMAC 2015 Subrecommendation FC-7.1, described in Section C.1.7.

Regional Regression Models: Regional regression models are statistically fitted functions or equations that relate flood-frequency estimates determined from distributional modeling at gaged locations to physiographic, climate, and land use characteristics of the basins the gages monitor. Regression models account for a significant portion of the flood estimates underpinning many FEMA FIRMs. To the extent that regional regression models incorporate measurements of climate conditions that force flooding, such as basin precipitation, temperature, or snow days, they could conceivable be used to estimate future flood conditions. In 2016, Selvanathan et al. (2016) demonstrated such a strategy. However, it is important to recognize that the coefficients linking the various inputs of the regional equations are calibrated against past flood observations and that a strategy based on estimating future conditions using the equations presupposes that the relative weights to the inputs (e.g., precipitation, temperature, evaporation) in the future is consistent with those that exist today. Unfortunately, there is no guarantee that will be the case.

Physically Based Models: Physically based models also use mathematical equations, together with dynamic algorithms to drive interactions among the equations and thereby simulate physical processes and their interactions. Global climate change models and river flood forecast models are examples of physically based models. These models are so complex and their scope so vast they commonly run only in high-performance computer environments. Perhaps the most significant development since 2015 is the integration of climate and hydrologic models through WRF-HYDRO to create and operationalize the National Water Model (NWM; Gochis et al., 2020). The NWM is rerun on a national scale to update river flow condition forecasts every 6 hours. Months long simulations have been performed to create a 40-year hydrologic retrospective.

Since 2015, the academic community and private sectors have also developed new climate change–informed hydrologic models that can be used to estimate future flood conditions. For example, First Street Foundation has developed a continental-scale national flood model that incorporates coastal, riverine, and pluvial phenomena to estimate graduated flood risks for plausible current and future conditions out to 2050 based primarily on select climate change and representative concentration pathways (First Street Foundation, 2020).

In addition, more robust process-based coastal modeling is now available that includes the increase in SLR as part of the dynamic modeling input, thus accounting for non-stationarity/non-linear responses (for example, wave runup, which impacts Zone V areas). Also, there are better methods for accounting for regional differences—such as in the Great Lakes and Alaska—that can be included in the analysis. Proposed changes to Recommendation FC-3 and its 11 subrecommendations capture these developments as they relate to the initial recommendations and provide necessary updates and justifications for doing so.

C.3.1.4 **UNCERTAINTY**

Uncertainty is unavoidable. In layperson's terms, uncertainty arises from our inability to see exactly and precisely all that is relevant or to understand the meaning of, and connections among, the things that we are seeing. In broader, scientific terms, uncertainty arises from imperfections in the data (what we see) that inform the models (the meaning of what we see) that we use to make predictions.

As described in the TMAC 2015 Annual Report (TMAC, 2015b), uncertainties exist in floodplain mapping. Even when we use established approaches that rely on observations of known floods to estimate the frequency, extent, and depth of future floods (under current conditions), there is always uncertainty. Uncertainties arise from (1) the incompleteness and imprecision of flood data, because no flood can be perfectly measured nor can any flood record be extended completely through all relevant time or space, and (2) the inadequacy of flood models, which cannot perfectly represent the relation between the input data and the eventually experienced floodplain, even if the future flood conditions do not differ from past flood conditions. In that situation, departures between our predictions and our data are used to estimate uncertainty. When future changes are considered, additional uncertainty is introduced due to our inability to know exactly what will happen in the future. Extrapolations beyond our data may be required; hence the data can no longer serve as the primary grounding for estimating uncertainty. In those cases, the consistency of the predictions among independent and varied models becomes the basis for estimating uncertainty.

In terms of climate change science and related policy considerations, the Fifth Assessment Report (AR5) of the IPCC (IPCC, 2014) identifies the two main sources of uncertainty already discussed but with slightly different names: internal variability (the inability to perfectly measure or know all data), model error (the inability to perfectly represent or replicate the data), and adds a third source of uncertainty, scenario uncertainty (the inability to know what course of action society will choose in the future) (Collins et al., 2013). Climate change and land use change scenarios pose presumptions about societal and political decisions with plausible outcomes given the assumed societal selections. Concerning these topics, additional uncertainty is introduced because we do not know in reality what society will choose to do about GHGs, urban development, or the likelihoods associated with those decisions. Thus, societal uncertainty cannot be quantified, but it can be expressed qualitatively, usually based on expert opinion and elicitation.

In summary, robust prediction of floodplains with known and useable uncertainties are possible, valuable, and can be made routinely. Floodplain map uncertainty can be projected and reported for current flood conditions based on observed data and, to a significant extent, for maps generated from analysis of flood data containing trends and predictions if the appropriate models are applied and assumptions regarding the continuation of underlying trends are valid. On the other hand, uncertainties are certainly larger but otherwise impossible to quantify for scenario-based predictions because the likelihood chain is incomplete or broken. Never-the-less, scenario-based analysis in general, and future, nonregulatory flood conditions maps and data, in particular, would be extraordinarily valuable to the nation because only they can illustrate the robustness, or conversely, the vulnerability of communities and property owners if exposed to plausible future flood conditions pending societal decision making and greatly improved data and models. In the meantime, and even with stated drawbacks, they would provide a conceptual stress test for communities who would otherwise have few tools for assessing an unknowable future. Both the TMAC 2015 Annual Report (TMAC, 2015b) and the 2015 Future Conditions report (TMAC, 2015a), particularly Recommendation FC-2, recommended that FEMA improve the communication of uncertainty in its flood data products.

C.3.1.5 TYPES OF FLOODING

It is important to understand the types of flooding within the context of TMAC's assignment to review the 2015 future conditions recommendations and identify additional ones because hazard and flood risk analyses are unique to flooding types. There are several different types of floods, based on the source of the water and the hazards they pose. However, the dynamics of how flooding occurs is much more complex. Historically, the National Flood Mapping Program (Risk MAP) has conducted flood hazard assessments for either coastal, riverine, or a combination of the two flooding sources. Recent studies have indicated that pluvial flooding poses an additional significant hazard, especially in urban areas (Falconer et al., 2009).

Coastal Flooding: Coastal flooding normally occurs when dry and low-lying land is submerged by seawater. Coastal flooding can result from a variety of different causes including storm surges created by storms like hurricanes and tropical cyclones, unusually high tides associated with alignment of the sun and moon, subsidence of coastal lands and communities, tsunamis, and SLR. Indeed, the NCA states that increases in the frequency, depth, and extent of tidal flooding due to SLR is exacerbating coastal flooding and is threatening America's trillion-dollar coastal property market and public infrastructure, with cascading impacts to the larger economy (USGCRP, 2018b).

Although coastal storms, floods, and erosion have always been hazards, in combination with rising sea levels, they now threaten approximately $1 trillion in national wealth held in coastal real estate (Figure C-3) and the continued viability of coastal communities that depend on coastal water, land, and other resources for economic health and cultural integrity.

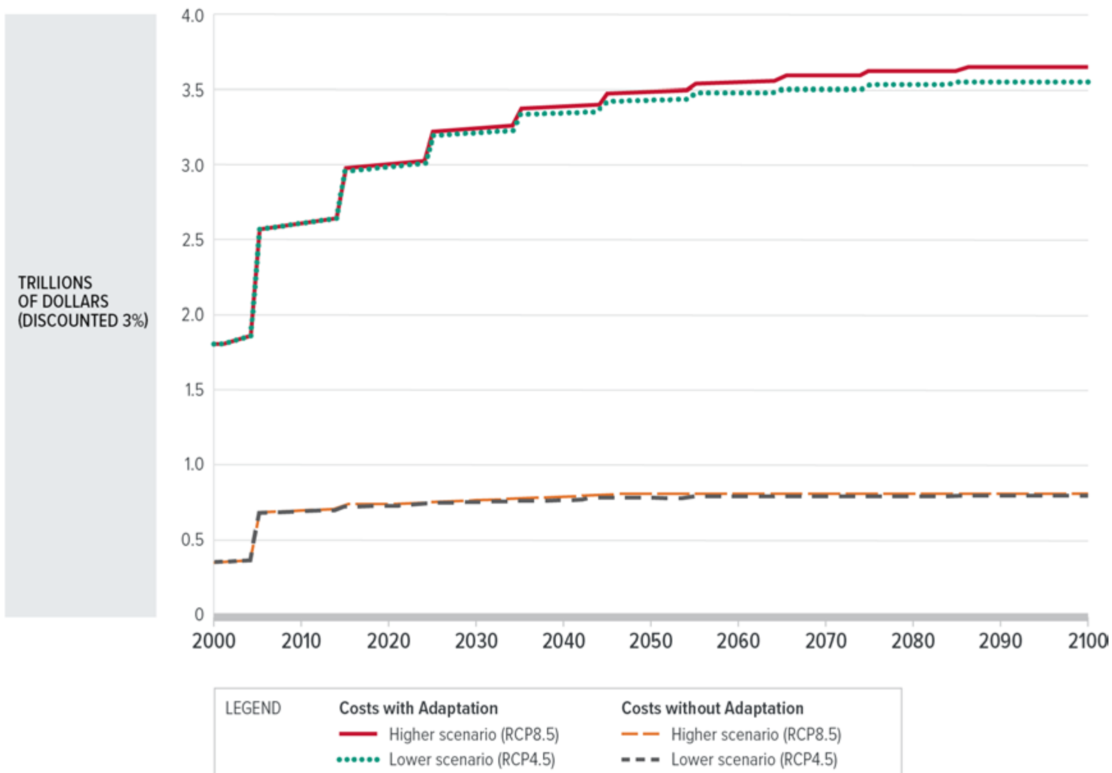


Figure C-3: Cumulative costs of SLR and storm surge to coastal property

Source: Coastline at Risk 2016 (air-worldwide.com)

Climate change impacts such as SLR may transform many coastal communities by the latter part of this century. Many individuals and communities will suffer financial impacts as chronic high tide flooding leads to higher costs and lower property values. (USGCRP, 2018b)

Since 2015, when the initial TMAC future conditions were developed, a new NCA4 has been conducted with updated actionable science, and newer science is forthcoming in NCA5, by 2023. Included in the updated science is a better understanding of relative SLR based on regional influences of oceanographic currents, ice sheet finger printing, and vertical land motion. The result is the availability of updated SLR scenarios that enable a risk management approach to future flood risk.

In addition, more robust process-based coastal modeling is now available that includes the increase in SLR as part of the dynamic modeling input, thus accounting for non-stationarity/ non-linear responses (for example, wave runup, which impacts Zone V areas). Also, there are better methods for accounting for regional differences such as the Great Lakes, and in Alaska, that can be included in the analysis. Section C.3.1.3, Models, describes these changes as they relate to the initial recommendations and provides recommended changes and justification for doing so. These developments motivated many revisions to TMAC 2015 recommendations and subrecommendations, including Future Conditions Recommendations FC-3 and FC-7.

Riverine Flooding: For the purpose of the information provided in this report, the term "riverine" encompasses flood hazards from inland flooding sources, such as rivers, streams, and lakes; shallow flooding, such as sheet flow; and secondary hazards such as ice jams, debris blockages of culverts and bridges; and failures of dams, levees, and flood gates. Rainfall and snowmelt are the major sources of riverine floodwater but their characteristic delivery varies vastly in terms of volumes, intensities, and durations that are often functions of location (including latitude, elevation, and topography) and season. These characteristics are the products of the types and frequencies of storms that might impact a basin, which deserve study as suggested in revised Subrecommendation FC-7.1. Since 2015, NOAA has updated various component volumes of NOAA Atlas 14 and has either adopted or is considering new approaches for fitting nonstationary, at-site duration-intensity-frequency curves and regionalizing the information for broader application. Bulletin 17C and new methods for modeling flood trends as referenced in Section C.3.1.3 also motivate changes to Subrecommendation FC-7.1.

Pluvial Flooding: A pluvial, or surface water flood, is caused when heavy rainfall creates a flood event independent of an overflowing water body. One of the most common misconceptions about flood risk is that one must be located near a body of water to be at risk. Pluvial flooding debunks that myth, as it can happen in any urban area or poorly drained landscape— even higher elevation areas that lie above coastal and river floodplains. There are two common types of pluvial flooding:

1. Intense rain saturates an urban drainage system. The system becomes overwhelmed and water flows out into streets and nearby structures.
2. Run-off or flowing water from rain falling on hillsides that are unable to absorb the water. Hillsides with recent forest fires are notorious sources of pluvial floods, as are suburban communities on hillsides.

Since 2015, national studies have highlighted the impact of pluvial flooding and various new models have been developed to evaluate pluvial flood hazards and project climate change-induced changes. A major example is the projections developed by the First Street Foundation (Bates, et.al. 2021). These new models and methods provide a high-resolution, continental-scale modeling framework that simulates fluvial, coastal, and pluvial flooding. The simulation of pluvial inundation is not a new concept, but traditional flood-inundation modeling has focused on inundation associated with backwater conditions and overflow of pre-existing water bodies. Pluvial flooding has been a largely neglected source of inundation. Its omission may result in a systemic and substantial underestimation of flood risk.

C.3.2 DATA SOURCES AND CHANGE PROJECTIONS

Future conditions flood hazard and risk assessments are dependent upon many factors, several of which are outlined in the following sections. Understand these data sources within the context of future conditions, and more specifically, flood hazard/risk identification and mapping is important so that stakeholders of all types with varying degrees of expertise can understand the impacts of future conditions and make land use decisions based upon them. It is also important to understand that data that inform future conditions flood hazard and risk modeling and assessments are consistently being enhanced by a wide array of FEMA stakeholders.

C.3.2.1 SEA LEVEL RISE AND LAKE LEVEL CHANGE

Several factors impact sea and lake levels. Both global sea level and local relative sea level (LRSL) vary by location, depending on local, regional, and global processes. Records from various sources show that there has been a long-term trend in rising global sea levels, with an increasing rate of change since the 1800s. Projecting future rates of SLR is challenging. Even the most sophisticated climate models, which explicitly represent the earth's physical processes, cannot simulate rapid changes in ice sheet dynamics and, thus, are likely to underestimate future SLR.

Great Lakes water levels represent evolving research and are still subject to considerable uncertainty, with water level projections for the individual lakes varying by several feet among the available climate models (USACE, 2021). Human response to rising water levels likely will also have a significant impact on future coastal flood hazards. Local shoreline decisions or policies to maintain the current shoreline location through beach nourishment and/or shoreline hardening, for example, versus a managed retreat from the most highly erodible areas will have major impacts on the extent of the future conditions floodplain.

Given the fast-paced changes encountered in these types of situations, the probabilistic modeling approach employed in FFRD will provide a more robust platform to incorporate these data. Since 2015, when the initial TMAC future conditions were developed, NCA4 has been conducted with updated actionable science, and newer science is forthcoming in NCA5, by 2023. Included in the updated science is a better understanding of relative SLR based on regional influences of oceanographic currents, ice sheet finger printing, and vertical land motion. The result is the availability of updated SLR scenarios that enable a risk management approach to future flood risk. Also, there are better methods for accounting for regional differences such as in the Great Lakes, and in Alaska, that can be included in the analysis

C.3.2.2 PRECIPITATION CHANGE

Warmer air contains more water vapor than cooler air. Global analyses show that the amount of water vapor in the atmosphere has increased over both land and oceans. In the mid-latitudes, where most of the continental United States is located, there is an upward trend in extreme precipitation in the vicinity of fronts associated with mid-latitude storms. Projections of future changes in precipitation show small increases in the global average, but substantial shifts in where and how precipitation falls. For instance, the increase in temperatures is already causing decreases in snowpack in the Sierra Nevada mountain region between California and Nevada, where more precipitation falls in the form of rain (Mote et al., 2018). In addition, warmer temperatures melt the snow faster and earlier making it more difficult to predict and for the system of reservoirs and rivers to store and convey the water without increasing the risk of flooding.

Generally, areas closest to the poles are projected to receive more precipitation, while the dry subtropics expand toward the poles and receive less rain. Certain regions, including the western United States (especially the Southwest) and the Mediterranean, are currently dry and are expected to become drier. The widespread trend of increasing heavy downpours is expected to continue, with precipitation becoming less frequent, but more intense. The patterns of the projected changes of precipitation do not contain the spatial details that characterize observed precipitation, because the projections are averages from multiple models and because the effective resolution of global climate models is roughly 100 to 200 miles. However, these data may be leveraged and enhanced where needed and necessary, to supplement FFRD modeling approaches.

Rainfall intensity-duration-frequency (IDF) data are commonly used to develop rainfall inputs for rainfall-runoff models used to develop FEMA floodplain maps. These data are available for current climatic conditions through a series of reports known as NOAA Atas 14 (NOAA NWS, n.d.; https://www.weather.gov/owp/hdsc_currentpf) and related websites (https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html). NOAA has proposed plans to develop a new series of IDF curves that will combine observed rainfall records, extrapolations of statistically detected and modeled precipitation trends, and climate model projections. The new data are not expected to be available for several years.

C.3.2.3 EROSION

Flowing water along ocean and lake coasts as well as large rivers and tributaries naturally interacts with shoreline and stream soils and rocks, eroding, entraining, moving, and redepositing shoreline and channel material in ways that may transform local topography, even shifting the locations of beaches and streams. These transformations can be both gradual or sudden and can often result in drastically increased risks to infrastructure and buildings, sometimes through increased flooding and often through foundation undermining and structure collapse. Land use change, particularly growth in impervious areas and hydraulic improvements that increase and speed runoff and streamflow, or that "harden" beaches, may increase erosion and other fluvial hazards. Rising sea levels and increases in precipitation expected from climate change may similarly increase these fluvial hazards.

Models and approaches for identifying and mapping both coastal and riverine fluvial hazards have been developed. As described below, some of these methods have been evaluated by FEMA in various pilot studies, and in recent years, some have been adopted by state agencies.

Coastal Erosion: As noted in the 2015 Future Conditions report (TMAC, 2015a), long-term coastal erosion (LTCE) fundamentally alters coastal landscape over time and can lead to substantial shifts in flood hazards. Although influenced by SLR (among many physical processes), LTCE is typically depicted and managed as a separate hazard.

With regard to coastal flood mapping, there are two categories of erosion:

- Storm- or event-driven erosion; and
- Long-term erosion

Storm- or event-driven erosion is the erosion that occurs during a storm event (e.g., dune erosion). Long-term erosion (more properly, long-term recession) is the erosion that occurs over a period of decades, and that can be projected into the future based on historical erosion trends and/or modeling. States and commonwealths commonly establish coastal setback lines or erosion hazard areas based on predicted shoreline locations 30, 60, or 100 years into the future. This method for determining long-term erosion rates and future shoreline locations is known as historical shoreline mapping and erosion rate analysis. As implemented by most states and commonwealths, this method generally assumes stationarity; that is, the predicted rate of shoreline change is assumed to be the same as the historical rate of shoreline change and does not consider potential acceleration or deceleration caused by geophysical processes, such as changes in the rate of relative SLR.

At the time of the 2015 TMAC future conditions recommendations, the scientific community had not developed consensus and minimum standards on nationally consistent ways to integrate LTCE and SLR into modeling of coastal flood hazards and coastal floodplain mapping. Since 2015, several pilot studies have included approaches for combining analysis of SLR and LTCE with flooding in the context of FEMA's coastal flood study process. In addition, non-traditional datasets such as satellite shoreline measurements are now available. Minimum standards for providing two shoreline scenarios (extreme shoreline excursions and daily conditions) are now needed as well as secured funding for national LTCE monitoring for periodic updates.

Riverine Erosion: Riverine erosion is a complex physical process involving the interaction of numerous factors, including fluvial hydraulics, geotechnical stability, sediment transport, watershed characteristics, land use, and vegetation. It can dramatically alter the landscape within and outside the mapped floodplain, not only during large flood events but also over time via a sequence of smaller floods. FEMA does not consider storm- or event-driven erosion, nor long-term erosion, when mapping riverine flood hazard areas. Since 2015, multiple states have developed geographic information system (GIS)-based approaches for mapping areas of fluvial erosion hazards (FEH) associated with geomorphic change. At the core of each of these approaches is mapping a FEH corridor or zone that represents where the river has meandered or changed course in the past and has the potential to do so in the future. This corridor is similar to the active river area described by The Nature Conservancy (TNC, 2008) and the geomorphically defined meander belt zone, but may differ from floodways and FEMA-designated 100-year floodplains (Figure C-4). Of special interest for erosion potential are constrictions in the floodway and floodplain relative to the width of the FEH corridor.

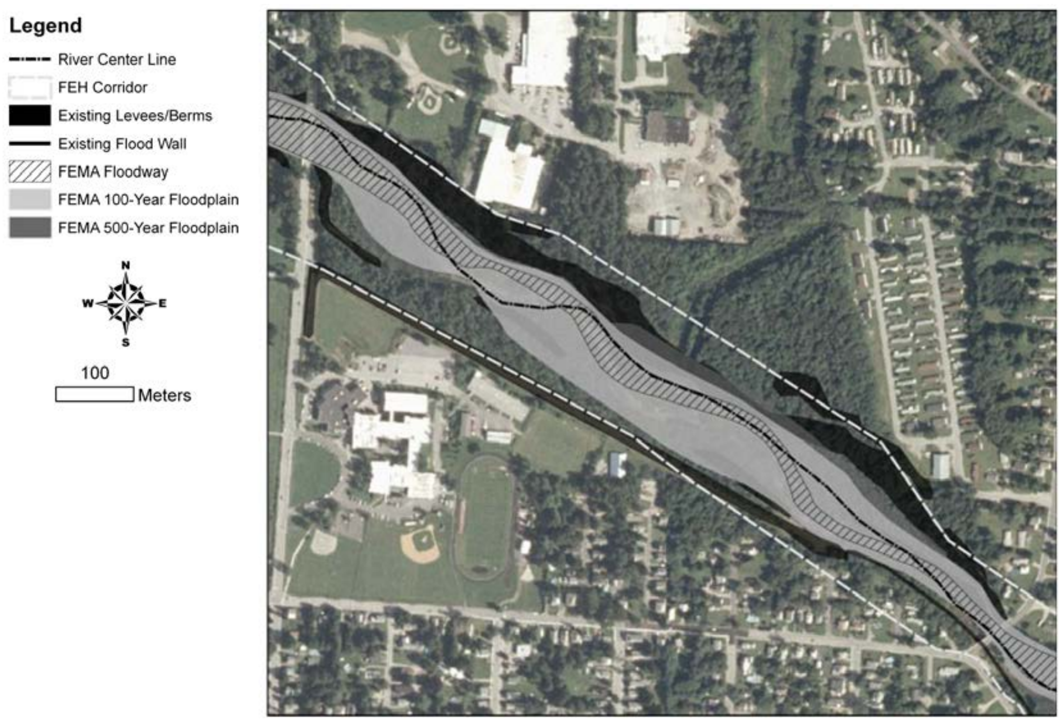


FIGURE 4. Municipally Adopted FEH Zone Providing Greater Setback Protection Than NFIP Floodway and Floodplains on Roaring Branch in Bennington, Vermont. VRMP data show contracted 100 year floodplain a result of deep incision from historic dredge and berm activities. Note existing river centerline in relation to 1986 floodway.

Figure C-4: Example of a municipally adopted FEH corridor for setback protection for a Vermont stream where the corridor is wider than the FEMA floodway and 100-year floodplain

Source: Kline and Cahoon, 2010, fig. 4

The GIS-based approaches for mapping the FEH corridor use a combination of methods at a variety of scales and resolutions and include estimation of a common meander belt width based on bank-full channel width, digital topology-based delineation of valley bottoms, floodplain maps, aerial photograph identification of valley bottomland and abandoned channels, and field-based geomorphic assessments of actively migrating and relatively stationary reaches. Three states—Indiana, Vermont, and Massachusetts—have detailed websites and supporting publications describing approaches and uses (respectively, Indiana Silver Jackets, 2018; Vermont River Management Program, 2008; and Kline and Cahoon, 2010; and Vogel, 2016). Uses include identification of vulnerability and risk of damage to property and infrastructure, identifying risks to stream crossing infrastructure, flood hazard planning and mitigation, and adoption of active and passive management strategies that help reduce future risk, including natural flood management techniques.

Assessments of future flood conditions have not been included in these approaches, but they could be if changes in flow characteristics are linked to how they might affect erosion potential or expand meander belt and FEH corridor widths.

Nonetheless, many communities have used various methods to calculate riverine erosion hazard areas and incorporate the data and information into their respective floodplain management programs.

C.3.2.4 **LAND USE/LAND COVER CHANGE**

As land cover and land use change in the future, flood hazards are also expected change. Historically, flood hazard information presented on NFIP flood maps has been based on the existing conditions of the floodplain and watershed, with no consideration given to future development and its impact on hydrology. Several communities already use zoning plans and “full build-out” conditions to map future flood extent. Even where such plans are not available, new tools permit the projection of urbanization and land use change that might be incorporated into flood models and regional flood-frequency equations. New equations that consider more recently collected hydrologic and land use data would enable a broad and consistent estimation of the impacts of urban development on flood frequencies.

The impacts of development can be very significant. Blum et al. (2020) estimated that a one percentage point increase in impervious basin cover causes a 3.3% increase in annual flood magnitude (95% CI, 1.9% - 4.7%) on average. Aspects of land cover, such as the extent of impervious surface and vegetation type, and land use, such as residential or open space, impact both the amount of water and the speed of that water entering the system, as well as how that water moves through the system. Use of the national urban equations in USGS Water-Supply Paper 2207, *Flood Characteristics of Urban Watersheds in the United States* (Sauer et al.,1983 [revised 1984]) shows that a percent impervious area of as little as 20% can double flow.

There is precedent within the NFIP for evaluating potential future land cover and its impact on hydrology. In 2001, FEMA issued regulations recommending that local communities determine their future conditions land use and use that information to determine future condition hydrology.

C.4 FEMA PILOT STUDY DETAILS

As a result of the recommendations in the 2015 TMAC Future Conditions report, FEMA initiated a series of pilot projects to assess the various implications of future conditions modeling and mapping (TMAC, 2015a). The following pilot projects were undertaken because of Future Conditions Recommendation FC-6, and are described in more detail in the subsections that follow:

- California Coastal Analysis and Mapping Project (CCAMP) Open Pacific Coast (OPC) Study/Sea Level Rise Pilot Study, Future Conditions and Mapping
- North Carolina Sea Level Rise Impact Assessment Study
- FEMA Region 4 Advisory Sea Level Rise Study: Hillsborough and Pinellas Counties, Florida
- FEMA SLR Advisory Map Proof of Concept Study, Puerto Rico
- Incorporating Climate Change into Future Conditions Riverine Floodplain Modeling
- FEMA Region 1 Coastal Erosion Study – Nantucket County, Massachusetts, September 2019

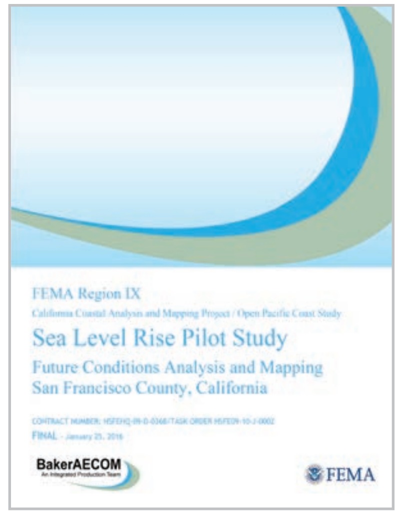
C.4.1 OPEN PACIFIC COAST STUDY (CALIFORNIA COASTAL ANALYSIS AND MAPPING PROJECT) AND SEA LEVEL RISE PILOT STUDY, FUTURE CONDITIONS AND MAPPING: SAN FRANCISCO COUNTY

FEMA published its *Open Pacific Coast Study* (OPC Study) (FEMA, 2015) as part of its CCAMP in Region 9 to analyze the existing coastal high hazard areas for the entire coast of California, update FIRMs for 15 coastal counties, and provide resources for communities to increase public awareness and encourage mitigation actions that reduce coastal flood risk. FEMA's nationwide coastal floodplain mapping efforts depict hazards associated with existing conditions and do not consider anticipated future sea levels or climate change.

An ancillary report, *Sea Level Rise Pilot Study Future Conditions Analysis and Mapping, San Francisco County, California* was published on January 25, 2016 (FEMA, 2016). As stated in the report, its purpose was to:

> evaluate the feasibility of incorporating sea level rise (SLR) and shoreline change into the analysis and mapping methodology developed as part

of the CCAMP OPC Study. The pilot study leveraged preliminary coastal analysis and mapping results from the CCAMP OPC Study to analyze future coastal flood risks in a wave runup-dominated Pacific Coast environment. Mid-range and high-range SLR projections from the 2012 National Research Council report on west coast SLR were incorporated into the coastal analysis methodology. The 8-mile segment of the open Pacific coast of the City and County of San Francisco west of the Golden Gate Bridge was selected as the study area for the pilot study.



The report includes the following key findings (FEMA, 2016):

- Water level, wave, and topographic datasets compiled as part of the CCAMP OPC study provide a solid foundation upon which to conduct future conditions analysis, not only in the pilot study area but throughout California.
- The direct analysis approach to incorporate SLR into the determination of wave runup elevations for coastal floodplain mapping was found to capture wave runup feedback processes that would not have otherwise been captured by a linear superposition approach for certain shore types. This finding was particularly applicable to steep and erosion-resistant shorelines such as rocky cliffs and coastal structures.
- Future changes to the coastal SFHA will result from both the vertical increase in BFEs due to SLR and the horizontal increase in the landward extent of the SFHA due to future shoreline change.
- Implementation of a GIS-based buffering technique was found to be a viable method to efficiently map future SFHA limits and produce geospatial datasets.

The report includes the following recommendations (FEMA, 2016):

- Future studies should consider adoption of a direct analysis methodology to estimate future conditions TWLs for certain shore types and shoreline characteristics; however, the direct analysis methodology may not be required at all locations. Implementation of the direct analysis methodology is most applicable to steep, erosion-resistant shorelines (such as coastal bluffs and cliffs) and coastal structures (such as revetments and seawalls).
- Future studies may benefit from application of the linear superposition methodology to estimate future conditions TWLs for certain shoretypes and shoreline characteristics. Implementation of the linear superposition methodology may produce results very similar to those based on direct

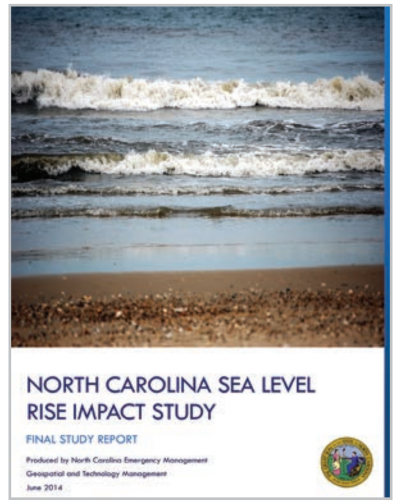
analysis methods for some shoretypes, such as sandy beaches and dunes and highly erodible bluffs.

- Future studies should explore the potential to develop a modified linear superposition approach or look-up table to facilitate rapid first-order approximation of future conditions TWLs in wave runup-dominated environments. The modified linear superposition approach could develop TWL amplification factors applicable to each shoretype based on the findings of this pilot study and further research. The study team recommends conducting additional testing of the methods developed for this pilot study across a larger suite of locations and environmental conditions to inform the development and application of the modified linear superposition approach.
- Future studies should evaluate other aspects of climate change such as changes in storminess, storm tracks, and frequency and intensity of future El Niño events. The pilot study methodology could be expanded to address these factors, many of which were of interest to the stakeholder group.
- Future studies in other communities should convene a local stakeholder group (similar to the stakeholder group assembled for the pilot study) to advise the study team on local conditions and assumptions, such as planned coastal protection projects (e.g., bluff armoring, sea walls, dunes, beach nourishment, etc.) and expected life span of existing coastal structures so appropriate treatments can be incorporated into the TWL and shoreline change analysis and mapping.
- Future studies may wish to refine the shoreline change methods developed for the pilot study and use local shoreline change data, where available, to provide more site-specific shoreline retreat projections. The pilot study relied on regional shoreline change rates developed from publicly available USGS shoreline change datasets.
- By identifying existing structures in areas of increased future SFHAs, communities can use a risk analysis program such as FEMA's Hazus methodology to estimate the incremental monetary impacts of future vs. existing coastal flooding. Such an analysis could be used to develop a benefit-cost ratio for potential flood and/or coastal erosion mitigation projects.
- Communities with coastal areas vulnerable to future conditions flooding in response to the 1-percent-annual-chance event due to a combination of shoreline retreat and wave overtopping may wish to analyze future impacts due to a less severe flood event (such as a 10-, 2-, etc., percent-annual-chance event). This could further inform planning and development of benefit-cost analyses for potential mitigation strategies.

C.4.2 **NORTH CAROLINA SEA LEVEL RISE IMPACT ASSESSMENT STUDY**

The following text is extracted from the *North Carolina Sea Level Rise Impact Assessment Study* report's executive summary (North Carolina Emergency Management, 2014),

> The North Carolina Sea Level Rise Impact Assessment Study (SLRIS) was undertaken to comprehensively evaluate the exposure and potential impacts associated with sea level rise (SLR) along North Carolina's coast. The study was structured to quantify changes to the coastal flood hazard environment, assess possible exposure of the built environment at the structure level, and evaluate strategies to reduce long-term losses…



> This study concluded that significant changes in coastal hazards will occur. These changes are in response to SLR scenarios of 20 centimeters (cm) (0.7 foot (ft)) and 40 cm (1.3 feet) that are based on future projections of observed historical trends across the State. A baseline condition of 0 cm was first established using detailed and quantitative flood modeling framework. Changes in the flood hazard for the 20- and 40 cm SLR scenarios were then computed and compared back to the baseline condition across a study area that encompassed the 20 coastal counties of North Carolina.
>
> - Loss of land to inundation is anticipated across coastal North Carolina's extensive low-lying areas as a result of SLR:
>   - 20 cm of SLR is projected to inundate approximately 250 square miles (Sq mi) of land, representing 3% of the land area in the 20 coastal counties.
>   - 40 cm of SLR is projected to inundate approximately 800 Sq mi of land, representing 9%of the land area in the 20 coastal counties.
> - Changes to the regulatory floodplain, especially expansion of floodplain boundaries, are expected and would affect a substantial number of additional buildings compared to the baseline condition.
>   - 20 cm of SLR is projected to increase the size of the regulatory floodplain (the area inundated by the 1%-chance flood) by approximately 175 sq mi, representing an 8% change over the baseline condition.
>   - 40 cm of SLR is projected to increase the regulatory floodplain by approximately 350 sq mi, representing a 20% change over the baseline condition.
> - Changes in the 10% annual-chance floodplain, an area subject to repetitive flooding due to frequent, less intense storm activity than

the 1%-annual-chance flood, are roughly double the size of the corresponding increases in the regulatory floodplain.

- 20 cm of SLR is projected to increase the 10% annual-chance floodplain by approximately 350 Sq mi, representing a 27% change over the baseline condition.
- 40 cm of SLR is projected to increase the 10%-annual-chance floodplain by approximately 600 Sq mi, representing a 47% change over the baseline condition.

- Changes in tropical storm frequency and intensity over the next 50 to 100 years have the potential to further modify the storm surge elevations that define the regulatory floodplain.
  - Plausible changes in tropical storm climatology would increase 1%-annual-chance elevations by approximately 15 to 25 cm (0.5 to 0.8 ft) over the historical climatology. These changes would be in addition to SLR.

... In conjunction with increases in flood hazards, potential exposure and impacts to coastal flooding were estimated to markedly increase with SLR. Flood exposure and impacts were calculated using comprehensive data assets at the individual building level. Exposure estimates are comparative to the study 0 cm baseline.

- The number of buildings lost to inundation were assessed and found to be significant for the study SLR scenarios.
  - 20 cm of SLR is projected to result in the loss of approximately 1,000 buildings with an estimated value of $215 million.
  - 40 cm of SLR is projected to result in the loss of approximately 5,000 buildings with an estimated value of $923 million.
- The increased number of buildings in the regulatory floodplain was projected in conjunction with the expansion of floodplain boundaries over the baseline condition:
  - 20 cm of SLR is projected to add over 11,000 buildings to the regulatory floodplain, a 38% increase over the baseline condition.
  - 40 cm of SLR is projected to add over 24,000 buildings, an 82% increase over the baseline condition.
- The number of buildings in the 10%-annual-chance floodplain was also projected to increase. The potential for flooding in this high-frequency but low-impact zone highlights the need for coastal communities to prioritize the mitigation efforts in these areas to help maintain resilient communities.
  - 20 cm of SLR is projected to add over 3,700 buildings to the 10%-annual-chance floodplain, a 75% increase over the baseline condition.
  - 40 cm of SLR is projected to add about 10,000 buildings, a 202% increase over the baseline condition.

… Consequences of the flood exposure to the baseline (0 cm) and each SLR scenario were calculated and compared through a robust loss-estimation framework leveraging individual building level attribute data.

- Annualized Loss Estimates (ALE) are a way of simplifying estimation of potential losses from coastal flooding to a monetary value that might be incurred for a specific building or area on an annual basis. In conjunction with the projected increases in exposure, ALEs are calculated to increase significantly with SLR.
  - 20 cm of SLR is projected to increase ALEs from coastal flooding by $79 million compared to the baseline condition, a 57% jump.
  - 40 cm of SLR is projected to increase ALEs from coastal flooding by $190 million compared to the baseline condition, an increase of 137%. About 90% of these losses would be incurred by residential structures.
- Critical infrastructure including facilities associated with agriculture, food, banking, finance, commercial, education, energy, government, healthcare, manufacturing, transportation, and water are expected to experience increased losses with SLR.
  - 20 cm of SLR is projected to increase losses caused by the 1%-annual-chance flood by about $400 million, an increase of 55% compared to the baseline condition.
  - 40 cm of SLR is projected to increase losses caused by the 1%-annual-chance flood by about $950 million, an increase of about 130% compared to the baseline condition.
- The economy of North Carolina is projected to be impacted by these increased losses:
- 20 cm of SLR is projected to result in $320 million in lost wages, $220 million in the government sector alone.
- 40 cm of SLR is projected to result in $766 million in lost wages, $524 million in the government sector.
- Barrier islands and inlets are greatly influenced by storm activity, sediment dynamics, and anthropogenic influences. The impact assessment study evaluated the response of the barrier islands and inlets to SLR with consideration only to increased water levels. In this context, it is anticipated that barrier islands and inlet conditions will be influenced, but not significantly impacted by, a 20-cm or a 40-cm rise in sea level.
- Marshes were found to have mixed response to a 40-cm SLR scenario depending on location:
  - In the northern area of North Carolina, although marsh losses to open water are projected at 28 Sq mi, low elevation gradients allow marshes to migrate and experience a projected net gain of 137 Sq mi at the expense of upland areas.

  - Steeper gradients in the Southern Province restrict the ability of marshes to migrate upland, resulting in an estimated net loss of 26 Sq mi of fresh and salt marsh.
  - It is anticipated that the projected trend in the northern area may negatively change with higher SLR scenarios as steepening and increasing water levels further restrict potential suitable marsh areas.

C.4.3 FEMA REGION 4 ADVISORY SEA LEVEL RISE STUDY, FLORIDA

The July 2018 A*dvisory Sea Level Rise Study: Hillsborough and Pinellas Counties, Florida* report was prepared by RAMPP for FEMA, Region 4 (RAMPP, 2018).

The following text is extracted from the report:

> The RAMPP effort involved assessment of surge and wave modeling techniques as well as mapping processes. The primary objectives were to:
>
> - Assess how SLR would modify storm surge dynamics in a typical Flood Insurance Study (FIS) process, including:
>   - Where non-linear effects occur
>   - Variance of modeled surge elevations from simple linear superposition
>   - The effect on the mapped floodplain.
> - Develop future condition coastal flood hazard products that take into account:
>   - Challenges in modeling and mapping future flood conditions through standard FIS approaches
>   - Sensitivity of modeling and mapping to future shoreline change
>   - Approximate methods based on empirical approaches and semi-automated geospatial mapping techniques to produce reasonably accurate information given the uncertainty in future conditions.
>
> The study assessed surge modeling for the full extent of both counties [Hillsborough and Pinellas Counties, FL], whereas mapping products were limited to 50 miles along the coast, spanning 25 miles in each county (Figure 1-1).
>
> Prototype non-regulatory mapping products (in geodatabase form) were created to delineate the coastal flood hazard area associated with the detailed and approximate approaches. …
>
> Lessons learned from the study:
>
> - Differences in the mapped floodplain do not always occur in the areas where the largest non-linearity was observed in the future condition return period elevations. Floodplains changed less than 1%, however, in this case such changes did occur in developed areas. Ultimately, local topographic gradients will control the growth of the floodplain as much as non-linear future condition surge dynamics.

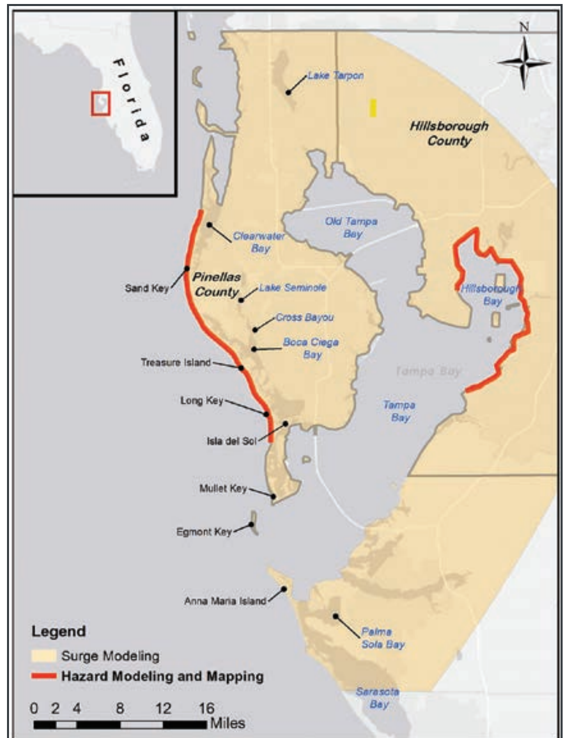


Figure 1-1. Overview of study area

- If detailed mapping approaches are followed, production of future condition products should be completed shortly after the FIS to maximize efficiency and product quality. Where possible, the same analyst should complete the future condition wave analysis and mapping to facilitate consistency in decision making, especially for areas where hazard zones and BFEs are merged for cartographic purposes.
- Approximate method approaches can provide future coastal flood hazard information for 4 to 5 times less effort than traditional detailed approaches. Although products are comparable to those produced by the standard approaches, some drawbacks in lost accuracy and the ability to fully replicate Zone VE exist.
- Spatial errors in GIS algorithms can result in logical inconsistencies in floodplain boundary locations for future conditions. This can occur in areas with relatively high topographic gradients, resulting in a future condition boundary that may be negligibly smaller than the existing condition. Such errors can be eliminated by merging the FIS floodplain into the future condition floodplain, or ignored as cartographic uncertainty.
- The USGS nationwide shoreline change dataset has some limitations for use in future shoreline change projections. Key among these is representation of the influence of beach nourishment projects on historical change rates.
- Shoreline change projections and associated products should be provided with caveats. These include acknowledgement of overall uncertainty given the limitations of the methodology and considerations for beach nourishment and shore protection structures.
- The existing technique for projecting future shoreline change is sensitive to nearshore slope and should not be applied in areas with questionable bathymetric data or complex cross-sectional morphology.

- Implementation of shoreline change projections in the FEMA modeling process had a site-specific and limited effect on mapped flood hazard zones. It is most important where shoreline change encroaches and removes dune features.

C.4.4 FEMA SLR ADVISORY MAP PROOF OF CONCEPT STUDY, PUERTO RICO

The *FEMA SLR Advisory Map Proof of Concept Study* (RAMPP, 2010) was prepared by RAMPP, a JV partnership of Dewberry, URS, and ESP for FEMA. The following text is excerpted from the report's executive summary:

- This study sought to evaluate methods for developing SLR advisory geospatial layer(s) that could be developed as a follow-on product to Flood Insurance Studies (FISs). The SLR advisory product is currently conceived as non-regulatory. It would be intended, instead, to help states and communities identify and adapt to potential changes in flood hazards for SLR scenarios. The study evaluated the relative accuracy and cost effectiveness of existing models, off-the-shelf data, and various methodologies for use in producing the SLR advisory layer.
- The initial study scope was to develop specific recommendations for programmatic implementation of advisory layer products on the basis of this pilot study. The scope was subsequently revised and limited to providing considerations and options for further consideration during potential follow-up pilot studies.
- The selected study areas consist of two reaches totaling 10 miles of coastline on the island of Puerto Rico. The reaches were selected to provide representative diversity of physiographic conditions over which to test the impacts of SLR on existing FEMA coastal hazard assessment and mapping products. An SLR scenario of 1.3 feet at the year 2050 was applied for this study. This value is in general agreement with that of the North Carolina Sea Level Rise Risk Management Study and is also supported by the U.S. Army Corps of Engineers (USACE) guidelines on sea level change for the study location.
- The analytical techniques assessed by the study team made use of existing data and represent a range of rigor and level of effort. Each method was evaluated for accuracy against a baseline established through an FIS-type approach using the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) and Wave Height Analysis for Flood Insurance Studies (WHAFIS) models. Methods for estimating changes to storm surge included the Sea, Lake and Overland Surges from Hurricanes (SLOSH) model and linear superposition. Overland wave hazard analysis methods included the Hazard United States (Hazus) Flood Information Tool (FIT) and Coastal Flood Model, in addition to application of wave equations.

- Storm surge modeling methods were evaluated by simulating the FIS storm suite in both the ADCIRC and SLOSH models for both existing conditions and the SLR scenario and calculating return period elevations. Comparisons of the baseline ADCIRC (FIS) and SLOSH results returned a median error of 25%, which decreased to 10% for the SLR scenario. In contrast, comparison of results from ADCIRC simulation of the SLR to linear superposition returned a median error of 1%.
- The analysis found linear superposition to be a suitable proxy for changes to storm surge return period elevations as modeled by ADCIRC and EST for Puerto Rico for the chosen SLR scenario. Despite this finding, it is unknown whether linear superposition would perform as favorably for other coast types present across the U.S. or for other SLR scenarios. Consequently, further investigation into the site-specificity of the linear superposition method is recommended.
- Overland wave height methods were evaluated, including WHAFIS, the FEMA Hazus coastal FIT and Coastal Flood Model software, geospatial application depth-limited wave relationships, and simple calculation of BFE changes based on BFE representation and simple wave equations. The FIS-level application of WHAFIS provided a detailed and spatially variable solution for changes in BFEs due to SLR. Wave height estimators as described in the Hazus FIT / Coastal Flood Model documentation were found to be non-functional. Geospatial application of the depth-limited relationship proved unnecessary, as a consistent difference value was rendered due to linear scaling of the relationship. Attempts at deriving wave hazard zone boundaries from these results were observed to consistently over-predict as compared to modeled baseline results. It was found that derivation of BFE changes from simple relationships based on the distribution of wave elevations across coastal insurance zones and through simple wave equations was effective.
- The major findings and recommendations from that study are summarized below:
  - FEMA should initiate additional studies leveraging recently completed FIS storm surge modeling to further examine the suitability of utilizing linear superposition as a proxy for SLR-induced changes in storm surge return periods over a variety of coastal areas/types.
  - Changes in both storm surge elevation and wave height should be considered when assessing any potential freeboard measures for SLR adaptation.
  - FEMA should re-evaluate FEMA Hazus FIT and the Coastal Flood Model for application to SLR hazard evaluation when the updated software release becomes available.
  - Accurate description of changes to the location of the Zone VE/AE boundary, LiMWA, or other coastal hazard flood zone boundaries should only be approached using WHAFIS and cartographic delineation.

- Wave equations could be combined with linear superposition to estimate both changes in floodplain and BFE increase to produce SLR advisory guidance with a low production cost.
- Implementation of the SLR scenario and re-simulation of the FIS storm suite should account for potential instability induced by increased water levels and flooding during the runs.
- Re-running WHAFIS for SLR considerations is best undertaken at the time or shortly after the effective study, when mapping and modeling considerations are fresh.

C.4.5 INCORPORATING CLIMATE CHANGE INTO FUTURE CONDITIONS RIVERINE FLOODPLAIN MODELING

Published as a white paper, *Incorporating Climate Change into Future Conditions Riverine Floodplain Modeling*, this pilot study focused on the Anacostia River in Washington, DC, and Prince George's County, MD. Primary considerations included FEMA's desire that any proposed approaches be technically acceptable and consider cost effectiveness, leveraging existing data when possible.

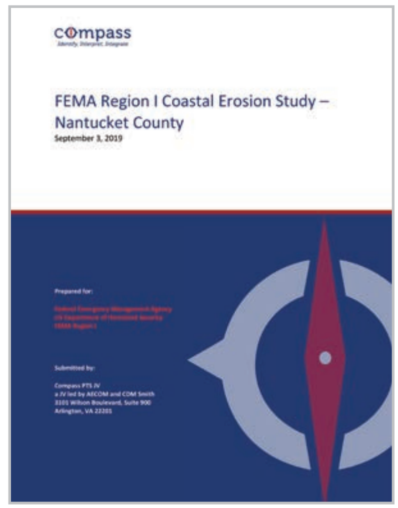
Findings as cited in the report included:

> … USGS hydrology regression equations provide one possible approach to determine peak runoff changes due to climate changes to temperature and precipitation. Where the current equations include temperature and precipitation variables, they may be used "as is" with climate change model data to predict future peak flow. Where they do not include these variables, such as Maryland, new regional or multi-state regression equations may need to be developed, such as the FEMA 2013 study, to include these variables.
>
> … Detailed rainfall-runoff models provide an alternative approach to estimating future peak runoff influenced by climate change. For certain communities where rainfall-runoff models have been developed for other reasons, there may be existing models that can be modified to incorporate climate change data for temperature and precipitation. In many locations, however, where rainfall-runoff models have not already been developed or when existing models may require excessive modifications to incorporate climate change variables, time and cost issues may not make rainfall-runoff models a practical solution for riverine climate change modeling.
>
> … Statistical approaches may be able to provide simplified ways to derive future peak flow values with climate change considerations. The main challenge will be to develop "rules of thumb" that can be defended as reasonable to represent changes for climate change model outputs. Publications like the USACE riverine climate change HUC 2 reports may provide information to help establish these rules of thumb.

C.4.6 FEMA REGION 1 COASTAL EROSION STUDY – NANTUCKET COUNTY, MASSACHUSETTS

In 2019, FEMA Region 1 funded a study, *FEMA Region I Coastal Erosion Study – Nantucket County,* conducted by Compass, to address the risk of coastal erosion by investigating future coastal erosion caused by SLR and producing future coastal erosion hazard maps (Compass, 2019). The following descriptions of the study and its resulting products are extracted from the report:

> These maps consider multiple SLR scenarios and future timeframes to provide stakeholders with information to plan mitigation actions and build resilience in the face of a changing climate. The technical analysis and mapping were initiated in a Pilot Study of distinct shorelines in Massachusetts, Rhode Island, and New Hampshire. After completion of the Pilot Study, the technical analysis and mapping were expanded to other areas of Region 1. This report summarizes the overall purpose of this Study and the technical methodology and the findings for Nantucket County. The maps are recommended as non-regulatory products to be used by communities as a tool to identify areas where coastal erosion is a hazard, plan future mitigation actions and ultimately facilitate the reduction of future erosion risk.



> . . . Compass completed a Study in Nantucket County to predict future coastal erosion hazard areas due to SLR within FEMA Region 1. This Study meets a critical need for coastal communities to understand the risk they will face in coming decades and plan for resilience. The Study also meets several agency objectives, including those set forth by FEMA, FIMA, and TMAC.

> The coastal erosion maps were presented to key stakeholders from Nantucket County during an outreach meeting conducted in June 2018. The meeting was conducted to ensure the community members understand the value of the maps and how they can be used. Further community outreach can help different stakeholders begin to plan mitigation actions and reduce their risk.

> Compass mapped future coastal erosion hazard areas for several specific timeframes: the years 2030, 2050, and 2100. These timeframes were adopted to be useful to different community members, ranging from homeowner to community planners. As with other coastal flood risk products, Compass recommends that the coastal erosion hazard maps be updated at regular intervals in the future, ideally every 15 years. Currently, there is still uncertainty and a large range in future climate change

scenarios and SLR projections. In future decades, more observations will allow these SLR projections to be refined. Regular updates to the maps will improve accuracy.

APPENDIX

D

ENTERPRISE RISK EXAMPLES

The content below outlines the full risk profile created by the TMAC. It is presented to add information for background related to tables and graphics presented in Section 4.2.3. The content is simply for the illustration of the power of an ERM application and does not represent any TMAC recommendation.

D.1 ENTERPRISE RISK **A – Status Quo Effect on Graduated Risk Adoption**

OPPORTUNITY RISK: *The inertia created by adherence to program status quo as well as the lack of available and credible graduated risk information mutes demand for, understanding of, and confidence in graduated risk mapping and risk communication around graduated risk.*

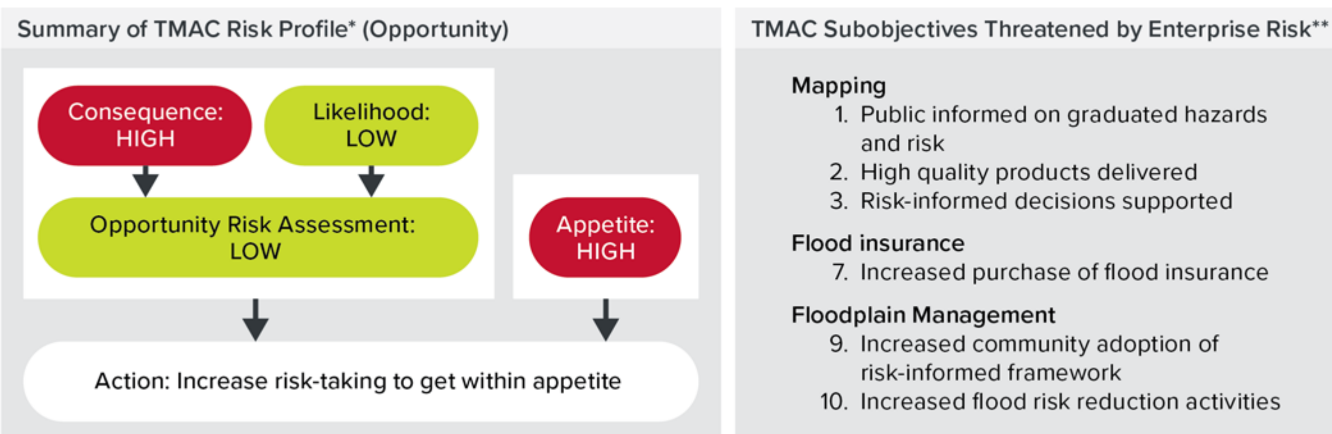
BACKGROUND

The boundary of the area inundated by the 100-year flood defines a community's SFHA. This boundary defines the reach of the Mandatory Purchase Requirement (MPR) and the Federal Minimum Regulation Standard for floodplain management. Mandatory purchase stops at the boundary of the 100-year floodplain as do minimum NFIP floodplain management regulations for community participation. Consequently, the boundary of the 100-year floodplain is often mistakenly interpreted as the delineation between flood-free versus flood-prone land. This misunderstanding has led to many households concluding that the area beyond this boundary is free of flood risk because there are no flood-related regulations or consistently available flood hazard data or mapping products. It has also led some to believe that the flood hazard within the SFHA is monolithic and uniform. Of course, neither are true, yet the floodplain boundary (or SFHA) remains given legal mandates and continues to oversimplify the challenge floods pose to people and property.

A lack of access to consistent, easily interpretable, graduated flood risk and hazard products impedes understanding and thus hinders improvements in FRM beyond the Federal Minimum Regulation standards. It also affects individuals deciding whether to purchase flood insurance independent of the requirements of the MPR. Traditionally, FIMA has sought to increase the quality of the maps that delineate the boundary of the 100-year floodplain and produces only limited information on graduated flood risk such as producing non-regulatory products only in communities that express an interest in such information and contribute to the cost of developing that information. However, the lack of information explaining the range of flood risk and hazard both within the SFHA and beyond it has created and continues to create significant risk to FIMA meeting its objectives by allowing the idea that areas are either flood-free or flood-prone to exist.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk A is shown in Figure D-1, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk A (Status quo effect on graduated risk adoption) threatens the accomplishment of the TMAC's notional subobjectives 1,2,3,7,9, and 10, which are based on FIMA's Strategic Outcomes.



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-1: Summary of risk profile for Enterprise Risk A – status quo effect on graduated risk adoption

Risk appetite and rationale. To provide and promote the use and acceptance of graduated flood hazard and risk information, even as the tools and methods are rapidly changing, is a risk that FIMA could take.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a high risk appetite for Enterprise Risk A (opportunity). In practice, an organization in this position is likely to be risk-seeking and believe aggressive risk-taking is justified. It would likely seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals, and act to maximize the likelihood that gains would be realized or that gains would be maximized when they occur because the potential upside benefits outweigh the potential costs for taking the action.

Risk assessment with evidence. The TMAC rated Enterprise Risk A (opportunity risk) as having a high consequence and a low likelihood. Based on these assessments, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains are unlikely to occur, given current operations. The resulting overall risk assessment is low. The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence
  The TMAC rated Enterprise Risk A as having high consequence because communities and individuals rely on FIMA products, including maps, as reliable information about flood hazards as they make decisions on the purchase of flood insurance, mitigation investments, community floodplain management, and related matters.
- Likelihood evidence
  The TMAC rated Enterprise Risk A as having low likelihood because at the current time, graduated risk information is newly available, and communities and property owners may not yet be confident in the quality and consistency of graduated risk information or have the capacity to interpret and apply that information to decision-making readily and easily.

Nonetheless, there is an opportunity created by rapidly expanded analytical capability to better identify and communicate graduated flood risks for an increasing number of communities and property owners, significantly enhancing the likelihood of achieving the at-risk objectives. In fact, BW-12 requires mapping of the 500-year floodplain, including areas of potential population growth. FEMA has responded with the FFRD initiative to communicate graduated flood risk.

Risk evaluation. The TMAC rated FIMA's risk appetite for opportunity Enterprise Risk A as high and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk A. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Specifically, FIMA could accept the Enterprise Risk opportunity of pushing forward with developing and communicating graduated flood hazard and risk information as a way of improving the nation's understanding of flooding and promoting the adoption of risk-informed floodplain management standards, even as the state of the practice evolves, to get within its risk appetite.

Illustrative Risk Treatments (not TMAC recommendations)

- Develop illustrative graduated flood risk and hazard maps as well as related products with educational videos explaining the difference between the graduated products and the limitations of the SFHA.

- Prepare technical reports with "plain English" supplements to explain the technical foundation for the graduated flood risk products.
- Accelerate the FFRD initiative to build the technical foundation for characterizing graduated flood risk and hazard data, initially relying on the Risk Rating 2.0 rating system to create graduated risk and hazard maps.
- Suspend or slow the use of deterministic methods for map updating and publish all future maps with graduated risk accompanied by explanations of analytical uncertainties.

D.2 ENTERPRISE RISK **B – Binary Notion of Flood Risk**

OPPORTUNITY RISK: *Existing programs organized around the Special Flood Hazard (SFHA) reinforce a binary notion of flood risk and provide disincentives for communities to adopt standards higher than the federal minimum.*

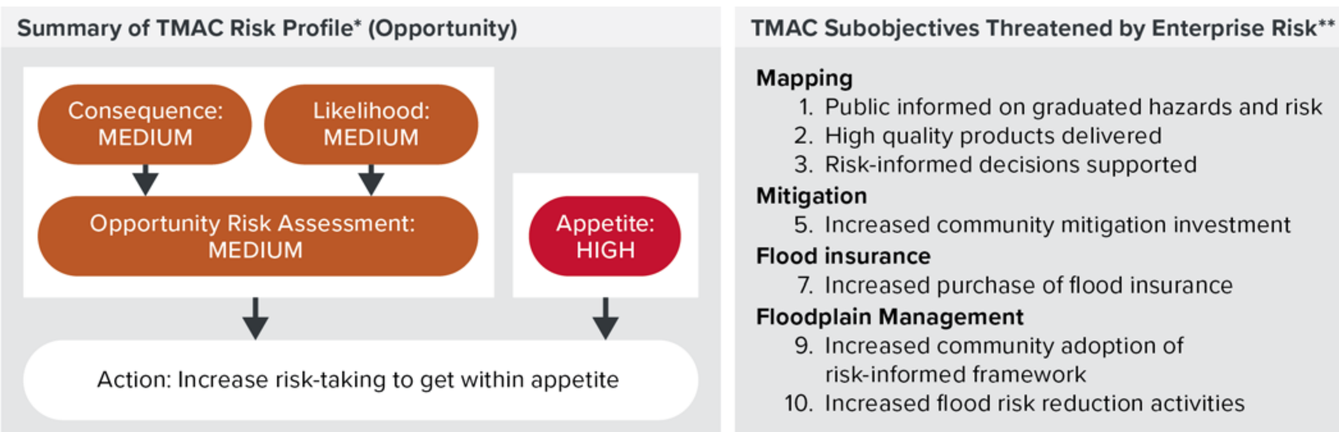
BACKGROUND

For decades, local land use decision making, federal grant programs, various federal agency planning practices, and flood risk ratings under the NFIP have been administered based on the SFHA. Reform of these programs and practices to better reflect graduated flood risk will require overcoming the inertia of continuing to do "business as usual." The modernized NFIP rating practices (Risk Rating 2.0) that now recognize graduated flood risk were years in development and application of these rating practices has been resisted. As Risk Rating 2.0 goes into effect in 2021 and 2022, the pattern of premiums across communities, untethered from the current SFHA boundaries and the previously used NFIP flood zones, will illustrate the outcome of using the graduated flood risk approach.

However, changing the FEMA Flood Insurance Rate Maps (FIRMs) to reflect graduated risk may require rethinking where minimum federal regulations apply, what constitutes "minimum" federal regulations and, by extension, where the MPR applies. The concept of the base flood elevation (BFE) does not account for graduated risk and FIMA has recognized that graduated risk information will call into question the justification for building elevation requirements based on the BFE + "X" feet. The use of graduated risk information may identify new places where the MPR should be applied and other places where it is not warranted. Any changes to the minimum floodplain management requirements or the mandatory purchase requirement structure would likely require significant regulatory and statutory reform. Nonetheless, the new products and data could be used voluntarily by communities, individuals, federal agencies, businesses, and others both before disasters strike and after.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk B is shown in Figure D-2, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk B (Binary notion of flood risk) threatens the accomplishment of the TMAC's notional subobjectives 1, 2, 3, 5, 7, 9, and 10, which were developed based on FIMA's Strategic Outcomes.



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-2: Summary of risk profile for Enterprise Risk B – binary notion of flood risk

Risk appetite. Departure from the SFHA as a benchmark and replacing it with graduated risk information is an opportunity to help communities implement high floodplain management standards while also providing intelligence for rethinking the MPR.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a high risk appetite for Enterprise Risk B (opportunity). In practice, an organization in this position is likely to be risk-seeking and believe aggressive risk-taking is justified. It would likely seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals, and act to maximize the likelihood that gains would be realized or that gains would be maximized when they occur because the potential upside benefits outweigh the potential costs for taking the action.

Risk assessment with evidence. The TMAC rated Enterprise Risk B (opportunity risk) as having a medium consequence and a medium likelihood. Based on these ratings, taking this risk could improve FIMA's ability to achieve one or more of its objectives or performance goals, and the potential gains are as likely to occur as not to occur, given current operations. The resulting overall risk assessment is medium.

The TMAC considered the following evidence when assigning consequence and likelihood ratings. Some FIMA grant programs for flood risk mitigation are limited to properties in the currently delineated SFHA. Additionally, other agencies' programs are sometimes implemented based on reducing risk only up to the 1-percent-annual-chance flood level, so that NFIP land use requirements and the MPR are removed. However, significant flood damage can and has occurred outside the SFHA. This evidence supports the opportunity for improvement to reduce disaster suffering beyond the limits of the SFHA do indeed exist.

Additionally, when thinking long-term (decades, not years) and considering the size of the United States, significant residual risk remains in areas outside the SFHA. Moreover, SFHAs are projected to expand with climate change and increased land development. Thus, there are opportunities for further risk reduction that may not be realized if regulations and mitigation strategies remain narrowly focused on the SFHA and published BFEs. To support the medium likelihood rating, local government programs like Mecklenburg County in North Carolina have developed risk management programs to manage risk independent of the Federal Minimum Standard (see Section C.4.2), however, there are few counties in the United States capable of producing such data and risk management frameworks without outside support. This provides evidence that counties can improve if information is available to base flood risk management activities upon, and that the likelihood that the opportunity could be achieved is possible but not certain.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk B (opportunity risk) as high and the overall risk assessment as medium. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk B. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Illustrative Risk Treatments (not TMAC recommendations)

- Leverage FEMA's authority to define the Special Flood Hazard Area to redefine it to better reflect risk as a composition of likelihood of the flood hazard and its consequences, and where necessary proposed Congressional legislation to reimagine the SFHA.

- Prepare a report for Congress identifying options organized around graduated risk and hazard data to support reforms to the minimum NFIP participation requirements and the MPR.
- Pending possible policy and program reforms, prepare and issue criteria for the circumstances under which the NFIP would accept a community flood risk management plan with building codes based on graduated risk as being deemed in compliance with NFIP minimum requirements.

D.3 ENTERPRISE RISK **C – Data Gaps in Unmapped Areas**

LOSS RISK: *Unmapped areas create a data gap causing many communities, homeowners, and businesses in these areas to be unaware of the potential for current or future flood risk exposure or the potential risk for future development.*

BACKGROUND

Some areas in the United States have no or only limited flood hazard modeling products. There are many reasons for this absence of flood maps or for the limited generation and portrayal of flood hazards for flooding sources beyond the 1-percent-annual-chance floodplain, such as:

- Currently, small drainage areas, such as at the end of tributaries, are not mapped due to FEMA's criteria for identifying and mapping the SFHA.
- Some areas of the nation are not mapped because the land is federal or state recreational land (e.g., national forests). While some of these areas will certainly remain recreational, thus limiting development that may be exposed to flood hazards, other federal land faces possible privatization in the future leading to possible development and risk exposure to life and property.
- Some areas are shown as "Zone D" meaning there is reason to believe there is a flood hazard in the area, but it has not been identified by FEMA.
- In addition, many urban flood hazards are not mapped or are inadequately mapped. In most cases, if an urban flood hazard has been mapped, it was mapped as a fluvial hazard and did not account for the pluvial hazard.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk C is shown in Figure D-3, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk C (Data gaps in unmapped areas) threatens the accomplishment of the TMAC's notional subobjectives 1, 2, 3, 5, 7, 8, 9, and 10, which are based on FIMA's Strategic Outcomes.

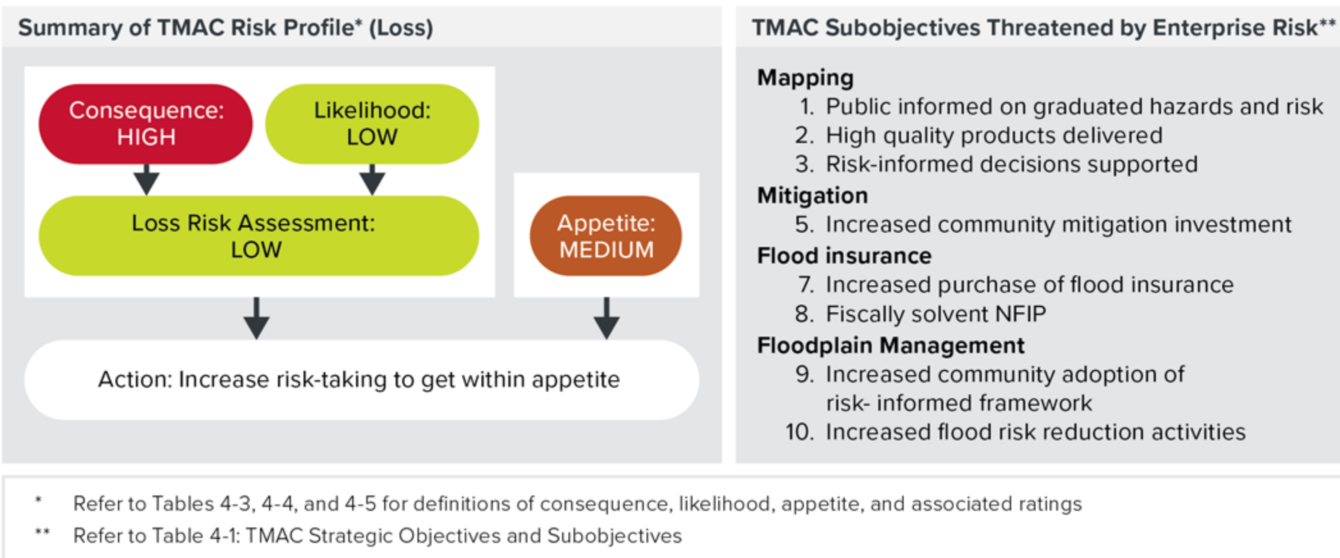


Figure D-3: Summary of risk profile for Enterprise Risk C – data gaps in unmapped areas

Risk appetite and rationale. FEMA recognizes the need for more of the nation's flood hazards to be identified and mapped, especially given population growth and expected climate change-related migration away from the coasts, with perhaps as many as 13 million Americans being displaced by 2100 (Robinson et al., 2020).

Given the information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk C (loss). In practice, an organization in this position is likely to be risk neutral and take a balanced approach to risk-taking. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, taking risk to avoid losses or impediments to achieving its strategic objectives only if the upside benefits are likely to exceed the downside costs.

Risk assessment with evidence. The TMAC rated Enterprise Risk C (loss risk) as having a high consequence and a low likelihood. Based on this assessment, the consequences could preclude or highly impair FIMA's ability to achieve one or more of its objectives or performance goals, but the consequences are unlikely to occur.

The resulting overall risk assessment is low. The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence
  The TMAC rated Enterprise Risk C as having a high consequence. Currently, these geographic areas (whether neighborhoods intersected by small tributaries, multi-family rowhomes within an urban center, recently privatized land in rural areas, or others) are outside of the federal regulatory flood requirements; therefore, families living in these areas or business owners operating businesses in these areas are likely unaware of the flood hazards and associated flood risks they may face. According to the TMAC 2018 Annual Report (TMAC, 2019), about 40% of the 3.5 million stream miles in the United States have yet to be mapped. According to the ASFPM 2020 Flood Mapping for the Nation report, the percentage yet to be mapped is a more startling 66% (ASFPM, 2021). In addition to unmapped streams or communities that do not have flood maps, areas subject to pluvial flooding are not mapped in urban centers across the country. While there are many ways to estimate the size of this data gap, one study estimates there are more than three times the number of persons living in a 1percent-annual-chance floodplain than would be computed based solely upon the mapped SFHA (Wing et al., 2018). Turning that into gross domestic product (GDP) exposure yields an estimate of $2.9 trillion (Wing et al., 2018). FEMA cannot achieve its objectives across the nation if so many Americans are unaware of the hazards present, therefore making uninformed decisions regarding their property, homes, and businesses.
- Likelihood evidence
  The TMAC rated Enterprise Risk C as having low likelihood rating. Currently, the National Flood Mapping Program operates as a result of Congressional appropriations plus fees collected with NFIP flood insurance policies. Historically, lack of resources and perceived lack of impact or existing risk have been reasons for areas to remain unmapped, so continuing the program as is will likely achieve stated objectives. However, greater recognition and understanding of flood risk by mapping additional flood hazards (both fluvial and pluvial) can help guide future development in communities across the nation and lead to better decisions that help reduce personal risk exposure through the purchase of flood insurance.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk C (loss risk) as medium and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its loss risk to move closer to its risk appetite for Enterprise Risk C. FIMA may be overinvesting in loss risk mitigation strategies and may want to consider increasing its loss risk.

Specifically, FIMA could evaluate the use of reduced resolution products for areas of reduced population and little future development pressure to get within its risk appetite.

Illustrative Risk Treatments (not TMAC recommendations)

- Evaluate the use of reduced resolution products for areas of reduced population and little future development pressure.
- Adopt a methodology for identifying and mapping pluvial flood risk and small catchment areas.
- Engage with SLTTs with currently unmapped flood hazards to encourage participation and acceptance of FEMA's FIRMs.
- Determine an approach to identify and map flood hazards on federal lands.
- Use graduated risk principles to map unmapped areas to aid the transition from deterministic assessments.

D.4 ENTERPRISE RISK D – Requirements that Limit Post-flood Aid

OPPORTUNITY RISK: *Benefit-cost analysis criteria as applied by FIMA combine with other regulations to slow FIMA post-flood aid and limit aid available to low-income communities and property owners.*

BACKGROUND

FIMA's Flood Mitigation Assistance (FMA) grant program is a competitive grant program that provides funding for flood risk reduction activities. Decisions about grant awards rely on a benefit-cost analysis (BCA) with a decision criterion that defines benefits in terms of reduced flood damages to insured real property. To be eligible, the community in which the property is located must be enrolled in the NFIP. BCA traditionally benefits higher income investments, reinforcing an ever-widening distribution of federal flood relief to higher income populations rather than to socially vulnerable disadvantaged populations.

The process by which the pre-disaster FMA mitigation grants are applied for by NFIP-participating communities and the process by which grant funds flow to property owners discourages pre-flood investments in risk reduction. In the case of post-disaster Hazard Mitigation Grant Program (HMGP) grants, the awards come too long after the flood to help property owners build back more resiliently. Furthermore, low-moderate income (LMI) households may not own real property and they are generally unlikely to have NFIP contents coverage. Renters displaced by a flood are offered limited support in securing new habitable housing and their landlords may not have the means or the flood insurance needed for repair and rebuilding after a flood. Finally, the community grant application process for mitigation assistance can be costly and confusing, working against the participation of LMI communities.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk D is shown in Figure D-4, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk D (Requirements that limit post-flood aid)) threatens the accomplishment of the TMAC's notional subobjectives 4, 5, 6, 7, and 10, which are based on FIMA's Strategic Outcomes.

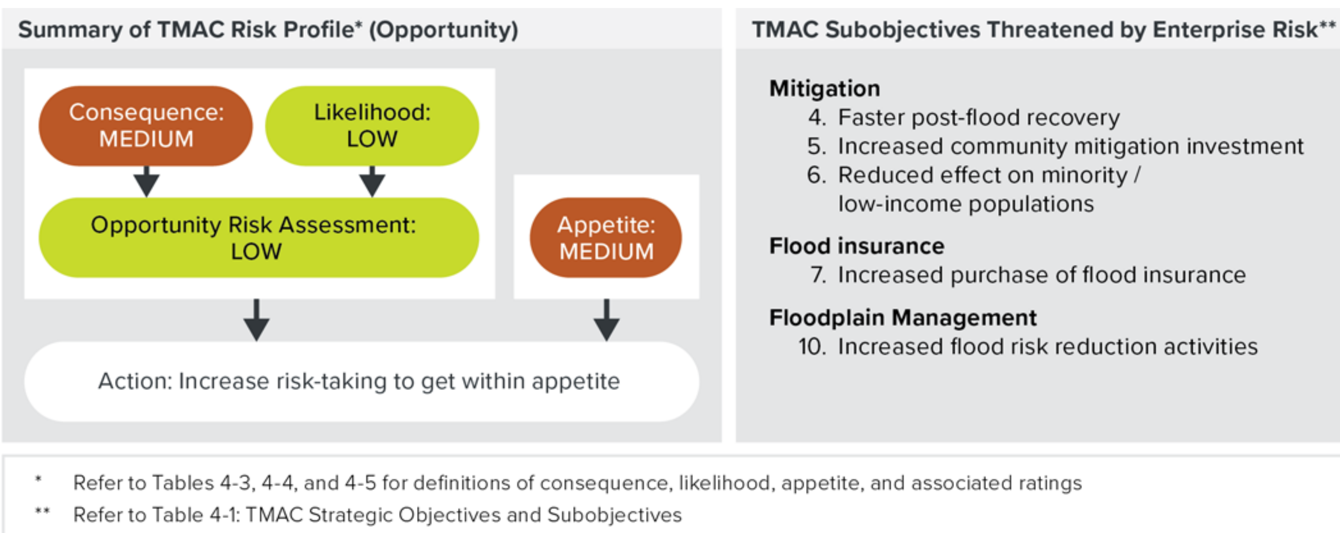


Figure D-4: Summary of risk profile for Enterprise Risk D – requirements that limit post-flood aid

Risk appetite. Due to a combination of economic, social, and cultural factors, many areas with significant low to moderate income households that are asset poor are located in flood prone areas where the land and property is inexpensive to own or where rents are affordable. Individuals of low income, who cannot afford to mitigate, manage, or transfer their flood risk (through insurance), are effectively denied access to pre-and post-disaster FIMA resources.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk D (opportunity). In practice, an organization in this position is likely to be risk tolerant and willing to take greater than normal risk. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, while maintaining a preference for disciplined risk-taking that promotes its strategic objectives.

Risk assessment with evidence. The TMAC rated Enterprise Risk D (opportunity risk) as having a medium consequence and a low likelihood. Based on these ratings, taking this risk could improve FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains are unlikely to occur, given current operations. The resulting overall risk assessment is low.

The TMAC considered the following when assigning consequence and likelihood ratings. FIMA has recognized some of the concerns related to existing requirements that limit post-flood aid and has a number of initiatives underway. Drafts of Congressional legislation have been proposed as ways to reduce delay in awarding grant funds. Particular attention is also being paid to the effects of FIMA practices on LMI households and communities. One highly visible FIMA response was the removal of the cross-subsidy from low value to high value properties in Equity in Action- Risk Rating 2.0. FIMA has also made some other changes, such as reducing the burden on LMI homeowners to prove ownership of a home as a condition of post-flood aid.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk D (opportunity risk) as medium and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk D. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Specifically, FIMA could adopt an aggressive stance on opportunities to enhance the speed of the grant process, to increase the eligibility of LMI property owners for grant funds, to get within its risk appetite.

Illustrative Risk Treatments (not TMAC recommendations)

- Design and seek Congressional approval for a separate program and budget for LMI communities and households. This program would have its own decision criteria divorced from NFIP solvency and property values.
- Allow property owners to apply directly to FIMA for pre- and post-flood grants and require FIMA to make grant approval decisions within a set number of days.
- Allow grant recipients to use Individual Assistance awards or other FIMA funds to repay a private loan or loan from the community when the borrowed funds were used to speed up the process of building back more resiliently or to accelerate implementing pre-flood risk reduction measures.

D.5 ENTERPRISE RISK **E – Changing Flood Risk**

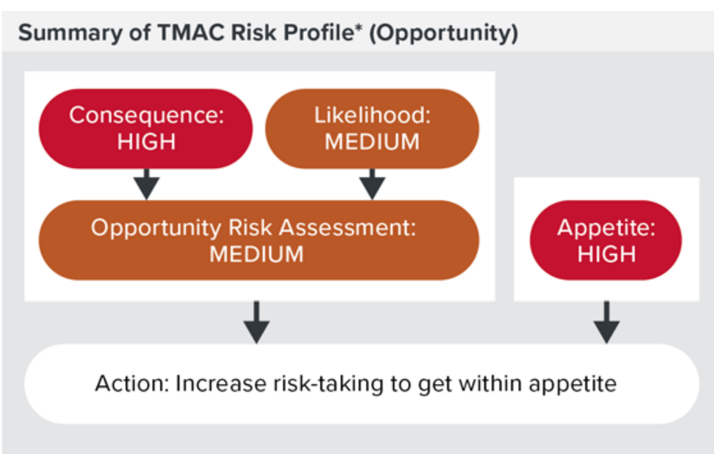
OPPORTUNITY RISK: *Flood risk will change over time with climate change and increased development.*

BACKGROUND

SLR and climate change are affecting the frequency and magnitude of flood hazards and, therefore, the flood risk faced by many in the United States. At the present time, future condition depictions of flood risk are inadequate for the purposes of effective long-term flood risk management. Without good depictions of future hazards, development is allowed to occur without regard for the future hazard and thus it increases a community's total flood risk.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk E is shown in Figure D-5, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk E (Changing flood risk) threatens the accomplishment of the TMAC's notional subobjectives 2, 4, 5, 6, 8, 9, and 10, which are based on FIMA's Strategic Outcomes.



TMAC Subobjectives Threatened by Enterprise Risk**

Mapping
2. High quality products delivered

Mitigation
4. Faster post-flood recovery
5. Increased community mitigation investment
6. Reduced effect on minority / low-income populations

Flood insurance
8. Fiscally solvent NFIP

Floodplain Management
9. Increased community adoption of risk-informed framework
10. Increased flood risk reduction activities

* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings
** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-5: Summary of risk profile for Enterprise Risk E – changing flood risk

Risk appetite and rationale. Increased public interest in natural and nature-based flood risk management features, along with continuing use of traditional treatments, provide opportunities for creative approaches to addressing on-going and future flood risk problems. Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, is driving federal agencies to tackle climate crises at home and abroad. There are ample opportunities for innovation.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a high risk appetite for Enterprise Risk E (opportunity). In practice, an organization in this position is likely to be risk-seeking and believe aggressive risk-taking is justified. It would likely seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals, and act to maximize the likelihood that gains would be realized or that gains would be maximized when they occur because the potential upside benefits outweigh the potential costs for taking the action.

Risk assessment with evidence. The TMAC rated Enterprise Risk E (opportunity risk) as having a high consequence and a medium likelihood. Based on these ratings, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, and the potential gains are as likely to occur as not, given current operations. The resulting overall risk assessment is medium.

The TMAC considered the following when assigning consequence and likelihood ratings. Climate change will tend to change flood hazards and flood risks. Exposed assets in areas of intensifying flood hazard—from SLR, changing fluvial conditions, or locally intense pluvial events—will experience greater risk if no action is taken. Aggressive innovation in flood-risk measures that include reliance on land use controls as well as natural and nature-based alternatives offer the potential to reduce existing and future climate change-induced flood risk. Providing communities and individuals with basic information about anticipated future flood hazards can help support local action to manage land use or take mitigation actions to reduce risk or adapt to climate change.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk E (opportunity risk) as high and the overall risk assessment as medium. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk E. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Specifically, FIMA could increase its risk-taking in pursuit of more innovative flood risk reduction measures that could pay substantial benefits.

Illustrative Risk Treatments (not TMAC recommendations)

- Expand attention to the formulation and evaluation of risk reduction plans; where justified, incorporate innovative flood-risk reduction measures including natural and nature-based alternatives.
- Improve tools such as the National Risk Index to communicate future conditions risks that reflect both increased development and the intensification of flood hazards.
- Enhance climate literacy and grow a next-generation workforce.
- Improve information provided to the public regarding future conditions hazards to help communities and individuals reduce the exposure of assets to the intensification of those future conditions.

D.6 ENTERPRISE RISK **F – Inadequate Personnel and Fiscal Resources**

LOSS RISK: *Inadequate personnel and fiscal resources at the federal, state, local, tribal and territorial levels prevent effective implementation of pre- and post-disaster mitigation programs.*

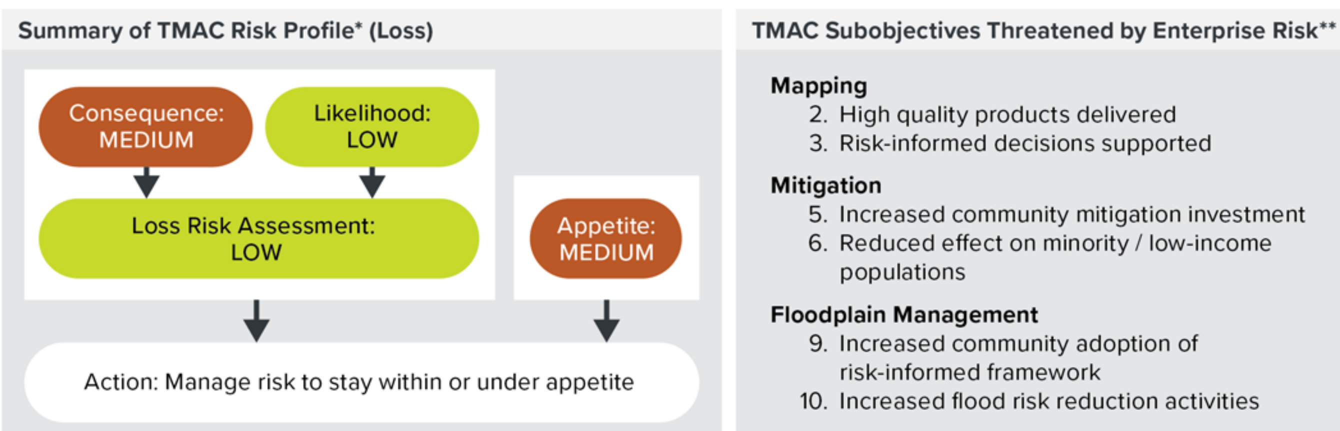
BACKGROUND

In many areas of the country, local floodplain management is carried out as an "other duty as assigned" by building code enforcement, zoning, or planning staff. This common situation, when compounded with increasing complex grant application requirements for flood-related aid programs and the "Applicant"/"sub-applicant" hierarchy between FEMA, states, and communities, yields a less than favorable outcome for the mitigation of flood risks in and out of the SFHA. Similarly, when presented with an influx of post-disaster funding, state-level staffing is often inadequate to deliver the funds to the impacted communities in a timely manner. Lastly, recent federal policy changes intended to protect personally identifiable information found in NFIP claims data have resulted in cut-offs in the flow of this information, which has handicapped both states and communities in their efforts to identify repetitive loss (RL) properties that are prioritized for pre-disaster mitigation funding.

Program reforms are needed to reduce the complexity of the grant application process to speed the distribution of funds. The existing complexity is partly a consequence of concerns over fraudulent post-flood claims or recipients receiving aid for the same damage from different agencies. A greater willingness to accept an occasional fraudulent claim, to be addressed after aid has been distributed, could allow for a more understandable, coordinated, and efficient aid distribution system. With the creation of the Building Resilient Infrastructure and Communities (BRIC) program in 2020 and with the significant new funding available through the 2021 Infrastructure Investment and Jobs Act, the administrative challenges to expediting grant awards must be addressed if these new opportunities are to be realized.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk F is shown in Figure D-6, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk F (Inadequate personnel and fiscal resources) threatens the accomplishment of the TMAC's notional subobjectives 2, 3, 5, 6, 9, and 10, which are based on FIMA's Strategic Outcomes.



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-6: Summary of risk profile for Enterprise Risk F – inadequate personnel and fiscal resources

Risk appetite. Working within the constraints of available personnel and fiscal resources will necessitate trade-offs in the emphasis competing programs receive in any given budget year. Efforts to provide justification for increased funding for mitigation program execution may not result in that increase.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk F (loss). In practice, an organization in this position is likely to be risk neutral and take a balanced approach to risk-taking. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, taking risk to avoid losses or impediments to achieving its strategic objectives only if the upside benefits are likely to exceed the downside costs.

Risk assessment with evidence. The TMAC rated Enterprise Risk F (loss risk) as having a medium consequence and a low likelihood. Based on this assessment, the consequences could significantly affect FIMA's ability to achieve one or more of its objectives or performance goals, but the consequences are unlikely to occur. The resulting overall risk assessment is low.

The TMAC considered the following when assigning consequence and likelihood ratings. The lack of staff and funding resources at both local and state levels contributes to a lengthy time lag between application submittals and subsequent funding award and to other inefficiencies in state and local mitigation programs justifying the likelihood the gains will be achieved to be low given current staffing. Lack of resources at the local level is beyond the reach of FIMA but it remains a real constraint on the ability to reduce expected annual flood damages for the nation. There is not likely to be any effective action taken by FIMA that can affect local resources. Resources at the state level can be influenced through grant program set-asides and increased eligibility for mitigation planning. The consequence rating of medium is justified because of the evidence that the long process delays recovery, which impacts subobjective 4 of faster post-flood recovery.

Risk evaluation. Assuming that FIMA's risk appetite for Enterprise Risk F is medium and the overall risk assessment is low, FIMA is within and below its appetite. This risk can be managed to stay within its risk appetite range.

Illustrative Risk Treatments (not TMAC recommendations)

- Create a dedicated post-disaster response staff to lead internal agency training and planning that would make FEMA staff more effective in the post-disaster environment. Because disasters are random and sporadic, when not responding to a disaster, these same staff would have responsibility for supporting local communities' emergency preparedness, as well as mitigation, plan development, and implementation.
- Develop a pre-grant "intent to apply" application form and then assign individual FIMA staff to tracking and facilitating the submission of the final FIMA grants, with emphasis on supporting low income and disadvantaged communities. Reprioritize budget resources to increase program delivery at the local level.
- Develop software that automatically accesses the required internal FIMA data. Increase state set-asides to allow for more local-level decisions on how and where funding is spent.

- Simplify the grant application process based on community or household profiles to encourage participation by communities with fewer resources.
- Monitor the success of the North Carolina Department of Public Safety "State Centric Plan," a pilot program that allows the State Hazard Mitigation Office to implement mitigation projects on behalf of local communities.
- Provide resources at the FEMA regional level to implement PII policy and respond to state and local requests for information.

D.7 ENTERPRISE RISK **G – Cost Perception of Flood Insurance**

OPPORTUNITY RISK: *Flood insurance is perceived as too costly for its benefit for many floodplain occupants.*

BACKGROUND

The value of insurance is the peace of mind that if a flood occurs, the insured will have the funds needed to recover. Property owners may not appreciate the value of insurance as a risk transfer service that, ideally, never pays out. Low voluntary purchase of flood insurance is the case throughout the developed world, and voluntary purchase insurance through NFIP is no exception. In the case of the NFIP, many of the policies in force are the result of the MPR.

Beginning in 2021, the NFIP's new Risk Rating 2.0[1] will calculate and move toward charging full-risk premiums. This new premium structure may affect the willingness or ability of some property owners to pay the full-risk premium for the risk transfer service. With Risk Rating 2.0 as a backdrop, alongside increased production and distribution of property-specific graduated risk products, FIMA must reconcile Congressional general interest in the NFIP charging full-risk premiums that support a fiscally sound and debt-free NFIP with equally intense Congressional calls for NFIP premiums to be "fair" and "affordable" so that the pool of NFIP-insured properties can grow over time.

The effect of Risk Rating 2.0 on the purchase NFIP insurance is not yet predictable. The use of Risk Rating 2.0 may increase premiums for many properties outside

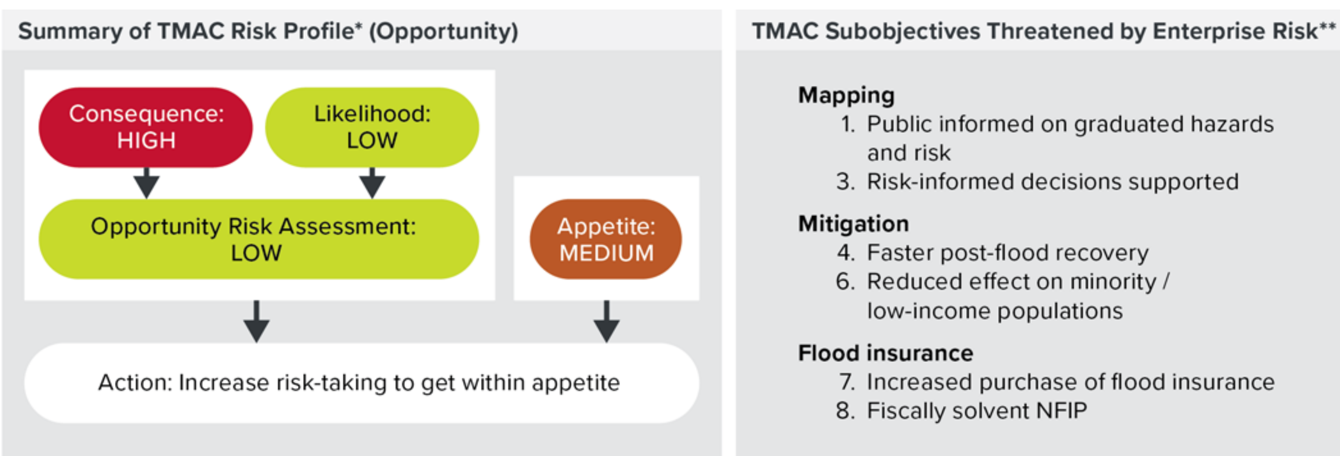
1 For more information on Risk Rating 2.0, https://www.fema.gov/flood-insurance/risk-rating

the SFHA where mandatory purchase does not apply, and coverage may be dropped. On the other hand, premiums for lower value properties and those subject to inland flooding may be lower under Risk Rating 2.0.

Additionally, the combined effect of FIMA's communication of flood risk information, the processes by which property owners interpret and then use flood risk information for insurance purchase decision-making, and how budget constraints limit the ability of willing buyers to purchase insurance remains unknown.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk G is shown in Figure D-7, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk G (Cost perception of flood insurance) threatens the accomplishment of the TMAC's notional subobjectives 1, 3, 4, 6, 7, and 8, which are based on FIMA's Strategic Outcomes.



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-7: Summary of risk profile for Enterprise Risk G – cost perception of flood insurance

Risk appetite and rationale. The risk transfer service offered by flood insurance is the essential cornerstone for post-flood recovery, but property owners do not perceive sufficient value in the service. Innovations in flood-risk communication methods to stimulate demand are being implemented by FIMA and are expected to continue. Other actions could be taken to encourage voluntary purchase.

Given the information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk G (opportunity). In practice, an organization in this position is likely to be risk tolerant and willing to take greater than normal risk. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, while maintaining a preference for disciplined risk-taking that promotes its strategic objectives.

Risk assessment with evidence. The TMAC rated Enterprise Risk G (opportunity risk) as having a high consequence and a low likelihood. Based on these ratings, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains are unlikely to occur, given current operations. The resulting overall risk assessment is low.

The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence
  The TMAC rated Enterprise Risk G as having high consequence because the risk transfer service offered by flood insurance is the essential cornerstone for post-flood recovery, and at the same time risk-based premiums can communicate flood risk and incentivize investments in risk reduction. In fact, the number of NFIP policies in force has been constant for 30 years, the total risk pool is small, and policies are concentrated in high-risk areas. FIMA is aware of this stagnation and has a moonshot goal of doubling coverage by 2023.
- Likelihood evidence
  The TMAC rated Enterprise Risk G as having low likelihood because property owners do not perceive sufficient value in the risk service relative to the charged premium. Research in the U.S. and internationally reports that most property owners are unlikely to voluntarily purchase flood insurance, leaving a large insurance coverage gap.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk G (opportunity risk) as medium and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk G. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Specifically, FIMA could make an aggressive effort to increase the perceived value of flood insurance along with increasing efforts to make insurance affordable.

Illustrative Risk Treatments (not TMAC recommendations)

- Design and conduct analyses to predict the effect of the changes on NFIP insurance demand that arise from the application of Risk Rating 2.0 combined with the increased information available on graduated risk.

- Prepare a report for Congress on the predicted effect of replacing the SFHA for triggering the MPR with criteria based on Risk Rating 2.0 premiums and graduated risk.
- Encourage state regulators to require private flood coverage equivalent to NFIP as default in all homeowners' policies, with an opportunity for property owners to opt out of the coverage.

D.8 ENTERPRISE RISK **H – Need for Congressional Action**

OPPORTUNITY RISK: *Congressional action is required for current FIMA programs to function and to correct flaws in the program.*

BACKGROUND

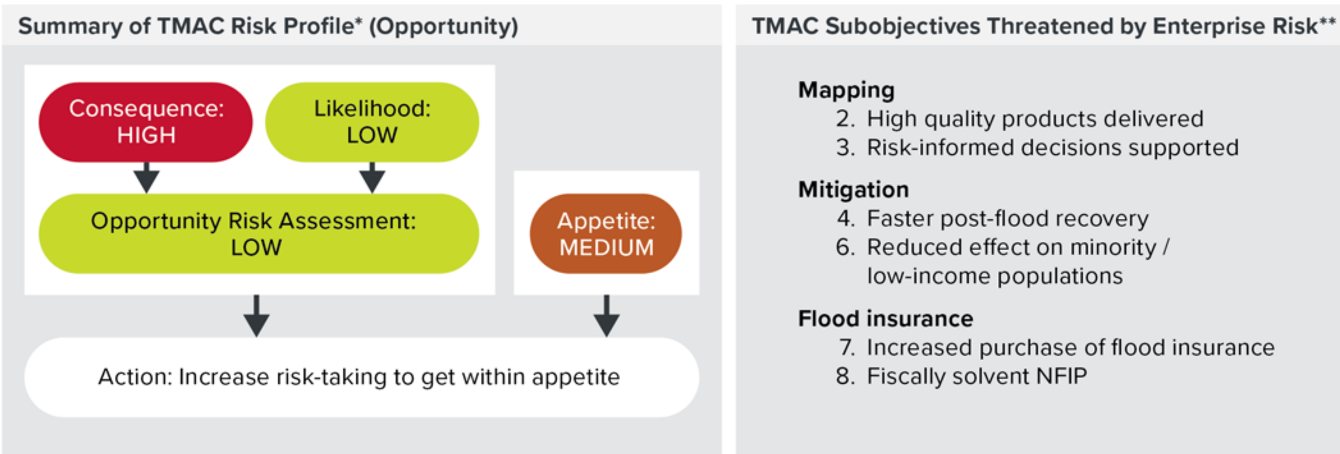
Congress has given FIMA competing goals for the NFIP and its associated mitigation grant programs (see also Enterprise Risk F and G). Congress expects the NFIP to charge premiums that reflect property-specific risk and that secure fiscal solvency for the program based mainly on premium revenues. Appropriations for flood risk mitigation grants have been directed to securing fiscal solvency for the NFIP.

At the same time, Congress expects premiums to be sufficiently affordable to stimulate voluntary purchase, including being affordable to low and moderate income (LMI) households facing the MPR and those that do not have the financial assets or borrowing authority to bear the costs for post-flood recovery. Additionally, premiums are expected to be fair to people who made building decisions consistent with the flood-risk information and building code requirements in effect at the time of their investment decision.

Grants are made for reducing flood risk at properties where expected future claims are greater than expected future premium revenues, but not for off-setting premium revenue lost due to effort to keep premiums affordable and fair.

RISK PROFILE

A summary of the TMAC's notional risk profile developed for Enterprise Risk H is shown in Figure D-8, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk H (Need for Congressional action) threatens the accomplishment of the TMAC's notional subobjectives 2, 3, 4, 6, 7, 8, 9, and 10, which are based on FIMA's Strategic Outcomes.



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings
** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-8: Summary of risk profile for Enterprise Risk H – need for Congressional action

Risk appetite and rationale. FIMA's dependence on Congressional actions for funding and authorization places the Agency in the position of reconciling competing objectives.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk H (opportunity). In practice, an organization in this position is likely to be risk tolerant and willing to take greater than normal risk. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, while maintaining a preference for disciplined risk-taking that promotes its strategic objectives.

Risk assessment with evidence. The TMAC rated Enterprise Risk H (opportunity risk) as having a high consequence and a low likelihood. Based on these ratings, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains are unlikely to occur, given current operations. The resulting overall risk assessment is low.

The TMAC considered the following when assigning consequence and likelihood ratings. Risk Rating 2.0 is a major advance for calculating the full risk premium at the property level, but some in Congress continue to express concerns related to affordability and fairness. In response to these concerns, recent legislation, as well as FIMA administrative actions, have begun to direct some share of grant program funds to reducing flood risk of LMI households independent of the effect on the fiscal solvency of the NFIP. The current political battles regarding Risk Rating 2.0 provide evidence that the current actions limit the likelihood of achieving the potential gains for this risk. The consequence is supported with evidence that if Risk Rating 2.0 succeeds, FIMA can significantly enhance multiple strategic objectives regarding fiscal solvency, decreasing the insurance gap, and reducing disaster suffering.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk H (opportunity risk) as medium and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk H. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Specifically, FIMA could take a more aggressive stance on pursuing changes to the current program.

Illustrative Risk Treatments (not TMAC recommendations)

- Use the analytical capabilities created by Risk Rating 2.0 to calculate the forgone net revenue to the NFIP program arising from the varied Congressional motivations that deviate from applying full-risk premiums for any given group of property owners.
- Propose a budget strategy—either as a structured process for debt forgiveness or as a regular transfer of funds to the NFIP reserve—that would be equal to the premium revenue forgone when the NFIP does not charge a full-risk premium.

D.9 ENTERPRISE RISK **I – Lack of Understanding of Flood Risk**

OPPORTUNITY RISK: *Large segments of the population fail to understand their true flood risk and to realize that recovery and repair costs will be their responsibility.*

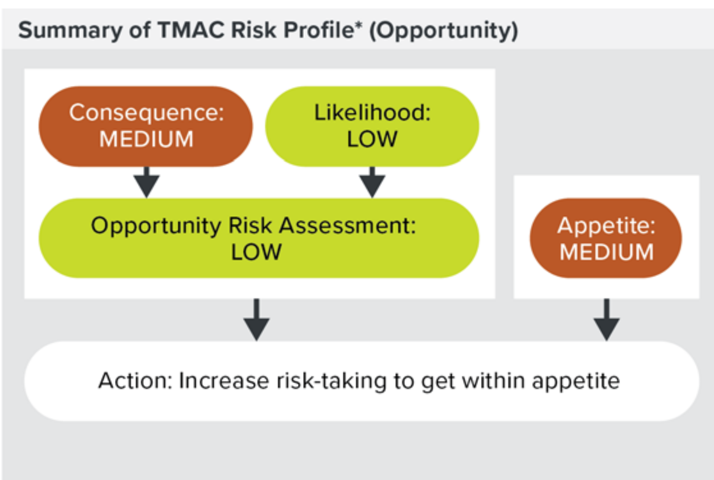
BACKGROUND

The SFHA as currently mapped on NFIP flood maps has been used to designate areas where NFIP minimum land use regulations apply and where the MPR is in effect. However, The SFHA mis-communicates flood risk in several ways. The 1-percent-annual chance event that defines the SFHA boundary is not a readily understood concept. Instead, households and community leaders rely on the area where MPR and NFIP minimum regulations are in effect as a proxy for flood-free versus flood-prone. Another issue is that the SFHA does not account for pluvial flood risk. Pluvial hazards exist within and outside the SFHA.

After a Presidentially declared flood disaster, public officials assure constituents that FEMA and other federal agencies will come to the area to help with recovery. In some cases, Congress might pass an emergency supplemental appropriation. However, the reality is that most of the funds go to community infrastructure, often for building back in anticipation of the next flood. FEMA and other federal programs that provide post-flood grant awards or loans both for emergency recovery and for building back are uncertain, and when available are limited.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk I is shown in Figure D-9, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk I (Lack of understanding of flood risk) threatens the accomplishment of the TMAC's notional subobjectives 3, 4, 5, 6, 7, 8, 9, and 10, which are based on FIMA's Strategic Outcomes.



TMAC Subobjectives Threatened by Enterprise Risk**

Mapping
3. Risk-informed decisions supported

Mitigation
4. Faster post-flood recovery
5. Increased community mitigation investment
6. Reduced effect on minority / low-income populations

Flood insurance
7. Increased purchase of flood insurance
8. Fiscally solvent NFIP

Floodplain Management
9. Increased community adoption of risk-informed framework
10. Increased flood risk reduction activities

* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings
** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-9: Summary of risk profile for Enterprise Risk I – lack of understanding of flood risk

Risk appetite and rationale. Current FIMA programs are not effective at communicating graduated flood risk.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk I (opportunity). In practice, an organization in this position is likely to be risk tolerant and willing to take greater than normal risk. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, while maintaining a preference for disciplined risk-taking that promotes its strategic objectives.

Risk assessment with evidence. The TMAC rated Enterprise Risk I (opportunity risk) as having a medium consequence and a low likelihood. Based on these ratings, taking this risk could improve FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains are unlikely to occur, given current operations. The resulting overall risk assessment is low.

The TMAC considered the following when assigning consequence and likelihood ratings. FIMA has recognized that its program implementation practices create a "safe / not safe" miscommunication of flood risk. In response to this miscommunication, FIMA developed Risk Rating 2.0 to replace previous rating practices and is adding emphasis on producing and disseminating graduated risk products. Meanwhile, the 2021 Infrastructure Investment and Jobs Act would give FEMA $3 billion for flood mapping, twice as much money as Congress has allocated in the past 7 years. The continued use of maps that reflect the SFHA line and perpetuate the binary notion of "in or out" flood risk thinking that Risk Rating 2.0 seeks to avoid will undermine risk communication efforts.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk I (opportunity risk) as medium and the overall risk assessment as low. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk I. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Illustrative Risk Treatments (not TMAC recommendations)

- Replace the 1-percent-annual chance line that delineates the SFHA with the graduated risk products being developed by FIMA; if the 1-percent-annual chance line must remain in place for legal or administrative reasons, provide contextualize for understanding it.
- Re-define minimum federal land use standards when using graduated risk concepts.
- Prepare a report for Congress describing options for revised MPR criteria using graduated risk.
- Emphasize the limits of post-flood aid in all NFIP marketing materials and provide examples.

D.10 ENTERPRISE RISK J – Lack of Effective Flood Risk Management Frameworks

OPPORTUNITY RISK: *Lack of effective flood risk management frameworks limits local communities' ability to participate effectively in flood risk management.*

BACKGROUND

Many local communities lack staff that have formal training or effective knowledge of risk management. Opportunities for learning about formal flood risk management frameworks are not widely available to local communities. Therefore, local communities commonly rely on the Federal Minimum Standard as the only tool to manage flood risk.

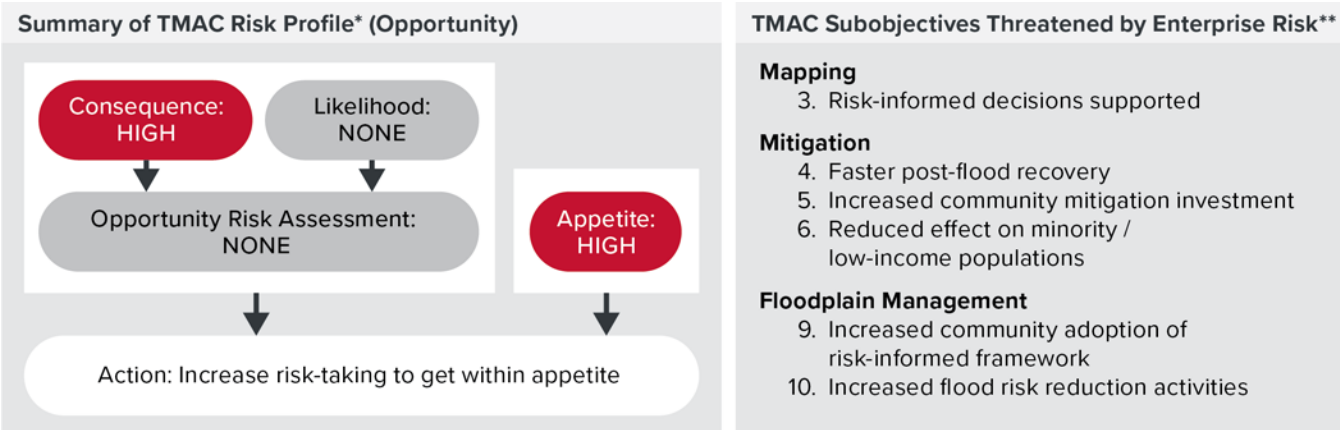
Flood risk management frameworks are distinct from ERM frameworks in that they are deployed at the operational and tactical levels of flood risk management. It would be desirable for local communities to begin with a flood risk management framework that could eventually mature into an ERM framework.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk J is shown in Figure D-10, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk J (Lack of effective flood risk management frameworks) threatens the accomplishment of the TMAC's notional subobjectives 3, 4, 5, 6, 9, and 10, which are based on FIMA's Strategic Outcomes.

Risk appetite and rationale. Graduated risk information to construct a flood risk management framework at the local level will soon be within reach of every interested and capable community. Some communities are in a position to use this new information to construct a modernized flood risk management framework, but most are not.

Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a high risk appetite for Enterprise Risk J



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-10: Summary of risk profile for Enterprise Risk J – lack of effective flood risk management frameworks

(opportunity). In practice, an organization in this position is likely to be risk-seeking and believe aggressive risk-taking is justified. It would likely seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals, and act to maximize the likelihood that gains would be realized or that gains would be maximized when they occur because the potential upside benefits outweigh the potential costs for taking the action.

Risk assessment with evidence. The TMAC rated Enterprise Risk J (opportunity risk) as having a high consequence and no likelihood. Based on these ratings, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, but the potential gains will not occur, given current operations. The resulting overall risk assessment is none.

The TMAC considered the following when assigning consequence and likelihood ratings. Few communities across the United States have adopted formal risk management frameworks. Risk management frameworks at the state and local government levels could be built on graduated flood hazard and flood risk data, once it is made available. Risk management can be deployed by local communities for long-term planning, including building code and land use regulations. FIMA is currently taking little or no action to provide training in formal risk management frameworks, thus this continued operation will provide no opportunity to achieve the opportunities presented with this risk.

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk J (opportunity risk) as high and the overall risk assessment as none. Using Table 4-5, FIMA could consider increasing its opportunity risk to move closer to its risk appetite for Enterprise

Risk J. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increasing its opportunity risk.

Illustrative Risk Treatments (not TMAC recommendations)

- Provide foundational datasets that enable low cost, evidence-based, risk-informed decision-making at the local level.
- Develop "model" flood risk management frameworks that can be adapted to particular local conditions by floodplain managers and local stakeholders.
- Develop on-demand online training for community use on how to develop flood risk management frameworks.

D.11 ENTERPRISE RISK **K – Repetitive Loss / Severe Repetitive Loss Structures**

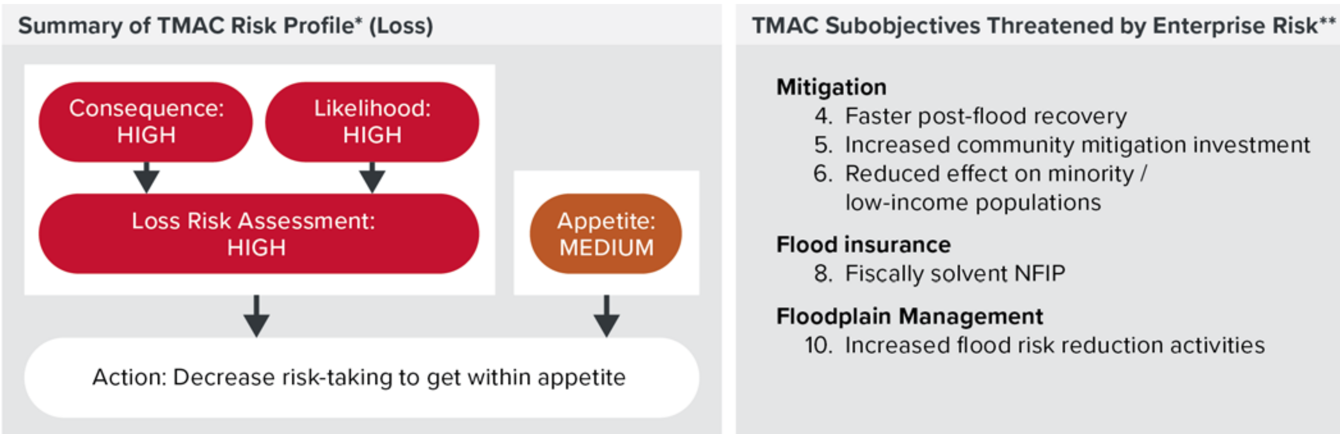
LOSS RISK: *Repetitive loss/severe repetitive loss structures, flood losses in flood zones outside SFHAs, and expected annual flood loss of the nation.*

BACKGROUND

The growing number of RL/SRL structures, combined with a limited budget for FIMA grant programs to mitigate risk at RL/SRL properties, will undermine the fiscal solvency of the program unless the premiums charged to these properties account for past claims as an indicator of likely future claims. RL/SRL structures can be a problem for those who are uninsured, but by virtue of circumstances cannot afford an NFIP policy. In some cases, even if the property owner had an NFIP policy, it would not meet the net benefits criterion used to allocate mitigation grant funding. For such properties, payment of post-flood mitigation grant funds may be delayed or denied and property owners may rebuild without consideration of future flood risk on their own funds without federal support in the hope that in the event of future hazards they will be bailed out.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk K is shown in Figure D-11, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk K (Repetitive Loss / Severe Repetitive Loss structures) threatens the accomplishment of the TMAC's notional subobjectives 4, 5, 6, 8, and 10, which are based on FIMA's Strategic Outcomes.



* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-11: Summary of risk profile for Enterprise Risk K – Repetitive Loss / Severe Repetitive Loss structures

Risk appetite and rationale. Given information available to the TMAC as this report was being prepared, the TMAC has assumed that FIMA has a medium risk appetite for Enterprise Risk K (loss). In practice, an organization in this position is likely to be risk neutral and take a balanced approach to risk-taking. It would likely strive to strike a balance between the potential upside benefits and potential downside costs of a given decision, taking risk to avoid losses or impediments to achieving its strategic objectives only if the upside benefits are likely to exceed the downside costs.

Risk assessment with evidence. The TMAC rated Enterprise Risk K (loss risk) as having a high consequence and a high likelihood. Based on this assessment, the consequences could preclude or highly impair FIMA's ability to achieve one or more of its objectives or performance goals and the consequences are very likely or reasonably expected to occur. The resulting overall risk assessment is high.

The TMAC considered the following when assigning consequence and likelihood ratings. FIMA has recognized that charged premiums for RL/SRL properties are a drain on the NFIP reserve fund, therefore the consequences are already known to be high. FEMA data have also shown that payouts to RL/SRL properties account for 30% of payments justifying the evidence that this risk is already occurring and will continue to occur without immediate substantial action (FEMA, 2014).

Risk evaluation. The TMAC rated FIMA's risk appetite for Enterprise Risk K (loss risk) as medium and the overall risk assessment as high. Using Table 4-5, FIMA could consider lowering its loss risk to move closer to its risk appetite for Enterprise Risk K. FIMA may not be investing enough in loss risk mitigation strategies and may want to consider reducing its loss risk.

Aggressive efforts to charge for SRL/RL claims are already in place. Programs to mitigate risks at RL/SRL properties in LMI communities await design.

Illustrative Risk Treatments (not TMAC recommendations)

- Dedicate surcharge revenues and additional premium revenues charged to SRL/RL properties to support a new “rapid payout” mitigation grant program.
- Develop criteria for mitigation of flood risk at SRL/RL properties that targets provision of mitigation funds in LMI communities.

ENTERPRISE RISK L – **Unaffordability for Low-income Individuals**

OPPORTUNITY RISK: *Individuals of low-income cannot afford to mitigate or manage their flood risk, even if they are aware of the flood risk in their current home.*

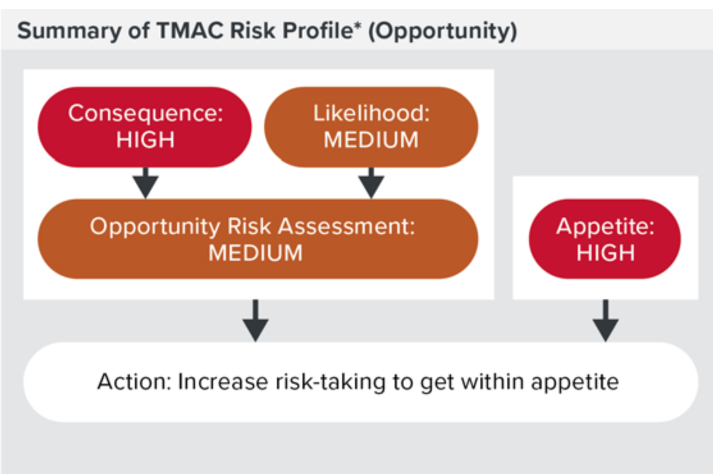
BACKGROUND

Low- to moderate-income (LMI) individuals and families facing flood risks often do not have the capability or capacity to effectively transfer (through insurance), reduce (through mitigation efforts), or avoid flood risks, which means they are left with one option: to accept the risk. Even with the removal of the cross-subsidy from low- to high-value homes as part of Risk Rating 2.0, NFIP premiums will still be unaffordable for some and in situations where the insurance is force placed, it will create a financial hardship. In summary, the lack of resources leads to a lack of choice, which in turn leads to additional financial hardship before a flood and greater suffering after it occurs.

Additionally, because LMI individuals and families often rent or own lower-value properties, they are not able to compete as effectively for assistance programs where benefit-cost analyses play a large role in project selection. In essence, when two homes are subject to the same flood hazard, investing in flood mitigation for the more valuable home is often more cost-effective. This reality tends to be even more pronounced at the neighborhood scale when the mitigation solutions involve levees or other measures that do not involve retrofitting individual structures; in these cases, those that are asset rich are better off due to the nature of traditional benefit to cost analysis. Likewise, grant applications favor those that have high asset value rather than those that are most sensitive to the impact of a hazard. Providing flood hazard and risk information to those with the means to do something about it can move them to more effectively manage their risks; however, providing information to those who cannot afford to implement risk management strategies does little more than frighten them and, in some cases, may even further devalue their property. Financial hardship combined with increasing risk and reduced access to assistance can create a downward spiraling effect making those who are already vulnerable even more vulnerable.

RISK PROFILE

A summary of the TMAC's risk profile developed for Enterprise Risk L is shown in Figure D-12, followed by explanatory text related to the risk appetite, risk assessment (consequence and likelihood, with evidence), and risk evaluation. Enterprise Risk L (Unaffordability for low-income individuals) threatens the accomplishment of the TMAC's notional subobjectives 3, 4, 5, 6, 7, 8, 9, and 10, which are based on FIMA's Strategic Outcomes.



TMAC Subobjectives Threatened by Enterprise Risk**

Mapping

3. Risk-informed decisions supported

Mitigation

4. Faster post-flood recovery
5. Increased community mitigation investment
6. Reduced effect on minority / low-income populations

Flood insurance

7. Increased purchase of flood insurance
8. Fiscally solvent NFIP

Floodplain Management

9. Increased community adoption of risk-informed framework
10. Increased flood risk reduction activities

* Refer to Tables 4-3, 4-4, and 4-5 for definitions of consequence, likelihood, appetite, and associated ratings

** Refer to Table 4-1: TMAC Strategic Objectives and Subobjectives

Figure D-12: Summary of risk profile for Enterprise Risk L – unaffordability for low-income individuals

Risk appetite and rationale. The administration and Congressional interest in increasing LMI community and household access to flood resiliency programs provides the impetus for TMAC's assumption that FIMA has a high risk appetite for Enterprise Risk L (opportunity). In practice, an organization in this position is likely to be risk-seeking and believe aggressive risk-taking is justified. It would likely seek risks that lead to program improvements or otherwise contribute to the achievement of its strategic goals and act to maximize the likelihood that gains would be realized or that gains would be maximized when they occur because the potential upside benefits outweigh the potential costs for taking the action.

Risk assessment with evidence. The TMAC rated Enterprise Risk L (opportunity risk) as having a high consequence and a medium likelihood. Based on these ratings, taking this risk could significantly enhance FIMA's ability to achieve one or more of its objectives or performance goals, and the potential gains are as likely to occur as not occur, given current operations. The resulting overall qualitative risk assessment is medium.

The TMAC considered the following when assigning consequence and likelihood ratings:

- Consequence evidence
  The TMAC rated Enterprise Risk L as having high consequence. Socially vulnerable populations suffer disproportionately more from floods in part due to their limited resources and inability to compete for assistance programs with an emphasis on economic returns. These issues are well documented and span a wide variety of impacts, including income sensitivity, food security, and medical supply security. Over the long term, these relationships—along with other incentive structures—have contributed to an intensification of the flood risk experienced by vulnerable populations rather than a reduction. FIMA can directly impact these populations through pre- and post-flood preparation and recovery programs. As one example, FEMA set up the Equity Enterprise Steering Group in 2021, which created a definition of equity for the Agency.

- Likelihood evidence
  The TMAC rated Enterprise Risk L as having medium likelihood. The 2021 Justice40[2] is a recent federal initiative, among others, that seeks to secure environmental justice and to spur economic opportunity in disadvantaged communities. Moreover, in 2018, as required by law, FEMA release a report entitled "An Affordability Framework for the National Flood Insurance Program" that laid out options for addressing the insurance affordability challenge (FEMA, 2018). Lastly, acting on this opportunity risk has the additional benefit of aligning FIMA with recent administration and Congressional initiatives for LMI flood resiliency.

Risk evaluation. The TMAC rated FIMA's risk appetite for opportunity Enterprise Risk L as high and the overall risk assessment as medium. Using these assumptions and

2 For more information of Justice40 initiative, https://www.whitehouse.gov/omb/briefing-room/2021/07/20/the-path-to-achieving-justice40/.

Table 4-5, FIMA may want to consider increasing its opportunity risk to move closer to its risk appetite for Enterprise Risk L. FIMA may be underinvesting in seeking this opportunity risk and may want to consider increased risk taking.

Specifically, FIMA could adopt a more aggressive stance on helping low-income families manage their flood risk more effectively, especially in post-flood circumstances.

Illustrative Risk Treatments (not TMAC recommendations)

- Develop programs with decision criteria directed specifically to the administrative capacities to support low-income communities and the needs of their residents.
- Develop, in partnership with HUD, a program with criteria that support the federally funded relocation of LMI households living in flood-prone properties to habitable and affordable housing with low flood risk.
- Develop and provide mitigation and NFIP products targeted to landlords who commit to offering habitable and affordable housing to LMI renters.
- Reduce the impact of benefit-cost analyses on flood mitigation project selection by including additional value streams, such as lowering life loss risk, enhancing environmental quality, and serving LMI people and families.

TMAC

TECHNICAL MAPPING ADVISORY COUNCIL