

How to Prepare for Natural Disasters

A Pre-Disaster Toolkit for Small- to Medium-Size Communities

Prepared by

URBANWATERS

FEDERAL PARTNERSHIP

Restoring Urban Waters, Revitalizing Communities

Why a Pre-Disaster Toolkit?

ABOUT THIS TOOLKIT

The creation of the *Pre-Disaster Toolkit for Small- to Medium-Size Communities* was inspired by comments made during a series of flood management planning workshops for local and regional officials conducted in regions identified by the Texas Division of Emergency Management as being especially hard-hit by Hurricane Harvey. What participants requested was a one-stop-shop for tools and resources to help them plan for flooding/hurricane events and know where to go for help afterwards. While the toolkit includes a number of agency and organization resources specific to the State of Texas, comparable resources can likely be found to help communities in other states and regions with pre-disaster planning for catastrophic flooding as well as other natural disasters.

When major natural disasters, including hurricanes and catastrophic flooding, strike throughout the nation, immediate disaster response is at hand through the Federal Emergency Management Agency (FEMA), as well as other federal, state and local emergency response teams, and disaster relief organizations such as the American Red Cross, The Salvation Army, Volunteers of America, AmeriCares, and others. But as the incidence of major storms and subsequent flooding increases, it is clear that pre-disaster planning for flood-prone communities is vital. This is especially true of small- to mid-size communities in counties that lack the financial resources and extensive social services network available in larger metropolitan areas. This Pre-Disaster Toolkit for Small- to Medium-Size Communities was created to help address this need. The toolkit is divided into two sections—one for local government officials including Emergency Management Coordinators (EMCs), utility district managers, and local elected officials—and a section for community residents. Within each section is information about tools and resources available through federal and state agencies. The toolkit also includes a section on disaster relief organizations, At-a-Glance Preparedness Checklists, an Emergency Contact Template, and an Attachment Section with additional tools and resources. The information contained in the toolkit is by no means an exhaustive list of all the pre-disaster planning resources and tools available, but is meant to help local government leaders and residents jump-start their disaster planning process. The toolkit will be updated as new information becomes available.

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The background is a solid dark blue color. Overlaid on this are several large, curved, layered shapes in various shades of blue, ranging from light to dark. These shapes create a sense of depth and movement, resembling stylized waves or a modern architectural design. The shapes are layered, with some appearing to be in front of others, creating a 3D effect.

Pre-Disaster Planning for Regional/Local Jurisdictions

Federal Government Resources & Tools

Additional tools and resources are available in Attachment Section of this toolkit.

Federal Emergency Management Agency (FEMA)

<https://www.fema.gov/>

To assist the local communities in preparing for disaster, FEMA provides annual funding opportunities for pre-disaster assistance to help communities with mitigation projects and mitigation plans. FEMA Mitigation Division includes Grants and Planning, Floodplain Management, and Risk Analysis branches, and all work closely with the State partners to provide assistance to local communities in developing a mitigation strategy to reduce vulnerability to natural disasters. The Grants and Planning branch will assist with the pre-disaster funding opportunities, including Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) grants. The Floodplain Management branch will provide the necessary resources on National Floodplain Insurance Programs (NFIP) and other floodplain management activities. The Risk Analysis branch will assist with risk mapping products to provide the best available data for the local communities. In addition, FEMA supports post-disaster long term recovery strategies and initiatives.

General Information

FEMA Hazard Mitigation Program

<https://www.fema.gov/hazard-mitigation-assistance>

Hazard Mitigation Grant Program

<https://www.fema.gov/hazard-mitigation-grant-program>

FEMA Map Service Center for flood data and maps

<https://msc.fema.gov/portal/home>

Pre-Disaster Mitigation Grant Program

<https://www.fema.gov/pre-disaster-mitigation-grant-program>

The one-stop federal government website where states, federally recognized tribes, U.S. territories and communities can research and apply for emergency-preparedness-plan funding grants.

Pre-Disaster Recovery Planning Guide

<https://www.fema.gov/media-library/assets/documents/129203>

General background and how-to FEMA information to help sub-federal-level governments and agencies, as well as private relief organizations, deal with emergency-preparedness and recovery-related issues.

Pre-Disaster Recovery Planning Guide for Local Governments

<https://www.fema.gov/media-library/assets/documents/129203>

Pre-Disaster Recovery Planning Guide for State Governments

<https://www.fema.gov/media-library/assets/documents/128572>

Pre-Disaster Recovery Planning Guide for Tribal Governments

<https://www.fema.gov/media-library/assets/documents/183019>

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Other Resources

<https://www.fema.gov/disaster/4339/emergency-preparedness>

A common-sense, step-by-step guide to help individuals, households and businesses prepare for natural disasters and what to do when and after they strike.

<https://www.fema.gov/preparedness-checklists-toolkits>

Comprehensive checklists that simplify individuals', households' and businesses' arduous task of preparing for natural disasters.

<https://www.fema.gov/media-library/assets/documents/90354>

A complement to <https://www.fema.gov/preparedness-checklists-toolkits> that lists the supplies families need to prepare for natural disasters.

https://www.fema.gov/pdf/areyouready/areyouready_full.pdf

Access to "Are You Ready? An In-Depth Guide to Citizen Preparedness": A compact booklet that covers emergency-preparedness basics for governments, organizations and citizens; where to go for disaster-preparation and -recovery guidance and assistance; and a "Who's Who" of private and government operations involved in every aspect of planning and recovery.

See **Attachment B** for FEMA Base Level Engineering (BLE) information.

U.S. Environmental Protection Agency (EPA)

<https://www.epa.gov/>

In addition to spearheading the identification and cleanup of toxic substances and materials released into the environment during natural disasters, EPA has a variety of tools and guidance to support drinking water and wastewater utility preparedness and response. EPA also promotes green infrastructure as a natural-based solution to hazard mitigation. EPA is a lead partner in the Urban Waters Federal Partnership, which promotes community preparedness and resiliency. Urban Waters served as a model for the flood management planning workshops conducted in 2019 in Texas regions impacted by major flooding events.

Drinking Water & Wastewater Utilities

<https://www.epa.gov/waterutilityresponse>

EPA guidance in determining a public water supply's at-risk factors and then building disaster-resiliency and emergency-response plans.

What is Water-Supply Resiliency?

<https://www.epa.gov/waterresilience>

How to stay up to date on one of the federal government's most-important and faster-developing public health topics.

Flood Resilience Checklist and Examples

<https://www.epa.gov/smartgrowth/flood-resilience-checklist>

Smart Growth Strategies for Disaster Resilience and Recovery - Vermont Example

<https://www.epa.gov/smartgrowth/smart-growth-strategies-disaster-resilience-and-recovery>

Building Resilient Communities through Green Infrastructure

<https://www.epa.gov/green-infrastructure/building-resilient-communities-green-infrastructure-and-hazard-mitigation>

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Sustainable Recovery after a Flood Event - Tribal Success Story

<https://www.epa.gov/land-revitalization/success-story-assisting-spirit-lake-tribe-plan-sustainable-recovery-after>

Flood Debris Mitigation

Flood debris removal how-to - Colorado Example

https://response.epa.gov/site/site_profile.aspx?site_id=8930

Centers for Disease Control and Prevention (CDC)

<https://www.cdc.gov/>

In line with its core mission to “protect America from health, safety and security threats,” the federal CDC offers an extensive and exhaustive variety of resources, tools and training programs to public and environmental health professionals, clinicians, communicators, laboratorians, responders, volunteers and government officials at all levels involved in mapping and updating emergency-preparation and disaster-aftermath models and strategies.

Environmental Health Training in Emergency Response

<https://www.cdc.gov/nceh/ehs/elearn/eheter.htm>

Disaster Epidemiology & Response

<https://www.cdc.gov/nceh/hsb/disaster/default.htm>

Agency for Toxic Substances & Disease Registry (ATSDR)

<https://www.atsdr.cdc.gov/>

ATSDR is the lead for chemical exposure, providing environmental health support to EPA, State and local health authorities, and the public on events involving toxic materials. ATSDR also partners with the **American Association of Poison Control Centers**, <https://aapcc.org>, to provide 24/7 healthcare access support during toxic exposure events. That toll-free number is 1-800-222-1222. Web pages that list chemical toxicological profiles and provide emergency response information for governments and the public include:

Identifying and Profiling Toxic Substances

<https://www.atsdr.cdc.gov/toxprofiledocs/index.html>

Deeply researched, up-to-date and peer-reviewed “Toxicological Profiles” on any given hazardous substance.

Best Case Disaster-Related Medical Response Practices

https://www.atsdr.cdc.gov/emergency_response/importance_disaster_planning.pdf

This document describes the importance of evidence-based disaster planning.

HazMat Emergency Preparedness Training and Tools for Responders

<https://www.atsdr.cdc.gov/hazmat-emergency-preparedness.html>

U.S. Department of Health & Human Services (HHS)

<https://www.hhs.gov>

The HHS—in its mission to “enhance and protect the health and well-being of all Americans”—established the extensive, constantly updated Technical Resources, Assistance Center and Information Exchange (TRACIE) program to meet the disaster-planning info and technical assistance needs of other federal government departments and agencies. The program also supports local, state, and

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regional governments, as well as public and private health-care providers, focused on emergency/disaster medicine, health-care-system preparedness and public health-related emergency-planning efforts.

A Guide to Local Government Disaster Planning

<https://asprtracie.hhs.gov/technical-resources/resource/7120/pre-disaster-recovery-planning-guide-for-local-governments>

The HHS Assistant Secretary for Preparedness and Response (ASPR) division's on-the-ground guide to help local governments develop recovery plans long before a natural disaster hits.

Natural Disaster Technical Resources and more

<https://asprtracie.hhs.gov/technical-resources/18/recovery-planning/16>

The HHS ASPR's Technical Resources Assistance Center and Information Exchange (TRACIE) tied to natural disaster issues from A to Z.

Addressing Disaster-Related Public Health Issues

<https://www.phe.gov/about/pages/default.aspx>

Where to find public health and medical emergency support related to natural and other disasters.

U.S. Department of Housing and Urban Development (HUD)

<https://www.hud.gov>

HUD assists state and local governments as they prepare and plan for disasters. In cooperation with the Federal Emergency Management Agency and the National Disaster Housing Task Force, HUD addresses the temporary, interim, and permanent housing challenges that communities confront in a post-disaster environment. HUD also administers the Community Development Block Grant Disaster Recovery (CDBG-DR) funds that may be appropriated by Congress after the President declares a major disaster. The special appropriation provides funds to the most impacted and distressed areas for disaster relief, long-term recovery, infrastructure restoration, housing, and economic revitalization.

Following a special Congressional appropriation of mitigation-specific recovery funds for states that received CDBG-DR grants for disasters in 2015, 2016, and 2017, HUD also created CDBG-Mitigation (CDBG-MIT) —a new ad hoc disaster grant. While normal federal CDBG funds are dedicated, recurring funds allocated annually to states irrespective of a disaster, CDBG-MIT funds are one-time allocations to states generated at the discretion of Congress, and only after a Presidential disaster declaration.

Community Development Block Grant Program

https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs

How to navigate the requirements of and take advantage of one of the federal government's largest seed-money and pro-growth post-disaster recovery programs.

Confronting Post-Disaster Housing Challenges

https://www.huduser.gov/portal/publications/pre_disasterplanning.html

Where to go in the federal government to get information and help in dealing with temporary, interim and permanent housing challenges in a post-disaster environment.

HUD Disaster-Related Resources

<https://www.hud.gov/hurricane>

News, information, resources, publications and more for individuals, businesses and local and regional governments.

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U.S. Economic Development Administration (EDA)

<https://www.eda.gov>

An agency within the U.S. Department of Commerce, EDA has a long history of successfully supporting disaster recovery and resiliency efforts. EDA's role in disaster recovery is to facilitate the timely and effective delivery of Federal economic development assistance to support long-term community economic recovery planning and project implementation, redevelopment and resiliency. EDA is uniquely positioned to coordinate regional disaster recovery efforts in partnership with its extensive network of Economic Development Districts (EDDs), University Centers, institutions of higher education and other partners in designated impact areas. Some disaster planning and mitigation resources follow:

Notice of Supplemental Disaster Funding for 2019

<https://eda.gov/funding-opportunities/>

Economic Resilience Planning

<https://www.eda.gov/ceds/content/economic-resilience.htm>

EDA and Disaster Recovery

<https://www.eda.gov/disaster-recovery/>

EDA Regional Contacts

<https://www.eda.gov/contact/>

National Oceanic & Atmospheric Administration (NOAA) - National Weather Service (NWS)

<https://www.noaa.gov>

<https://www.weather.gov>

NOAA, along with the NWS, generates leading-edge research and current short- and long-term weather, forecasting and environmental data that federal, state and local governments and agencies can access in designing disaster-resilient infrastructure projects, among other emergency-related preparation and recovery initiatives. NOAA provides several datasets for pre-disaster planning including data on historical weather events, analysis of rainfall statistics for planning and infrastructure design, sea level rise information and elevation control information for the nation. See **Attachment C** for additional NOAA/NWS tools and resources.

Hurricane Preparedness

<https://www.weather.gov/wrn/hurricane-preparedness>

Everything—preparedness, dangers, recovery, meteorology, history and more—that a household, an organization or government body needs to know about hurricanes.

Green Infrastructure Options to Reduce Flooding

<https://coast.noaa.gov/data/docs/digitalcoast/gi-econ.pdf>

Definitions, Tips and Considerations

U.S. Geological Survey (USGS)

<https://www.usgs.gov>

The USGS researches and develops scientific information about naturally occurring hazards such as earthquakes, landslides and volcanoes, as well as the potential impacts of climate- and land-use-related changes, that can be incorporated into governmental and private-sector disaster-planning

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efforts. USGS works closely with NOAA to develop tools for preparing and monitoring major storms and flooding events and in developing tools that assist with recovery efforts.

Emergency Operations Portal

<https://www.usgs.gov/land-resources/hdds>

Flood Inundation Maps

<https://fim.wim.usgs.gov/fim/>

InFRM (Interagency Flood Risk Management)

<https://webapps.usgs.gov/infrm/>

This flood risk monitoring tool was developed by an InFRM team comprised of FEMA, U.S. Army Corps of Engineers, U.S. Geological Survey, and the National Weather Service to help develop measures to reduce long-term flood risks.

Emergency Management Tools

<https://www.usgs.gov/natural-hazards/emergency-management>

Hurricane Information basics

https://www.usgs.gov/centers/lmg-water/science/hurricane-information?qt-science_center_objects=0#qt-science_center_objects

U.S. Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS)

<https://www.usda.gov>

The USDA and its NRCS division offers research, technical guidance and financial assistance tied to emergency preparedness, resource assessment, risk management and disaster recovery and regional resiliency to state and local governments, private-sector enterprises, trade organizations, and individual farmers and ranchers engaged in agricultural and food-production efforts. See **Attachment D** for Emergency Flood Planning information.

USDA Disaster Recovery

<https://www.farmers.gov/recover>

Tropical Storm and Hurricane Information

<https://www.dm.usda.gov/beprepared/hurricane.htm>

Disaster Resource Center

<https://www.usda.gov/topics/disaster>

NRCS Funding Opportunities

<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?&cid=stelprdb1048817>

NRCS Conservation Programs

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/>

U.S. Department of Transportation (DOT)

<https://www.transportation.gov>

The DOT focuses on airspace- and airport-management, road and highway, maritime-navigation and

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HAZMAT issues to support federal, state and local government efforts to develop disaster-preparation plans and recovery strategies.

Best Practices in Emergency Transportation Operations Preparedness and Response

https://ops.fhwa.dot.gov/publications/etopr/best_practices/etopr_best_practices.pdf

Evacuation Publications

https://ops.fhwa.dot.gov/weather/weather_events/hurricanes.htm

DOT and U.S. Government Resources for Hurricanes

<https://www.transportation.gov/2017-hurricanes>

DOT Emergency Preparedness, Response, and Recovery Information

<https://www.transportation.gov/emergency>

U.S. Department of Education (ED)

<https://www.ed.gov>

The U.S. Department of Education works with other federal agencies, such as FEMA and Department of Homeland Security, to ensure continuation of critical services to students, families, and educators during a natural disaster, and to restore the learning environment after a disaster strikes. The ED maintains a toll-free Natural Disaster Hotline, 1-844-348-3243, and a Disaster Distress Helpline, 1-800-985-5990.

<https://www.ed.gov/hurricane>: Hurricane help for students, parents and educators that includes toll-free information numbers and guidance on managing student loans and post-disaster recovery funding options.

U.S. Army Corps of Engineers (USACE)

<https://www.usace.army.mil>

The USACE allots a good share of its public and military engineering services to support FEMA and other federal, state and local government and agency efforts to develop, build and upgrade emergency-resilience projects, including flood damage-reduction initiatives; strengthening utility-infrastructure systems; and assessing ongoing and future risks. In any disaster, Corps of Engineers three top priorities are to support immediate emergency response priorities, sustain lives with critical commodities, temporary emergency power and other needs; and Initiate recovery efforts by assessing and restoring critical infrastructure.

Emergency Operations

<https://www.usace.army.mil/Missions/Emergency-Operations/>

Disaster Impact Models

<https://www.usace.army.mil/Missions/Emergency-Operations/Disaster-Impact-Models/>

U.S. Fish & Wildlife Service (FWS)

<https://www.fws.gov>

The FWS—responsible for managing and protecting federally owned natural, cultural and historic properties and fighting wildfires on public lands—also provides scientific, technical and engineering information and counsel to governments at all levels charged with water-control systems (including dams, levees and purification/delivery facilities) and addressing the impact of oil spills and other hazardous material-related incidents. As part of the FWS' mission of "protecting fish and wildlife

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and their habitats for the continuing benefit of people,” emergency management plays a vital role, providing strategy and support in dealing with planning, preparedness and response to natural and manmade disasters.

Emergency Response Information

<https://www.fws.gov/emergency/>

U.S. Forest Service (FS)

<https://www.fs.fed.us>

In carrying out its mission to “sustain the health, diversity and productivity” of federally controlled forests and grasslands—many abutting communities of all sizes nationwide—the FS, often in tandem with the National Park Service and other federal agencies, continuously works with state and local governments, private-sector organizations and individual citizens to develop and update wildfire risk-mitigation, evacuation and recovery plans. The Forest Service and its federal, tribal, state and local partners also are implementing a National Cohesive Wildland Fire Management Strategy to develop what the FS has termed “Fire Adapted Communities” and more widely draft sophisticated wildfire-response strategies.

All Hazard Site

<https://www.fs.fed.us/managing-land/fire/ibp/all-hazard>

U.S. Department of Interior (DOI)

<https://www.doi.gov>

The mission of the Department of Interior’s Office of Emergency Management is to provide expertise and leadership for the Department’s emergency management responsibilities worldwide through the integration of emergency management programs, functions, and supporting activities to prevent, protect against, mitigate the effects of, respond to, and recover from all hazards. DOI, along with its divisions, including the National Park Service, work in tandem with other federal agencies to prepare for and respond to natural and manmade disasters.

Office of Emergency Management

<https://www.doi.gov/emergency>

General Information

Emergency Management Planning

<https://www.doi.gov/museum/emergency-management>

General Services Administration (GSA)

<https://www.gsa.gov>

As the federal government’s supply-shopping, service-procurement and building-management agent, the GSA oversees pre- and post-disaster elements that affect government functions at all levels, as well as public and private-sector health and welfare entities, including facility and office closings; emergency supply-, service- and equipment-access/purchase procedures and special initiatives; and federal aircraft, motor vehicle and ship deployments. See **Attachment E** for Surplus Equipment Guide.

How to Acquire Surplus Federal Personal Property

<https://www.gsa.gov/buying-selling/government-property-for-sale-or-disposal/personal-property-for-reuse-sale/for-state-agencies-and-public-orgs/how-to-acquire-surplus-federal-personal-property>

State/Regional Resources – Texas Example

Additional resources and tools are included in the Attachment Section of this Toolkit.

Texas Department of Agriculture (TDA)

<https://texasagriculture.gov/>

The Texas Department of Agriculture assists rural communities with disaster relief mitigation and recovery funding. TDA oversees the Community Development Block Grant Program for Rural Texas (TxCDBG), a program that helps develop viable communities by providing decent housing and suitable living environments, and expanding economic opportunities principally for low- to moderate-income residents. Eligible applicants are non-entitlement cities under 50,000 in population and non-entitlement counties that have a non-metropolitan population under 200,000 and that are not eligible for direct CDBG funding from the U.S. Department of Housing and Urban Development.

Community Development Block Grant Program for Rural Texas

[https://texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant\(CDBG\).aspx](https://texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant(CDBG).aspx)

Disaster Relief and Urgent Need Funding

[https://texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant\(CDBG\)/CDBGResources/Applications/DisasterReliefFundApplicationandGuide.aspx](https://texasagriculture.gov/GrantsServices/RuralEconomicDevelopment/RuralCommunityDevelopmentBlockGrant(CDBG)/CDBGResources/Applications/DisasterReliefFundApplicationandGuide.aspx)

Texas General Land Office (GLO)

<http://www.glo.texas.gov>

The Texas General Land Office (GLO) is the state agency designated by the governor to administer all Community Development Block Grant disaster recovery (CDBG-DR) funds allocated to Texas by the U.S. Department of Housing and Urban Development (HUD) following a Presidentially-declared disaster *and* subsequent Congressional appropriation. GLO's Community Development and Revitalization division (GLO-CDR): (1) writes the HUD-required state action plan and any amendments for each respective grant, (2) scores project applications and provides technical assistance to communities, (3) monitors all grant expenditures, and (4) files the required quarterly grant activity reports with HUD.

Following a special Congressional appropriation of mitigation-specific recovery funds for states that received CDBG-DR grants for disasters in 2015, 2016, and 2017, HUD created CDBG-Mitigation (CDBG-MIT)—a new ad hoc disaster grant type related to CDBG-DR grants. While normal federal CDBG funds are dedicated, recurring funds allocated annually to states irrespective of a disaster (in Texas, these funds are administered by the Texas Department of Agriculture), CDBG-DR and CDBG-MIT funds are one-time allocations to states generated at the discretion of Congress, and only after a Presidential disaster declaration. GLO-CDR is currently administering over \$13 billion in disaster recovery funds across Texas for housing, green and grey infrastructure, economic revitalization, and planning projects. Additional information on GLO-CDR can be found at their website: <https://recovery.texas.gov/>

The Texas General Land Office Coastal Resources Division (GLO-CRD) works to restore, enhance, and protect the state's coastal communities and habitats. The GLO Coastal Resources Division has produced the *Texas Coastal Resiliency Master Plan* (Resiliency Plan) to guide the vision for coastal planning for the state. The GLO is in partnership with the U.S. Army Corps of Engineers on the *Coastal Texas Protection and Restoration Feasibility Study* that examines the feasibility of constructing federally funded coastal storm risk management and ecosystem restoration projects along the Texas coast. The division operates the state's Coastal Erosion Planning and Response Act (CEPRA) Program and the federally funded Coastal Management Program (CMP), programs that offer funding

State/Regional Resources – Texas

opportunities to improve management of the state’s coastal zone. The GLO also provides management of the coastal zone through the Beach Access and Dune Protection Program and the Coastal Field Operations offices.

Texas Coastal Resiliency Master Plan

www.glo.texas.gov/crmp

The latest version of a statewide plan to protect and promote what administrators term a “vibrant and resilient Texas coast.”

Texas Coastal Management Program (CMP)

<http://www.glo.texas.gov/coast/grant-projects/cmp/index.html>

The Texas Land Commissioner’s program to monitor the condition of the state’s coastal waters, while protecting natural habitats and wildlife populations.

Coastal Erosion Planning & Response Act (CEPRA)

<http://www.glo.texas.gov/coast/grant-projects/cepra/index.html>

Texas state government’s action plan to mitigate beach depletion, as well as promote and fund replenishment efforts.

Hurricane Preparedness and Planning

<http://www.glo.texas.gov/coast/coastal-management/hurricane-preparedness/index.html>

A clearinghouse for GLO initiatives to pool local, state and federal resources directed at maintaining a resilient Texas coast.

GLO Programs, Tools and Resources

<http://www.glo.texas.gov/coast/coastal-management/tools/>

Round-up of the Texas state government’s initiatives and programs to monitor, protect and improve beach-related resources.

Texas Division of Emergency Management (TDEM)

<https://tdem.texas.gov/>

TDEM coordinates the state emergency management program to ensure that the state and local governments respond to and recover from emergencies and disasters, and implements plans and programs to help prevent or lessen the impact of emergencies and disasters. TDEM administers the FEMA Pre-Disaster Mitigation Program known as Building Resilient Infrastructure and Communities (BRIC) as well as the FEMA Hazard Mitigation Grant Program (see FEMA section on Pages 5–6). In addition, TDEM also develops the State Hazard Mitigation Plan and works with local communities on their Local Hazard Mitigation Action plans, and coordinates the State Hazard Mitigation Team (SHMT). This team, which is comprised of all state agencies involved in mitigation, informs the State Hazard Mitigation Plan. TDEM also provides programs that increase public awareness about threats and hazards, coordinates emergency planning, offers an extensive array of specialized training for emergency responders and local officials, and administers disaster recovery and hazard mitigation programs.

Preparedness Planning and Training

https://tdem.wpengine.com/?page_id=50

The TDEM program to inform and train emergency-preparation and -response managers at all government levels.

State/Regional Resources – Texas

Emergency Preparedness Preparation Checklists

<https://tdem.texas.gov/national-preparedness-month-2019/>

Ground-level review of the basics that go into emergency-preparation planning.

Texas Health & Human Services Commission (HHSC)

During a large scale disaster, HHSC quickly mobilizes to help affected Texans, including posting updates on its website <https://hhs.texas.gov/services/financial/disaster-assistance>. Links are provided to assist clients and providers during and after a disaster.

Post-Disaster Assistance Resources

<http://hhs.texas.gov/doing-business-hhs/provider-portals/long-term-care-providers/resources/regulatory-services-facility-surveyorsliaisons/emergency-preparedness>

Where to find disaster-recovery-related sources of relief and assistance information tied to food, health, shelter and other major issues.

Texas Department of State Health Services (DSHS)

<https://www.dshs.state.tx.us/commprep/welcome.aspx>

DSHS maintains a number of programs dedicated to emergency preparedness and response. Among these is the Center for Health Emergency Preparedness and Response which is dedicated to mitigation, preparedness, response and recovery from natural disasters, terrorist attacks, and other public health emergencies in Texas.

Within DHSE is the Preparedness Grants Management Branch (PGMB) which administers Public Health Emergency Preparedness (PHEP) and Hospital Preparedness Program (HPP) CDC/ASPR Cooperative Agreement. The PGMB maintains a relationship with federal grant sources and local contractors to include local health departments, health service regions, and regional advisory councils and/or other HPP contractors and serves as the foundation for the Community Preparedness Section, tying all three branches together through the work plans created by the PHEP and HPP grants.

Hospital Preparedness Program (HPP)

<https://www.dshs.texas.gov/commprep/hcsp/Hospital-Preparedness-Program.aspx>

Public Health Emergency Preparedness (PHEP)

<https://www.dshs.texas.gov/commprep/phep/program/>

DSHS Emergency Preparedness Tips for Residents

https://www.dshs.texas.gov/preparedness/e-prep_public.shtm

Texas Department of Transportation (TxDOT)

<https://www.txdot.gov>

TxDOT coordinates evacuation and road-condition information prior to and during a disaster. It also administers the Federal Highway Administration's emergency relief program for the repair or reconstruction of federal-aid highways and roads that suffer serious damage as a result of natural disasters.

Evacuation and Road-Condition Information

<http://www.txdot.gov/inside-txdot/division/traffic/safety/weather/hurricane.html>

Central, continuously updated source of storm-preparedness, road-condition and evacuation-related information before, during and after a natural disaster.

State/Regional Resources – Texas

Emergency Relief Resources

<https://www.txdot.gov/government/programs/emergency-relief.html>

Texas Water Development Board (TWDB)

<http://www.twdb.texas.gov/>

The Texas Water Development Board (TWDB) was formed in 1957 in response to Texas' record-breaking drought. Prior to the most recent legislative session, the agency had three main responsibilities: assisting with regional water planning and preparing the state water plan every five years; collecting, analyzing, and distributing water-related and geographic data; and providing loan and grant money for Texas water, wastewater, and flood projects. As a result of the 2019 legislative session, the TWDB was charged with creating the state's first State Flood Plan, to be adopted in 2024, and implementing two new funds, the Flood Infrastructure Fund (FIF) and the Texas Infrastructure Resiliency Fund (TIRF). Over the next year, the agency will expand its existing flood-related programs and establish a clearinghouse of information about state and federal flood planning, mitigation, and control programs that may serve as sources of funding for flood projects.

TWDB offers two main Flood Mitigation Assistance (FMA) programs and Flood Protection (FP) Grant Program. FMA is funded by FEMA but administered through the TWDB. FMA can assist with home elevations, buyouts, demolitions, and dry flood proofing. FP helps entities obtain funding for watershed studies, flood response plans, and flood early warning systems, such as rain gauges.

Flood Legislation from the 86th Texas Legislative Session Frequently Asked Questions

<https://www.twdb.texas.gov/flood/>

Texas Water Development Board General Information

<http://www.twdb.texas.gov/publications/shells/1pagers.asp>

Flood Assessment

<https://www.dshs.texas.gov/commprep/phep/program/>

Flood Preparedness (For Residents)

TexasFlood.org / <http://www.twdb.texas.gov/flood/prep/>

Texas Commission on Environmental Quality (TCEQ)

<https://www.tceq.texas.gov>

In addition to overseeing and protecting the quality of the state's environmental resources, the TCEQ prepares for and responds to natural disasters, spills and other environmental emergencies and situations. The TCEQ also provides hurricane preparedness tips, tools and resources, which are updated during storms and administers the new FEMA High Hazard Dams Program, <https://www.fema.gov/rehabilitation-high-hazard-potential-dam-grant-program>.

Pre-Disaster Tips for Securing Public Water Supplies

https://www.tceq.texas.gov/drinkingwater/homeland_security/disasterprep/disasterprep.html

Interruption-prevention procedures for safeguarding public water systems across Texas.

Hurricane Preparedness and Response

<https://www.tceq.texas.gov/response>

State/Regional Resources – Texas

Texas A&M AgriLife Extension Service

Agrilifeextension.tamu.edu

The Texas A&M AgriLife Extension Service provides educational programs, tools, and resources on a local and statewide level. With 250 county offices in all 254 counties, Extension Agents serve families, youth, communities, and businesses throughout the state. Programs provide objective, practical, and science-based information through the application of research-backed knowledge that teaches people how to advance health practices, protect the environment, strengthen communities, and enrich youth. As a result of the 2019 legislative session, Extension is developing its Disaster Assessment and Recovery Team to build new organizational capacities. Staff works with communities on pre-disaster activities to build local capacity for resilience, planning, green infrastructure, and economic development. Post-disaster, AgriLife Extension operates animal supply points, assists with animal sheltering, supports Texas Division of Emergency Management (TDEM) with surveying and assessing damage, and participates at the State Operations Center.

AgriLife Extension Disaster Education Network

texashelp.tamu.edu

CHARM (Community Health And Resource Management)

<https://tcwp.tamu.edu/charm>

Charm is a new user-friendly mapping tool that enables everyday citizens and local officials to create planning scenarios that are complex and dynamic with results that are instantaneous in terms of a variety of impacts.

Disaster Readiness Program

<https://agrillife.org/exceptional-item/disaster-readiness-and-recovery-for-texas/>

Texas Association of Regional Councils

<https://txregionalcouncil.org>

The Texas Association of Regional Councils assists state and federal partners by coordinating and improving regional homeland security preparedness, planning and response activities across jurisdictional boundaries. The regional councils support disaster recovery by partnering with state agencies and local governments and work cooperatively and collaboratively with the Office of the Governor's Homeland Security Grants Division to obtain program and project funding for regional and local projects. Regional councils work with the Texas Division of Emergency Management during disasters and to ensure that all regional and local emergency plans are up-to-date and compliant the Texas Government Code. Using preparingtexas.org, regional councils accurately track first-time and continuing education programs for emergency responders and the general public. Regional councils also manage regional Citizen Corps Councils and Citizen Corps programs, which allow community members from across the state to engage in public safety-based volunteer activities. See links to these and other resources:

<https://txregionalcouncil.org/regional-programs/emergency-preparedness/>

<https://txregionalcouncil.org/regional-programs/emergency-preparedness/regional-disaster-recovery/>

<https://www.nctcog.org/ep/mitigation>

<https://hotcog.org/regional-services/emergency-preparedness-program/>

State/Regional Resources – Texas

Texas Facilities Commission (TFC) – Federal Surplus Property Program

<http://tfc.state.tx.us/FSP>

The Texas Facilities Commission (TFC) is the state agency responsible for surplus property administration for the State of Texas. TFC's Federal Surplus Property Program enables qualified organizations involved in emergency management, such as state agencies, local governments, volunteer fire/EMS/SAR, special purpose districts, Councils of Government, and certain nonprofits to save money in acquiring the equipment necessary to prepare for and respond to emergencies. Businesses certified by the SBA's 8(a) Business Development Program are also eligible to participate. The program is also set to expand to Veteran Owned Small Businesses in late 2020. Examples of property that may be available include rescue/fire trucks, bulldozers, forklifts, boats, trailers, generators, storage containers, command trailers, tools, etc. As an added benefit, the property obtained from the Federal Surplus Program may be used as a "match" toward certain grants. Additional information about the match grant criteria can be found on the sites below.

For full description of the Surplus Property Program, email or call:

federal.surplus@tfc.state.tx.us / (512) 463-2688

Texas Parks and Wildlife Department (TPWD)

<https://tpwd.texas.gov>

TPWD encompasses more than 268,000 acres of Texas, 1200 miles of international border, and 600 miles of coastline. TPWD coordinates with other state agencies as well as local governments to serve the residents of Texas during and following disasters. TPWD has land, sea and air assets that have been called into service in fighting wildfire and conducting search and rescue operations, both on land (high angle rescue) and during floods (swift water and airboat strike teams). TPWD stands ready to assist and partner with communities before, during and after disasters of all types and sizes.

Texas A&M Forestry Service

Wildfire Protection Management

<https://tfsweb.tamu.edu/>

Texas A&M has developed a wide array of info portals, research databanks and sophisticated action plans that government officials, hazard-mitigation planners and wildland fire professionals can tap in generating risk-summary reports and disaster-prevention strategies.

Regional/Local Jurisdictions

At-a-Glance Preparedness Checklist

Having a plan and a resilient infrastructure in place is critical to mitigating damage caused by natural disasters of all types. The following is a brief checklist of ways local and regional authorities can prepare for flooding caused by hurricanes and other major storm and watershed events.

- Develop and/or update a comprehensive flood management plan for your city, county, or region. As part of the plan, consult with FEMA on the best available data pertaining to flood risk. See sample Flood Management Plan **Attachment F**.
- Visit the EPA's Flood Resilience Checklist for ideas: <https://www.epa.gov/smartgrowth/flood-resilience-checklist>
- As part of the pre-disaster planning process, conduct an inventory of resources available to assist your community or region in the event of a flood or other natural disaster. Make sure vulnerable populations such as elderly and disabled individuals and those with chronic illnesses are included in the assessment. (See relevant Federal resources throughout this Toolkit and its Attachment Section.)
- Regularly maintain and clear debris from drainage areas, including ditches, storm drains, and grassy common areas.
- Develop clear lines of communication with state and federal agencies to ensure that thoroughly coordinated information prior to, during and following a hurricane or other major flooding event occurs.
- Develop a communication plan that will engage the largest number of residents during a flood event - as it is unfolding - to ensure that the most up-to-date information reaches the most residents (e.g., social media updates).
- Develop a list of contacts that can be quickly accessed in case of an emergency. (See the Local/Regional Jurisdiction Preparedness Resource Contact List Template in **Attachment A**.)
- Make sure that residents know what to do before, during or after a natural disaster. Consider developing consumer educational campaigns to address debris clean up, pollution prevent and pre-disaster awareness. [See Resident & Business Section for ideas and a Checklist.]
- Identify the federal and state agencies that can provide loans, grants and other funding assistance for preparedness efforts and post-disaster recovery. Also find out which agencies and organizations, including universities, can provide grant-writing assistance.
- Become familiar with the tips, tools and resources described throughout this Toolkit.

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Pre-Disaster Planning for Residents & Businesses

Pre-Disaster Planning for Residents & Businesses

Following are resources, tips and tools geared to help community residents and businesses prepare for and recover from flooding events and other natural disasters. Additional information about each agency listed can be found in the State/Regional Jurisdiction section of this toolkit or by visiting each agency's general website. ***An At-a-Glance Flood Event Checklist for Residents can be found on page 25.***

Federal Resources

Federal Emergency Management Agency (FEMA)

In addition to the mitigation and disaster relief resources provided to state and local governments, FEMA provides the following pre-disaster resources to residents. General information: **www.fema.gov**.

<https://www.fema.gov/disaster/4339/emergency-preparedness>

A common-sense, step-by-step guide to help individuals, households and businesses prepare for natural disasters and what to do when and after they strike.

<https://www.fema.gov/preparedness-checklists-toolkits>

Comprehensive checklists that simplify individuals', households' and businesses' task of preparing for natural disasters.

<https://www.fema.gov/media-library/assets/documents/90354>

A complement to <https://www.fema.gov/preparedness-checklists-toolkits> that lists the supplies families need to prepare for natural disasters.

https://www.fema.gov/pdf/areyouready/areyouready_full.pdf

"Are You Ready? An In-Depth Guide to Citizen Preparedness": A compact booklet that covers emergency-preparedness basics for governments, organizations and citizens; where to go for disaster-preparation and -recovery guidance and assistance; and a "Who's Who" of private and government operations involved in every aspect of planning and recovery.

Department of Homeland Security

General Information: **www.dhs.gov**

<https://www.ready.gov/>

A user-friendly array of community emergency preparedness and recovery tips and resources for a variety of natural disasters, including floods.

U.S. Environmental Protection Agency (EPA)

General information: **www.epa.gov**

<https://www.epa.gov/natural-disasters/general-information-disasters>

A Step-by-Step Guide for preparing for and recovering natural disasters.

<https://www.epa.gov/natural-disasters/hurricanes>

How to prepare for hurricanes and recover from resulting damage.

Pre-Disaster Planning for Residents & Businesses

U.S. Health & Human Services (HHS)

General Information: www.hhs.gov

See *Attachment G – A Human Service Leader’s Quick Guide to Disaster Response & Recovery, a Comprehensive Checklist of Resources for Residents.*

<https://www.hhs.gov/civil-rights/for-individuals/special-topics/emergency-preparedness/index.html>

Emergency preparedness guidance for at-risk individuals and those who care for them.

Centers for Disease Control and Prevention

General information: www.cdc.gov

<https://www.cdc.gov/disasters/>

Emergency Action Plans for all age, demographic, special-needs and other groups of individuals on the health issues tied to disaster planning and preparedness, including common-sense info on how to stay healthy, informed and in contact during and after an emergency.

<https://www.cdc.gov/cpr/prepareyourhealth/PlanAhead.htm>

Plan Ahead. A guide to preparing for natural disasters from a health perspective.

U.S. Department of Housing and Urban Development (HUD)

General Information: www.hud.gov

<https://www.hud.gov/hurricane>

News, information, resources and publications on hurricane preparedness and disaster recovery assistance for citizens, including homeowners, and partners.

National Oceanic & Atmospheric Administration (NOAA) - National Weather Service

General information: www.noaa.gov

<https://www.nhc.noaa.gov/prepare/ready.php>

A comprehensive guide to preparing for and recovering from hurricanes and flooding events.

U.S. Geological Survey (USGS)

General Information: www.usgs.gov

<https://usgs.gov/water-onthego/>

A U.S Geological Survey app that lets users locate stream gauges and water conditions near them.

U.S. Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS)

General Information: www.usda.gov

<https://www.farmers.gov/recover>

A guide to help farmers, ranchers and other residents prepare for hurricanes and other natural emergencies.

Pre-Disaster Planning for Residents & Businesses

<https://www.dm.usda.gov/beprepared/hurricane.htm>

Hurricane monitoring and advice center.

U.S. Department of Education (ED)

General Information: www.ed.gov

Toll-free Natural Disaster Hotline, 1-844-348-3243; Disaster Distress Helpline, 1-800-985-5990.

<https://www.ed.gov/hurricane>

Hurricane help for students, parents and educators that includes toll-free information numbers and guidance on managing student loans.

Small Business Administration

General Information: www.sbg.gov

<https://www.sba.gov/node/4633>

Emergency Preparedness resources to help small businesses develop a plan to protect employees, lessen the financial impact of disasters, and re-open their businesses quickly to support economic recovery in the community.

<https://www.sba.gov/business-guide/manage-your-business/prepare-emergencies>

A guide to help small businesses prepare for emergencies.

General Services Administration (GSA)

General Information: www.gsa.gov

<https://www.gsa.gov/buying-selling/government-property-for-sale-or-disposal/personal-property-for-reuse-sale/for-state-agencies-and-public-orgs/how-to-acquire-surplus-federal-personal-property>

Qualifying community nonprofit organizations may be able to acquire federal government surplus property. This guide explains eligibility requirements. See **Attachment E** for the GSA Surplus Equipment Guide.

State and Regional Resources – Texas Examples

Texas General Land Office (GLO)

General Information: www.glo.texas.gov

<https://recovery.texas.gov/preparedness/index.html>

A comprehensive site for natural disaster preparedness for residents that includes links to other federal and state agency emergency preparedness sites.

Texas Division of Emergency Management (TDEM)

General Information: <https://tdem.texas.gov/>

<https://tdem.texas.gov/national-preparedness-month-2019/>

Emergency Preparedness Preparation Checklists. A ground-level review of the basics that go into emergency-preparation planning.

Pre-Disaster Planning for Residents & Businesses

Texas Department of State Health Services (DSHS)

General Information: www.dshs.state.tx.us

https://www.dshs.state.tx.us/preparedness/e-prep_public.shtm

Emergency Preparedness: Disasters can strike at any time. Is your family prepared? A site devoted to tips, plans and resources to help families plan ahead.

Texas Department of Transportation (TxDOT)

General Information: www.txdot.gov

<http://www.txdot.gov/inside-txdot/division/traffic/safety/weather/hurricane.html>

Evacuation and Road-Condition Information. A central, continuously updated source of storm-preparedness, road-condition and evacuation-related information before, during and after a natural disaster.

Texas Water Development Board (TWDB)

General Information: www.twdb.texas.gov

[TexasFlood.org](http://www.twdb.texas.gov/flood/prep/) / <http://www.twdb.texas.gov/flood/prep/>

Flood preparedness guidance for residents.

Texas Commission on Environmental Quality (TCEQ)

General Information: www.tceq.texas.gov

<https://www.tceq.texas.gov/response/hurricanes>

Hurricane preparedness, a regularly updated site to help residents prepare for, endure and recover from hurricanes.

Texas Facilities Commission (TFC) – Federal Surplus Property Program

<http://tfc.state.tx.us/FSP>

The Texas Facilities Commission (TFC) is the state agency responsible for surplus property administration for the State of Texas. TFC's Federal Surplus Property Program enables qualified organizations, including businesses certified by the SBA's 8(a) Business Development Program, to obtain surplus equipment for a fraction of their original value. The property offered by the program includes vehicles, furniture, and equipment (e.g., trailers, generators, forklifts, etc.) that can help prepare for or recover from a disaster. The program also is set to expand to Veteran-Owned Small Businesses in late 2020. The program is not open to residents for personal use.

For full details, including how to qualify to receive federal surplus property, email or call federal.surplus@tfc.state.tx.us / (512) 463-2688.

Texas A&M AgriLife

CHARM (Community Health And Resource Management)

<https://tcwp.tamu.edu/charm/>

Charm is a new user-friendly mapping tool that enables everyday citizens and local officials to create planning scenarios that are complex and dynamic with results that are instantaneous in terms of a variety of impacts.

At-a-Glance Flood Event Checklist for Residents

LONGER-TERM PLANNING

- Know your area's risk of hurricanes and floods. Sign up for your local community's warning system.
- Practice going to a safe shelter. Or know where local storm shelters are.
- Know your family's plans for emergency evacuation. Plan a meeting place. Take smartphone photos of emergency evacuation routes.
- Maintain your yard. Clear leaves and other debris that can cause water to pool.
- Check local neighborhood storm drains. Regularly clean leaves and debris from storm drain grates to minimize flooding.
- Stock up on flashlights and a battery-operated weather radio. Store batteries for each.
- Buy a cellphone charger adaptor. Place this in your vehicle.
- Keep important contact information handy. Make sure this list is on your cellphone and computer.
- Store important items in portable waterproof containers. Include documents like passports, Social Security cards, deeds, family photos, etc. Better yet, consider off-site storage.
- Keep a stocked first-aid kit handy. Include pain relievers, multiple sizes of bandages, antibiotic creams, gauze, hand sanitizer, latex gloves, an emergency blanket, thermometer, tweezers, essential oils, bug spray, etc. Check expiration dates of perishable items yearly.
- Don't forget your pets. Make sure they have tags or chips so that they can be readily identified should they get loose during a flooding event.
- Know what resources are available. Review the resources available in the Resident/Business section of this toolkit.

STORM WATCH PLANNING

- Tune into local radio or TV stations, or NOAA radio. Tune into the latest information about the path and potential impact of the storm. Know your connections and stations ahead of time and plan on ample battery service for updates during a storm.
- If local officials say to evacuate, do so! Heed these alerts and don't try to ride out the storm.
- Stock up on nonperishable food, water, and medicine—especially prescriptions. Have supplies for at least one week for all family members and pets. Fill plastic bottles or large containers with water (gallon jugs, etc.) Plan one gallon per person per day for a minimum of one week. For imminent storms purchase bread, cheeses, nut butters, crackers, spaghetti (if gas grill available), toiletries, and other non-perishables.

At-a-Glance Flood Event Checklist for Residents

- Fill your car with gas. Avoid long lines during an evacuation and prepare an extra gas container for your trunk.
- Have cash available. ATMs may not be functioning due to power outages.
- Flashlights. Use them over candles which can start a fire. Have plenty of batteries. (See above).
- Keep important documents handy in case of an evacuation. (See previous page.)
- Know where your first-aid kit is located. (See previous page.)
- Charge your phone. And keep it on low-battery mode. Download screenshots of maps of evacuation routes and important contact information to save battery life. (See above.)

HURRICANE OR FLOOD WARNING PREPAREDNESS

- If local officials say to evacuate, do so! Heed these alerts and don't try to ride out the storm.
- Prepare your house. Board up windows, use sandbags as advised, unplug electronics. Turn freezer and refrigerator to coldest settings and open only when necessary so items remain cold during power outage.
- Find shelter right away.
- Fill bathtubs with water for washing, if storm is imminent.
- No generators in the home. Place them outside.
- Turn Around! Don't Drown! Do not walk, swim, or drive through flood waters. Six inches of fast-moving water can knock you down, and one foot of moving water can sweep your vehicle away.
- Secure outdoor objects. Bring inside loose, lightweight objects that could become projectiles, like lawn furniture, garbage cans, etc. Tie down/secure propane tanks, which can become major hazards if they float away.
- Avoid standing water and floodwater. Floodwater can carry disease, be contaminated with sewage, or hide dangerous objects. Standing water increases mosquito-borne West Nile Virus risk.
- Don't use tap water. Tap water can become contaminated and no longer safe. In severe thunderstorms, the CDC also recommends avoiding being near plumbing to avoid being struck by lightning.
- Document the damage. Take photographs for insurance coverage assistance. Check the list of post-disaster resources and tools available in the Resident/Business section of this toolkit.

(Sources: ready.gov/hurricanes, CNN.com and weather.com)

Other Resources

The Salvation Army

Impact of Hurricanes Harvey, Irma & Maria report.

https://s3.amazonaws.com/usn-cache.salvationarmy.org/1db7f7a7-a19a-478f-9cb1-df5fc3c7d186_SAL_hurricane_anniversary_booklet_9_10_18.pdf

AmeriCares

Provides assistance in disaster relief and recovery.

<https://www.americares.org/en/what-we-do/emergency-programs/united-states-disasters/>

All Hands and Hearts

Information about Texas Hurricane Harvey Relief efforts through 2020.

<https://www.allhandsandhearts.org/programs/texas-hurricane-relief/>

SBP, originally St. Bernard Parish, was founded to assist in the rebuilding of that New Orleans parish, which was decimated by Hurricane Katrina. SBP provides resources nationally.

“Disaster Preparedness at Home”

https://sbpusa.org/public/uploads/pdfs/SBP_HomeResourceGuide_En.pdf

This guide provides short, interactive courses with the critical information you need to know and the practical steps you can take to better protect your home before disaster and maximize resources for recovery after disaster.

<https://sbpusa.org/index.php?p=elearning>

Disaster Management Software

A guide to software that can assist in the planning and management of volunteer preparation, response, recovery, and seamless communication through all phases of disaster. Users will need to create a user name and password to access.

<https://www.galaxydigital.com/disaster-management-software/>

Cajun Navy Relief

Mission is to provide immediate rescue and relief during a natural disaster, by integrating civilian volunteers into the Incident Command Structure.

<https://www.cajunnavyrelief.com/about-us-2/>

OneStar Foundation

Coordinates efforts with Texas Volunteer Organizations Active in Disasters (VOADs), faith-based and other organizations to provide assistance with recovery and mitigation efforts. Many VOADs also administer recovery grants.

<http://onestarfoundation.org/>

<http://onestarfoundation.org/disaster-services/disaster-network-partnerships/>

Resources compiled by the Community Planning and Capacity Building (CPCB) team following Hurricane Harvey

1. Community Visioning, Identity and Engagement

- a. Broadening Public Participation Using Online Engagement Tools
https://www.ca-ilg.org/sites/main/files/file-attachments/broadening_participation_via_online_tools_final_draft_1.pdf
- b. Effective Coordination of Recovery for State, Tribal, Territorial and Local Incidents
<https://www.fema.gov/media-library-data/1423604728233-1d76a43cabf1209678054c0828bbe8b8/EffectiveCoordinationofRecoveryResourcesGuide020515vFNL.pdf>
- c. Effective Disaster Management Strategies in the 21st Century
<https://www.govtech.com/em/disaster/Effective-Disaster-Management-Strategies.html>
- d. Post-Disaster Recovery Public Engagement
<https://planning-org-uploaded-media.s3.amazonaws.com/document/post-disaster-paper-1-public-engagement.pdf>
- e. Post-Disaster Recovery Visioning
https://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/research/postdisaster/briefingpapers/pdf/visioning.pdf
- f. International Development Council Public-Private Partnership Toolkit
<https://www.iedconline.org/web-pages/conferences-events/2017-disaster-preparedness-recovery-series/>
- g. Tips for Competently Engaging Culturally Diverse Communities
https://www.fema.gov/media-library-data/1530637792835-761c6cf60366bf4162023ff05f86b37b/FEMA_Tip_Sheet_Creating_an_Engagement_Plan.pdf
- h. What is Public Engagement? And How to Do It.
<https://www.ca-ilg.org/document/what-public-engagement>

2. Funding and Grants

- a. HUD Community Development Block Grant Fact Sheet
<https://files.hudexchange.info/resources/documents/CDBG-DR-Fact-Sheet.pdf>
- b. Federal Disaster Recovery Funding - Minimizing Roadblocks to Maximize Resources
<https://www.hudexchange.info/resource/3090/federal-disaster-recovery-funding-minimizing-roadblocks-maximize-resources/>
- c. Financial Planning for Natural Disasters - A Workbook for Local Governments and Regions
<https://www.fema.gov/media-library/assets/documents/136778>
- d. Listing of Disaster Recovery Funding Resources - FEMA
<https://www.fema.gov/media-library-data/1474548130660-db3c22abcc037416428fe7db69d45926/FundingResources.pdf>
- e. Planning for Post-Disaster Financial Recovery
<https://www.fema.gov/media-library/assets/documents/166800>
- f. Select Funding and Technical Assistance to Support Disaster Local Planning and Management
https://www.fema.gov/media-library-data/1509385208762-6c6f9bb3a648fa755d4cca12f8a928df/PartnerProgramsandFunding_GuidanceforLocalGovtments.pdf

3. Lessons Learned

- a. At the Crossroads of Long-Term Recovery in Joplin, MO, six months after the May 22, 2011 Tornado
<https://academiccommons.columbia.edu/doi/10.7916/D8TB1G94>
- b. Disaster Recovery Public Information Partnership Joplin & Duquesne
<http://www.joplinproud.com/wp-content/uploads/2016/06/Joplin-Public-Information-Partnership-Expedited-Debris-.pdf>
- c. EPA technical assistance, Joplin, MO: Green Streets - EPA
https://www.epaosc.org/sites/7989/files/1.%20Joplin_Final_Report_093013.pdf
- d. Improving Disaster Recovery—Lessons learned in the United States
https://www.mckinsey.com/-/media/mckinsey/business%20functions/risk/our%20insights/improving%20disaster%20recovery/improving_disaster_recovery_280615_final.ashx
- e. Incorporating Green Infrastructure and Low-Impact Development into the Ashland Hazard Mitigation Plan - EPA
https://www.epa.gov/sites/production/files/2019-04/documents/472595_fema_epa_report_final_-_508.pdf
- f. Lessons in Recovery—Case Study on Recovering Through Partnerships - FEMA
<https://www.fema.gov/media-library-data/1455829901865-c233a52d60d41a9311e1584afa657947/CPCBArkansasCaseStudy.pdf>
- g. Planning for Flood Recovery and Long-term Resilience in Vermont - EPA
<https://www.epa.gov/sites/production/files/2014-07/documents/vermont-sgia-final-report.pdf>

4. Mitigation, Sustainability and Resiliency

- a. Achieving Hazard-Resilient Coastal & Waterfront Smart Growth - EPA
<https://www.epa.gov/smartgrowth/achieving-hazard-resilient-coastal-waterfront-smart-growth>
- b. Brazoria County Adopts Freeboard Regulation in Combating Flood Loss - FEMA
https://www.fema.gov/media-library-data/1441822561672-254e32a71d6e179b8d32ecfbbb1358d4/08-Brazoria-County-Adopts-Freeboard-Regulation-in-Combating-Flood-Loss_web.pdf
- c. Building Community Resilience by Integrating Hazard Mitigation Planning - FEMA
<https://www.fema.gov/media-library-data/20130726-1908-25045-9918/factsheet1.pdf>
- d. Collaborative Community Resilience - Multi-Jurisdictional Hazard Mitigation Planning - FEMA
<https://www.fema.gov/pt-br/media-library/assets/documents/108609>
- e. Community Solutions for Stormwater Management - A Guide for Voluntary Long-Term Planning - EPA
https://19january2017snapshot.epa.gov/green-infrastructure/community-solutions-stormwater-management-guide-voluntary-long-term-planning_.html
- f. Designing for Impact - A Regional Guide to Low-Impact Development - Houston/Galveston Area Council, Texas
<http://www.h-gac.com/low-impact-development/designing-for-impact.aspx>
- g. Enhancing Sustainable Communities with Green Infrastructure - EPA
<https://www.epa.gov/sites/production/files/2014-10/documents/green-infrastructure.pdf>
- h. EPA Flood Resilience Checklist
<https://www.epa.gov/sites/production/files/2014-07/documents/flood-resilience-checklist.pdf>
- i. Hazard Mitigation—Integrating Best Practices into Planning Guide
<https://www.planning.org/publications/report/9026884/>

Other Resources

- j. Hurricane Ike—Planning for a Sustainable Coast – FEMA Mitigation Assessment Team
https://www.fema.gov/media-library-data/20130726-1644-20490-3272/hurricane_ike_ras_09rev.pdf
- k. Integrating Hazard Mitigation into Local Planning—Case Studies and Tools for Community Officials – FEMA
<https://www.fema.gov/media-library/assets/documents/31372>
- l. Planning for Post-Disaster Recovery Hazard Mitigation Briefing Papers
<https://www.planning.org/research/postdisaster/>
- m. Planning Framework for a Climate-Resilient Economy –EPA
<https://www.epa.gov/sites/production/files/2016-05/documents/planning-framework-climate-resilient-economy-508.pdf>

5. Recovery Planning

- a. Federal Resources for Sustainable Rural Communities -EPA
<https://www.epa.gov/smartgrowth/federal-resources-sustainable-rural-communities>
- b. Joplin, MO, Disaster and Economic Recovery and Resiliency Strategy
<https://joplincdbg.com/DocumentCenter/View/42/2014-Economic-ZRecovery-Strategy-PDF>
- c. Lessons from the Storm - Case Studies on Economic Recovery and Resilience
<https://www.nado.org/lessons-from-the-storm-case-studies-on-economic-recovery-and-resilience/>
- d. National Disaster Recovery Framework – FEMA
<https://www.fema.gov/national-disaster-recovery-framework>
- e. Planning for Post-Disaster Recovery - Measuring Success in Recovery
https://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/research/postdisaster/briefingpapers/pdf/measuringprogress.pdf
- f. Planning for Post-Disaster Recovery - Next Generation - FEMA
<https://www.fema.gov/media-library/assets/documents/103445>
- g. Pre-Disaster Recovery Planning Guide for Local Governments - FEMA
<https://www.fema.gov/media-library-data/1487096102974-e33c774e3170bebd5846ab8dc9b61504/PreDisasterRecoveryPlanningGuideforLocalGovernmentsFinal50820170203.pdf>
- h. Six Perspectives on How Communities Can Recover After a Disaster
<https://icma.org/blog-posts/6-perspectives-how-communities-can-recover-after-disaster>
- i. Smart Growth Self-Assessment for Rural Communities
https://www.epa.gov/sites/production/files/2015-12/documents/rural_self_assessment_121815.pdf
- j. Successful Disaster Recovery Community Capitals Framework
<https://www.ag.ndsu.edu/publications/disasters/successful-disaster-recovery-using-the-community-capitals-framework>

6. Targeted Areas of Recovery

- a. Disaster Recovery - HUD Approaches to Inclusive Recovery
<https://www.hudexchange.info/homelessness-assistance/disaster-recovery-homelessness-toolkit/recovery-guide/>
- b. Disaster Recovery - HUD Recovery Resources
<https://www.hud.gov/info/disasterresources>
- c. Enhancing Emergency Preparedness for Natural Disasters—Actions to Prepare
https://www.npc.org/reports/NPC_EmPrep_Report_2014-12-18.pdf
- d. Healthy, Resilient and Sustainable Communities after Disasters (National Academies Press)
<https://www.ncbi.nlm.nih.gov/books/NBK316532/>
- e. Incorporating Resilience into Critical Infrastructure Projects - DHS
<https://www.dhs.gov/sites/default/files/publications/NIPP-2013-Supplement-Incorporating-Resilience-into-CI-Projects-508.pdf>
- f. Leadership in Times of Crisis—A Toolkit for Economic Recovery and Resiliency
<https://restoreyoureconomy.org/index.php?src=blog&srctype=detail&refno=228&category=Business%20Continuity>
- g. Planning Resilient Infrastructure
https://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/research/postdisaster/briefingpapers/pdf/infrastructure.pdf
- h. Practical Advice for Transitioning to Recovery
<https://www.iedonline.org/clientuploads/Downloads/Recovery/Practical-Advice-for-Transitioning-to-Recovery.pdf>

7. Watershed Planning and Floodplain Management

- a. A Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction
<https://coast.noaa.gov/data/docs/digitalcoast/gi-cost-benefit.pdf>
- b. Building Effective State Floodplain Management Programs
<https://www.floods.org/index.asp?menuID=683&firstlevelmenuID=185&siteID=1>
- c. Developing Watershed Plans to Restore and Protect Our Waters
https://www.epa.gov/sites/production/files/2015-12/documents/watershed_mgmnt_quick_guide.pdf
- d. Zoning Practice—Flood Water Resiliency
<https://www.planning.org/publications/document/9006917/>

Acknowledgements

The **Urban Waters Partnership** reconnects urban communities—especially those that are overburdened or economically distressed—with their waterways by improving coordination among federal agencies. The Partnership also collaborates with community-led revitalization efforts to improve the nation’s water systems and promote its economic, environmental and social benefits. The Urban Waters model, which fosters collaboration among 14 federal agencies, as well as state, local and non-governmental partners, was instrumental in assisting regions throughout Texas with their flood management planning processes and in the subsequent development of this Pre-Disaster Toolkit for Small- to Medium-Size Communities. The Urban Waters Partners team, led by U.S. Environmental Protection Agency – EPA Region 6, wishes to thank the following local, state and federal agencies and organizations for their assistance with the flood management planning workshops and in the preparation of this Toolkit:

Local/Regional Texas Partners: Local officials with Aransas, Cameron, Jasper, Jefferson, Hardin, Orange Polk and Refugio counties, and Capital Area Council of Governments (CapCOG); Austin, Fulton, Harlingen, Lumberton, Pine Forest, Rockport, and San Benito; and Angelina & Neches River Authority, Sabine River Authority, and Lower Colorado River Authority.

Texas State-Wide Partners: Texas Division of Emergency Management, Texas General Land Office, Texas Water Development Board, Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, Texas A&M and Texas A&M AgriLife, Texas Facilities Commission, and Texas Department of State Health Services.

Federal Partners: Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and the U.S. Department of Health and Human Services.

Attachments

This section includes PDFs of additional information and resources for pre-disaster preparedness and post-disaster recovery. Click on each index item to access resources and tools.

ATTACHMENT A

Local/Regional Jurisdiction Disaster Preparedness Contacts Template

ATTACHMENT B

- a. FEMA Base Level Engineering (BLE) Fact Sheet
- b. FEMA BLE Estimated Base Flood Level Viewer Fact Sheet

ATTACHMENT C

- a. National Weather Service Flood Inundation Information
- b. NOAA Data Set Information

ATTACHMENT D

USDA Flood Plain Easements Fact Sheet

ATTACHMENT E

GSA Surplus Equipment Guide

ATTACHMENT F

- a. Sample Flood Management Plan - Feather River, CA
- b. Flood Management Plan Outline

ATTACHMENT G

A Human Service Leader's Quick Guide to Disaster Response & Recovery: Current Key Resources for Human Service Providers, Emergency Managers, & Residents

ATTACHMENT H

Coastal Hazards Center Community Recovery Checklist

BASE LEVEL ENGINEERING

Flood data to expand
local risk awareness



WHAT IS BASE LEVEL ENGINEERING?

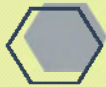
Base Level Engineering produces quality data. The Base Level Engineering production approach combines high-resolution ground elevation data, and modeling technology advancements to create engineering models and flood hazard data. These analyses are produced at a large scale, like a watershed, as opposed to targeting individual stream reaches. The flood hazard information prepared is based off engineering models that determine flood elevations along each stream reach studied. The data prepared provides flood hazard information to community officials and allows them to interact with analysis results and review areas identified as prone to flooding.

Base Level Engineering increases public awareness. Producing and sharing this data provides FEMA an opportunity to broaden and expand risk awareness conversations with local communities, ultimately strengthening disaster resilience, and reducing public spending on recovery efforts after a flood event. The Estimated Base Flood Elevation Viewer, an interactive web portal, allows Federal, State, Regional, local entities; industry professionals; and the public at large to interact with the Base Level Engineering results. This tool increases FEMA's ability to present comprehensive flood hazard information to the public, providing additional risk assessment resources where there are currently gaps in the current national flood hazard data inventory.

Base Level Engineering will lead to flood risk reduction. Communities can access and use data prior to updates to their regulatory Flood Insurance Rate Maps (FIRMs). Once a Base Level Engineering assessment is completed, FEMA releases the flood risk information on the Estimated Base Flood Elevation Viewer (www.infrm.us/estBFE), providing flood risk information that may be immediately used for community floodplain management activities, local land use discussions, all-hazard mitigation planning, and identification of mitigation strategies, as well as providing a basis for more informed community development. The datasets may be used to inform future land use decisions, support grant submissions, generate flood vulnerability assessments, prioritize flood risk reduction projects, evaluate; design and prioritize capital improvement projects. The approach ultimately will allow FEMA to build a more robust network of flood risk information, an expedited process to update regulatory products and enable future expansion to risk-based analysis and future risk scenario modeling opportunities.



Base Level Engineering is collaborative. FEMA worked with Federal, State, Regional and Local entities to develop the Base Level Engineering concept. FEMA has interacted with a variety of State and local officials to further refine the concept, and inform the identification of flood risk datasets prepared. Base Level Engineering assessments produce datasets that can be shared publically to broaden conversations about flood risk and inform opportunities for disaster resilient growth and restoration. The data produced by these assessments can be used across a variety of FEMA programs to assist in the identification and prioritization of projects. This effort allows increased transparency and data availability at all levels of government, growing the efficiency and integration of agencies working in the realm of flood risk.



Can I use Base Level Engineering to determine Base Flood Elevations in my community?

Yes, in most cases, the data made available through the Estimated BFE Viewer can be used to inform local community identification of the Base Flood Elevations.

The data on the viewer (www.infrm.us/estBFE) can be used if the stream is shown as a Zone A flood zone and the floodplains are similar in shape and width OR if the stream is not shown on the current effective FIRM.

If the stream has been studied by more detailed methods (Zone AE), then the current effective Flood Insurance Rate Maps (FIRMs) and stream profiles in the Flood Insurance Study (FIS) text should be used to determine the Base Flood Elevation in detailed study areas.



Using Base Level Engineering to update Flood Insurance Rate Maps (FIRMs)

The engineering approach used to prepare Base Level Engineering meets all modeling and mapping standards outlined in FEMA's Standards for Flood Risk Projects and the results may be used to rapidly update Zone A. The models developed during these assessments can be refined by communities or FEMA to include survey and structure information to efficiently update the detailed study (Zone AE) areas experiencing growth.



Developers can download and refine engineering models to identify the floodplain changes and determine Base Flood Elevations in project areas near streams analyzed with Base Level Engineering.

Why is FEMA investing in Base Level Engineering?

Each mile of stream shown on a Flood Insurance Rate Map (FIRM) is required to be reviewed and validated by FEMA every five years. The flood hazard information is reviewed to determine if the built environment or expected flood flows have changed since the previous study was performed. A large portion of the national flood hazard inventory of stream miles is currently unknown or unverified.

How are watersheds selected for Base Level Engineering assessment?

FEMA works with its Federal, State and local partners to determine areas where high resolution ground elevation data (i.e. LiDAR) is available. High resolution ground data allows more accurate results than previous Zone A efforts. Incoming requests are prioritized with help from our State partners.

Does Base Level Engineering replace the Flood Insurance Rate Maps for my community?

Base Level Engineering information **does not** replace the information shown on any current effective FIRM panel in a community. The Base Level Engineering is used to assess the current validity of the existing flood hazard inventory and assists local communities to estimate Base Flood Elevations (BFEs) in Zone A areas.

Community & Public Access to Results

Base Level Engineering results are available for use by the public on the Estimated Base Flood Elevation Viewer at: www.inFRM.us/estBFE.

Users can interact with data through the on-line portal, view data with a singular or side-by-side window.

Users may also point-click and download:

- engineering models,
- floodplain extents, and
- estimated flood depths, and
- water surface elevations.

Users may also run a site specific report to review flood risk in their vicinity at their convenience.

Welcome to the

View Base Level Engineering Data

Access all available Base Level Engineering data without GIS software.

- Click the **DATA LAYERS** button to add or remove map layers.
- Click the **LEGEND** tab to view an explanation of all data shown.
- Click the **MAP VIEW** button to open or close a second viewing window for side-by-side comparisons.

Download Datasets & Models

Download the Base Level Engineering data presented in the viewer.

- Click the **DATA LAYERS** button and add the **DOWNLOADABLE DATA** layer.
- Click shaded areas in the map to open a dialog for choosing datasets to download.

Property Look Up

Where data is available, produce a property-specific report with estimated base flood information.

- Click the **REPORT** tab to create a flood risk report for a specific location.

[Click a topic to get started!](#)

Now that you have identified your flood risk, what should you do next?

First, review the flood depth information for the two events and determine the flood risk in the vicinity of your property. Meet with your local building and floodplain officials to collect more information and make your plan.

- Local building and permitting varies by community; discuss your individual property building requirements.
- Elevating your living structure above the estimated BFE is a good way to reduce your risk of flooding during the 1% annual chance storm event. Any property or structure can be impacted by flooding.
- You can elevate your HVAC and other utilities above the BFE to reduce your financial risk when a flood occurs.
- Elevating your home above the minimum standard may provide a few additional benefits, including a reduction in flood insurance premiums and reduce the likelihood of being affected by floodwaters or debris near your structure.
- Contact your insurance agent to determine the best flood insurance policy to insure your risk. Information made available from the Estimated BFE Viewer needs to be accepted by local community officials to be used for insurance rating purposes.
- Consider relocating your structure to minimize the hazards your home or business may encounter.
- Flood risk changes over time. Reduce future risk by building to a higher standard and using construction practices that have been shown to reduce flood risk for business and home owners.

Base Level Engineering data assists community development decisions.



New development may reference the estimated Base Flood Elevation to assure new homes are built with the lowest floor above identified flood elevation. The viewer works in collaboration with any existing flood hazard information depicted on FIRMs.



Land developers may also download the available engineering models from the estBFE Viewer and review the effects their development will have should they move dirt or place stream crossings, like bridges and culverts. The BLE models can act as pre-project models and can be refined to add structures, culverts and field survey information.



FEMA and its state partners identify and prioritize FIRM update projects. If a community would like to include some of the Base Level Engineering results onto a FIRM, FEMA would like to discuss these opportunities. Base Level Engineering models are prepared to allow them to act as technical back up for BLE stream mileage that is moved onto a FIRM.



Base Level Engineering data is a great source for communities to assess their flood extent and vulnerability during local and state hazard mitigation plan updates. The datasets can be downloaded for local use. The models can be used to prepare engineering analyses or benefit cost assessments.

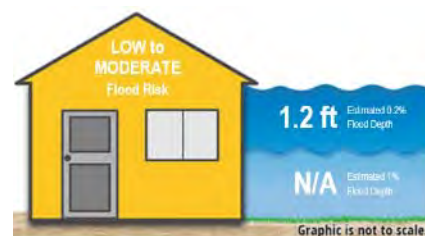
The Site Specific Report

The report produced by the estBFE Viewer includes three informational areas to provide the estimated flood hazard information intended to support individual and community decision making.

The results are determined by the tool based on the user identified location. Results are provided in both a side-by-side view and table format. **Flood depth** describes how deep flood water may be during the 1% and 0.2% annual chance storm events. The **1% annual chance storm event** indicates the probability of a storm's occurrence. A 1% chance can be better described as the probability of a single marble landing in one of 100 slots of a roulette wheel, a 0.2% chance is a one in 500 chance. The wheel is spun once each year,



Side-by-side viewports show floodplain extents on the left and 1% flood depth on the right. Estimated flood depths and water surface elevations are tabularized below for ease of use.



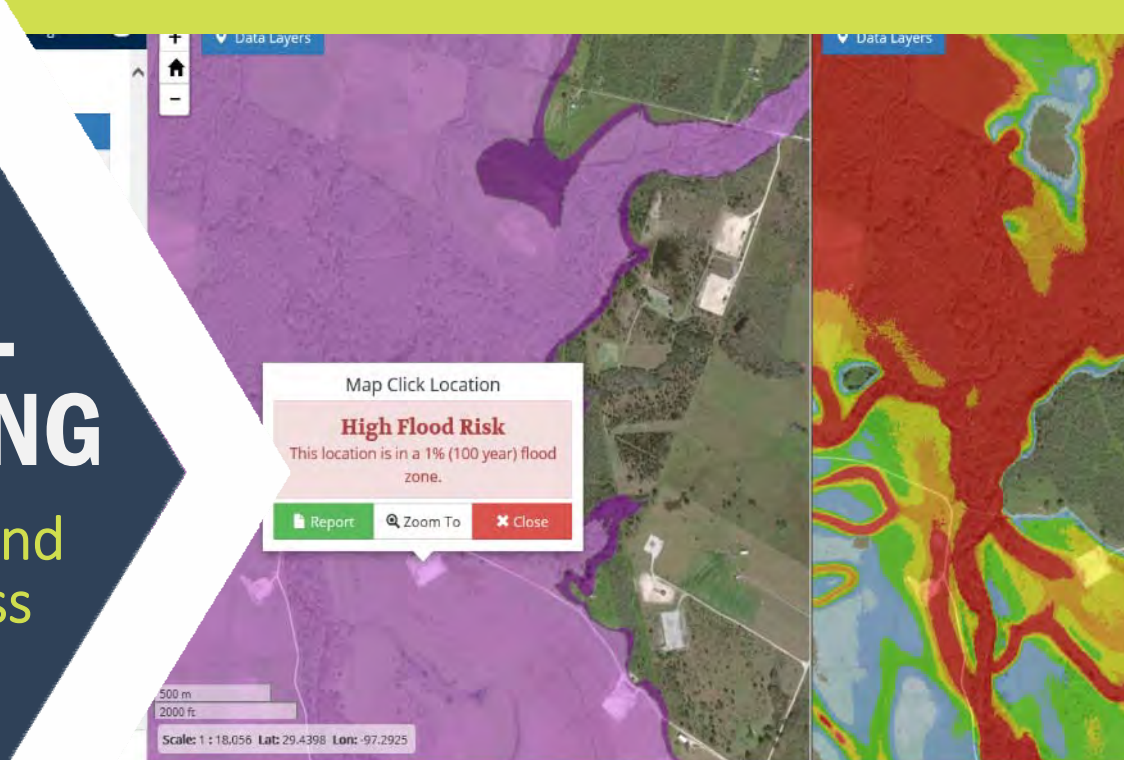
this indicates the selected location is within areas that may be subject to a 0.2% storm event, with low to moderate risk. It is important to understand that floods larger than the 1.0 or 0.2% events have the possibility of occurring in your area. A flood depth of 2 to 3 feet puts adults and children at risk of being swept away by storm water.

The second page of the report provides users some information on how to use the information and the report for insurance, local development coordination and submittal of LOMAs.

The web address of the report can be shared or bookmarked. The report is connected to an point (latitude, longitude)

BASE LEVEL ENGINEERING

Flood data to expand local risk awareness



THE ESTIMATED BASE FLOOD ELEVATION VIEWER

What is Base Level Engineering?



An investment approach allowing creation of flood hazard data. This approach expands the availability of information to communities currently unmapped and unmodernized.



Engineering analysis across land areas, using high-tech modeling software and high resolution ground data to produce credible engineering analysis for thousands of miles of stream at a time.



Data informing FEMA's continuing assessment of the flood information shown on the nation's FIRMs.



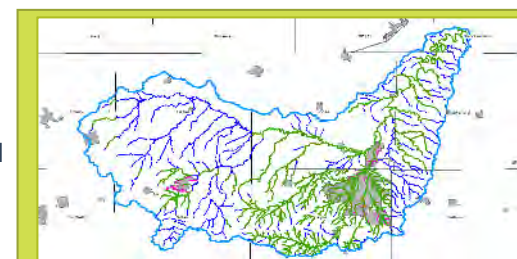
Expedient data delivery, providing useable flood information to communities far ahead of regulatory map updates.



Skeleton engineering models that can be further refined by engineering and development industry professionals working with both FEMA and local communities.

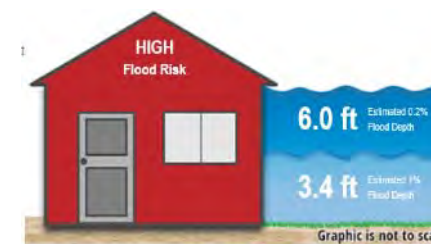
The current inventory of **Flood Insurance Rate Maps (FIRMs)** provides regulatory flood hazard information for approximately 1.3 million of the nation's 4.0+ million miles of stream. More than half of the nation's streams do not have readily available flood hazard information for individuals or communities to accurately assess and understand the potential for flooding in their area.

Base Level Engineering watershed assessments are being performed across the nation in an effort to increase the availability of flood hazard information. Once assessments are Completed, the thousands of engineering models are compiled into an expanded collection of spatial data allowing this information that can be easily shared with the public.



Upper Clear Fork Brazos Watershed, Texas
Base Level Engineering will prepare 2,170 miles of study. Blue and pink streams are not currently included on FIRMs

The **Estimated Base Flood Elevation Viewer** (available at www.InFRM.us/estBFE) is an interactive web portal that transforms thousands of models and data results into a few datasets that provide users with a variety of useable and meaningful information. Users can review estimated flood extents for three different event scenarios, and can review possible flood depths in the vicinity of their homes using this tool.



Structures and land areas within the estimated flood 1% annual chance extent are identified to have HIGH flood risk. **Site specific reports provide individual results based on the user identified location.** The estimated flood elevations and flood depths are provided in easy-to-understand graphics identifying an estimate of the flood depth for the user.

Point – Click and Download

The **Estimated Base Flood Elevation Viewer** provides users immediate access to the geospatial datasets and underlying engineering models through our point-click and download feature. The areas of assessment shown on the viewer are available for download and local use.

Connect to Detailed Flood Information

The viewer also identifies where detailed study areas are shown on community Flood Insurance Rate Maps (FIRMs). When users click in an area where detailed information is available, the upgrades to the viewer allow the “click location” to be transferred over to the National Flood Hazard Layer (NFHL) to enhance the user experience and provide the most detailed flood information to the user. Users can then easily print a FIRMette for the area of interest.

www.inFRM.us/estBFE

Quick Launch Screen

Welcome to the

Base Level Engineering assessments are produced using high resolution ground data to create technically credible flood hazard information that may be used to expand and modernize FEMA's current flood hazard inventory.

I Want to Explore

View Base Level Engineering Data

Access all available Base Level Engineering data without GIS software.

- Click the **DATA LAYERS** button to add or remove map layers.
- Click the **LEGEND** tab to view an explanation of all data shown.
- Click the **MAP VIEW** button to open or close a second viewing window for side-by-side comparisons.

I Want to Download

Download Datasets & Models

Download the Base Level Engineering data presented in the viewer.

- Click the **DATA LAYERS** button and add the **DOWNLOADABLE DATA** layer.
- Click shaded areas in the map to open a dialog for choosing datasets to download.

What is My Flood Risk?

Property Look Up

Where data is available, produce a property-specific report with estimated base flood information.

- Click the **REPORT** tab to create a flood risk report for a specific location.

Click a topic to get started!

Users can choose between three different ways to interact with the data on the Estimated Base Flood Elevation Viewer.

Just click and you will be provided a layout to suit your data needs.

Using the Viewer

Launch the Estimated Base Flood Elevation Viewer by typing www.inFRM.us/estBFE in the internet browser window. Users will encounter a disclaimer screen; click “OK” to clear this message.

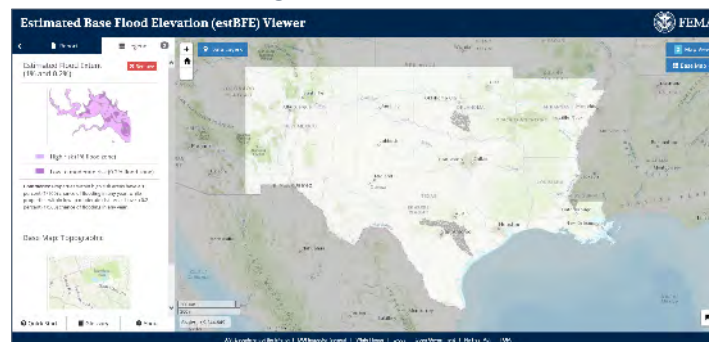
Next, the **Quick Launch Screen** will allow the user to choose how they would like to interact with the Base Level Engineering results. Users can choose between three options:

- View Base Level Engineering Data
- Download Datasets & Models, or the
- Property Look Up tools within the Viewer

For more information on each of these selections, review the detailed information within the factsheet.

View Base Level Engineering Data

Users who choose View Base Level Engineering Data will be greeted with one view port with the floodplain extents loaded in the viewing area.



On the left users will see the legend tab is promoted. The legend provides users with information on the datasets loaded within the view port.

Other features to enhance your experience:

- Zoom in to see the floodplain extents with the **+ and – buttons** at the top left of the screen
- Choose a side by side view with two viewing windows. To load a second viewing area, click on **Map View**, at the top right of the screen.
- Load additional datasets by clicking on **Data Layers** on the upper left hand side of the viewing area. The legend will expand as new layers are added.
- Select from one of six available underlying maps using the **Base Map** menu.



For general questions about navigating the estBFE Viewer, please contact the FEMA Map Information eXchange (FMIX):
 Telephone: 877-FEMA-MAP (1-877-336-2627)
 Email: FEMAMapSpecialist@riskmapcds.com

Download Datasets & Models

Users who choose Download Datasets and Models will be greeted with one viewing window showing the study areas that have data packaged for download.



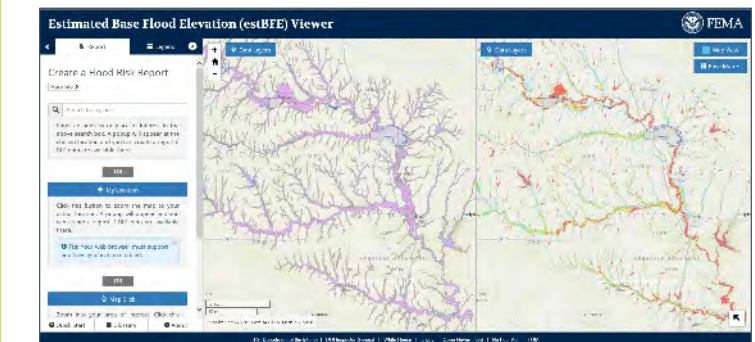
It is easy to download any dataset, just hover the mouse over the watershed area of interest and click.

Data Set	File Name	Size	Description	Download
HECRAS models	11130303_Models.zip	253.19 MB		Download
1% event depths, raster	11130303_Depth01.zip	348.45 MB		Download
0.2% event depths, raster	11130303_Depth02.zip	396.50 MB		Download
1% event elevations, raster	11130303_Elev01.zip	226.19 MB		Download
0.2% event elevations, raster	11130303_Elev02.zip	250.93 MB		Download
Vector spatial data, file geodatabase	11130303_VectorData.zip	131.21 MB		Download
Reports and documents	11130303_Documents.zip	30.12 MB		Download

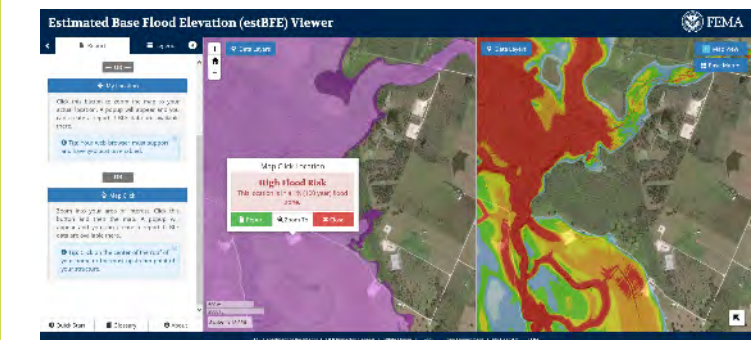
A table will pop up with a variety of options for download. Users can download the HEC-RAS models, water surface elevation grids, flood depth grids or the Vector file which houses floodplain extents, model cross-sections and streamlines. Users are given an option to download the table which will generate an Excel file with all hyperlinks.

Property Look Up

Users who choose Property Look Up will be greeted with a side-by-side double viewport, showing floodplains (1% and 0.2%) on the left and flood depths on the right.



Use the search function or zoom into an area of interest. Once the structure of interest is located, click on the center of the structure. If the location selected falls within the estimated flood extents (depicted in purple), a report can be run for that location.



The report will open in a new window. The web address of the report page is tied to a latitude and longitude, allowing it to be shared via email. The recipient will see the same report. Reports are available in the high and low to moderate flood risk areas, within the floodplains shown.

The Viewer assists LOMA Submittals

If a property owner believes that a structure is above or outside of the base flood extent in an effective Zone A, a LOMA request may be submitted and the flood risk report from the Estimated BFE Viewer should be included.

To complete an application, use the online web-based tool or download the paper forms (<https://www.fema.gov/letter-map-changes>).

A LOMA may result in removal of the SFHA designation and the Federal requirement for flood insurance. However, maintaining a flood policy may still be required by the lender. Flood insurance coverage to repair damage caused by flooding is available for areas outside the SFHA.

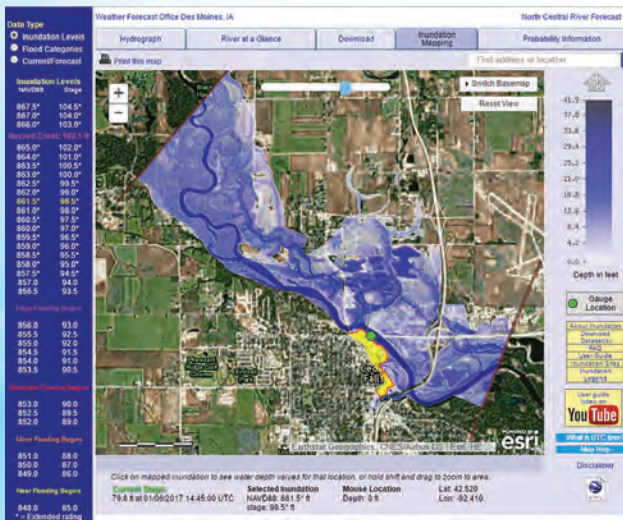


The Estimated Base Flood Elevation Viewer was a collaborative effort brought to life by the Data and Spatial Studies team of the USGS' Texas Water Science Center. The Region's collaboration in the Interagency Flood Risk Management (InFRM) team has allowed this vision to become a reality. The InFRM team strives to collaborate nationally, to empower locally. Learn more at www.inFRM.us.



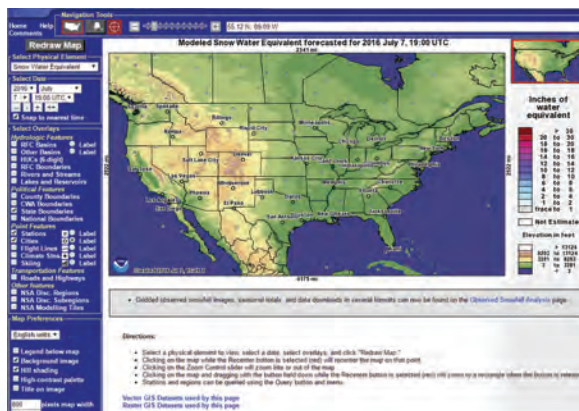
FLOOD INUNDATION MAPS

The inundation mapping interface from the water.weather.gov website provides information on the spatial extent and depth of floodwaters in the vicinity of NWS forecast locations. This feature is available for NWS forecast points where data sets known as flood inundation libraries have been developed through partnerships with federal, state and local agencies. It provides the ability to view inundation levels at stages to the nearest foot or at the minor, moderate and major flood categories. From this interface, the user can also view maps of observed or forecast inundation levels based on current NWS river forecasts.



SNOW INFORMATION

The Office of Water Prediction offers users a variety of web-based snow observations, analyses, data sets and map products for the Nation at www.nohrsc.noaa.gov. These include in-depth analyses of national and regional snow conditions; interface to remotely-sensed snow information; national snow analyses in 3D; airborne snow survey data; satellite observations of northern hemisphere snow cover; forecasts, watches and warnings; national snow analyses data archive; and alphanumeric data products in Standard Hydrologic Exchange Format (SHEF).



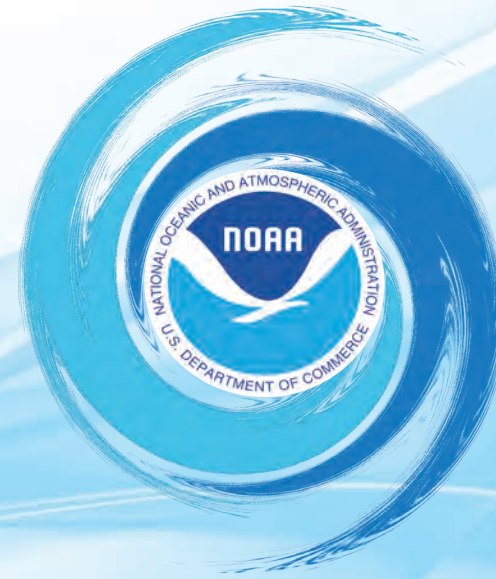
U.S Department of Commerce
National Oceanic and Atmospheric Administration



National Weather Service
June 2017
NOAA/YPA-201751

NATIONAL WEATHER SERVICE

WATER RESOURCES INFORMATION ON THE WEB



Your gateway to web resources provided through NOAA's Advanced Hydrologic Prediction Service begins here:
water.weather.gov

Your www.water.weather.gov website provides: **NATIONAL AND REGIONAL MAPS**

RIVER OBSERVATIONS

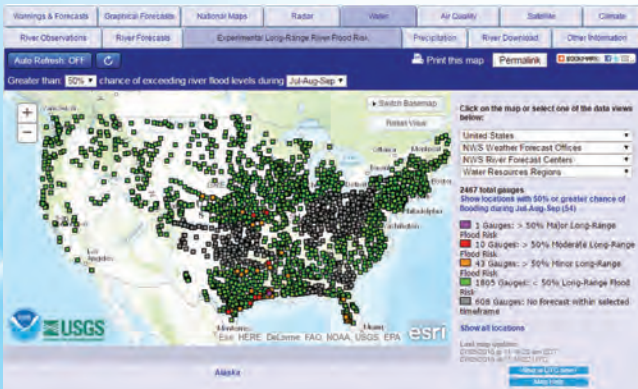
A map of NWS river forecast locations which are color-coded according to the flood status of their most recent river stage or streamflow observation.

RIVER FORECASTS

A map of NWS river forecast locations which are color-coded according to the flood status of their maximum river stage or streamflow forecast through the entire period.

EXPERIMENTAL LONG-RANGE RIVER FLOOD RISK

A map showing the 3-month risk of minor, moderate and major river flooding at locations where NWS River Forecast Centers (RFCs) produce probabilistic streamflow forecasts.



DETERMINISTIC AND PROBABILISTIC FORECASTS

HYDROGRAPHS

Clicking on a color-coded river location on a regional “River Observations” or “River Forecasts” map shows the hydrograph web page for your selected location. The hydrograph depicts recent stage and/or streamflow observations, and for many locations, a forecast for the next few days.

WEEKLY CHANCE OF EXCEEDING LEVELS

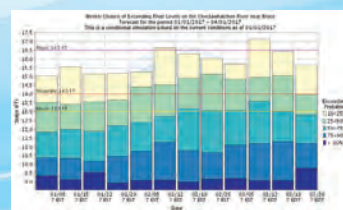
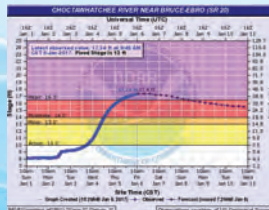
This graphical product shows the probability of the maximum stage, flow or volume exceeding a particular value for consecutive 7-day periods in a 90-day interval.

CHANCE OF EXCEEDING LEVELS DURING ENTIRE PERIOD

This graphical product shows the probability of the river stage, flow or volume going above various levels during the forecast period labeled above the graph (usually 30 or 90 days).

EXPERIMENTAL SHORT-TERM PROBABILISTIC GUIDANCE

This graphical product depicts short-range river forecast uncertainty and conveys the range of possible river stages and flows at each forecast timestep. These possibilities are shaded using different categories of forecast probability, ranging from most likely to less likely, and are derived from ensemble river forecasts produced by NWS RFCs.



PRECIPITATION

Users may access short-term observed and climatic trends of precipitation across the conterminous United States, Puerto Rico and Alaska.

OBSERVED PRECIPITATION

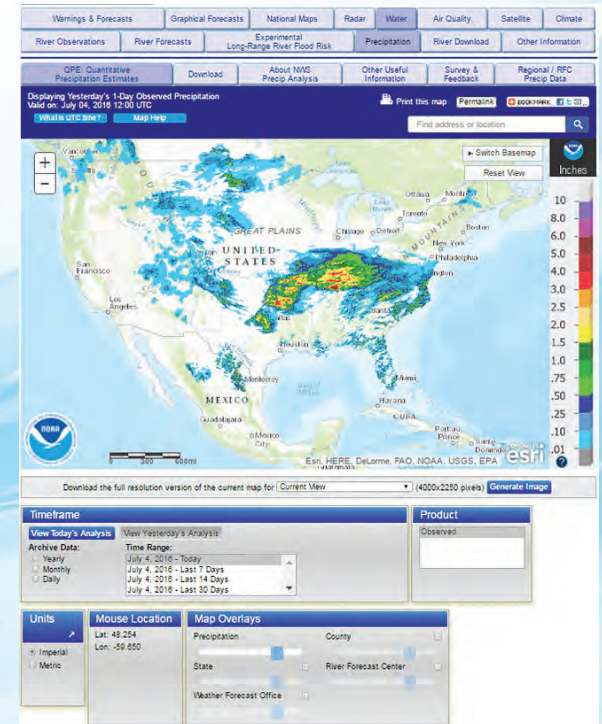
This map integrates 24-hour totals of multi-sensor precipitation estimates from the NWS RFCs. Multi-sensor precipitation estimates are produced by integrating radar and satellite precipitation estimates and ground-based precipitation gage data.

NORMAL PRECIPITATION

Normal precipitation is derived from 1981-2010 Parameter-elevation Relationships on Independent Slopes Model (PRISM) climate data created by Oregon State University.

DERIVED PRECIPITATION

“Departure from Normal” and “Percentage of Normal” graphics are available.



For more information, visit www.water.weather.gov

NOAA National Weather Service Flood Forecast Services

CPACOG Regional Flood Management Planning Workshop

Austin, Texas

July 16, 2019

Mark Lenz

Senior Service Hydrologist

National Weather Service

Austin/San Antonio



Advanced Hydrologic Prediction Service - AHPS

- Observations and deterministic forecast
- Some probabilistic forecast information is available at various locations with more to be added as time allows.
- Graphical Products
- Static Flood Inundation Mapping slowly spinning down in an effort to put more resources to Dynamic Flood Inundation Maps!



water.weather.gov



AHPS Basic Services

Dynamic Web Mapping Service

- Shows Flood Risk Categories Based on Observations or Forecast
- Deterministic Forecast Hydrograph
- River Impacts

water.weather.gov





- Local forecast by "City, ST"
- City ST Go
- RSS RSS Feeds
- Warnings
- Current
- By State/County...
- UV Alerts
- Observations
- Radar
- Satellite
- Snow Cover
- Surface
- Weather...
- Observed Prcip
- Forecasts
- Local
- Graphical
- Aviation
- Marine
- Hurricanes
- Severe Weather
- Fire Weather
- Text Messages
- By State
- By Message Type
- National
- Forecast Models
- Numerical
- Models
- Statistical
- Models...
- MOS Prod
- GT-S-LAMP Prod
- Climate
- Past Weather
- Predictions
- Weather Safety
- Weather Radio
- Hazard Assmt...
- StormReady /
- TsunamiReady
- Skywarn™
- Education/Outreach
- Information Center
- Tsunamis
- Publications...
- Contact Us
- FAQ
- Comments...
- USA.gov
- Find us on Facebook
- NWS on Facebook

Site Map

News

Organization

Search NWS All NOAA Go

National Observations

Warnings & Forecasts | Graphical Forecasts | National Maps | Radar | Water | Air Quality | Satellite | Climate

River Observations | River Forecasts | Living Range River Flood Risk | Precipitation | River Download | Other Information

Auto Refresh: OFF

All Locations

Click on the map or select one of the data views below:

- United States
- NWS Weather Forecast Offices
- NWS River Forecast Centers
- Water Resources Regions

Probability and forecasts available
 Observations only available
 Forecasts available

9129 total gauges
 Show all locations in flood (97)

- 5 Gauges: Major Flooding
- 24 Gauges: Moderate Flooding
- 68 Gauges: Minor Flooding
- 137 Gauges: Near Flood Stage
- 5615 Gauges: No Flooding
- 2610 Flood Category Not Defined
- 22 At or Below Low Water Threshold
- 571 Gauges: Observations Are Not Current
- 77 Gauges: Out of Service

Last map update:
 7/14/2015 at 9:49:51 AM EDT
 7/14/2015 at 09:46:53 UTC

- Hydrologic Resources**
- River Forecast Centers
 - About AHPs
 - Partners
 - AHPs Feedback
 - AHPs RSS
 - Automated Flood Warning Systems
 - Hydro-meteorological Automated Data System
 - Inundation Mapping Locations
 - River Stage Summary
 - Office of Water Prediction: National Water Model

- Additional Resources**
- National Significant River Flood Outlook
 - U.S. Geological Survey Streamflow Information
 - Show Information
 - NWS Precipitation and River Forecasting
 - Experimental Hourly Precipitation
 - Guide to Hydrologic Information on the Web
 - Precip Frequency/BMP
 - AHPs Iframes for Developers
 - Mobile AHPs for emergency management
 - Flood Damage Costs/Fatalities in the US

water.wether.gov





National Weather Service Advanced Hydrologic Prediction Service

Home

News

Organization

Local weather forecast by "City, ST"

City, ST Go

Adjacent Areas:



National Conditions
Rivers
Satellite
Climate
Observed Precip

Local Conditions
Warnings
Weather
Forecast
Radar

AHPS Documentation
User Guide
User Brochure

What is AHPS?
Facts
Our Partners

Feedback/Questions
Provide Feedback
Ask Questions



National Observations

WFO Observations

Weather Forecast Office Austin/San Antonio, TX

West Gulf River Forecast Center

River Observations

River Forecasts

Long-Range Flood Risk

Precipitation

Download

Auto Refresh: OFF

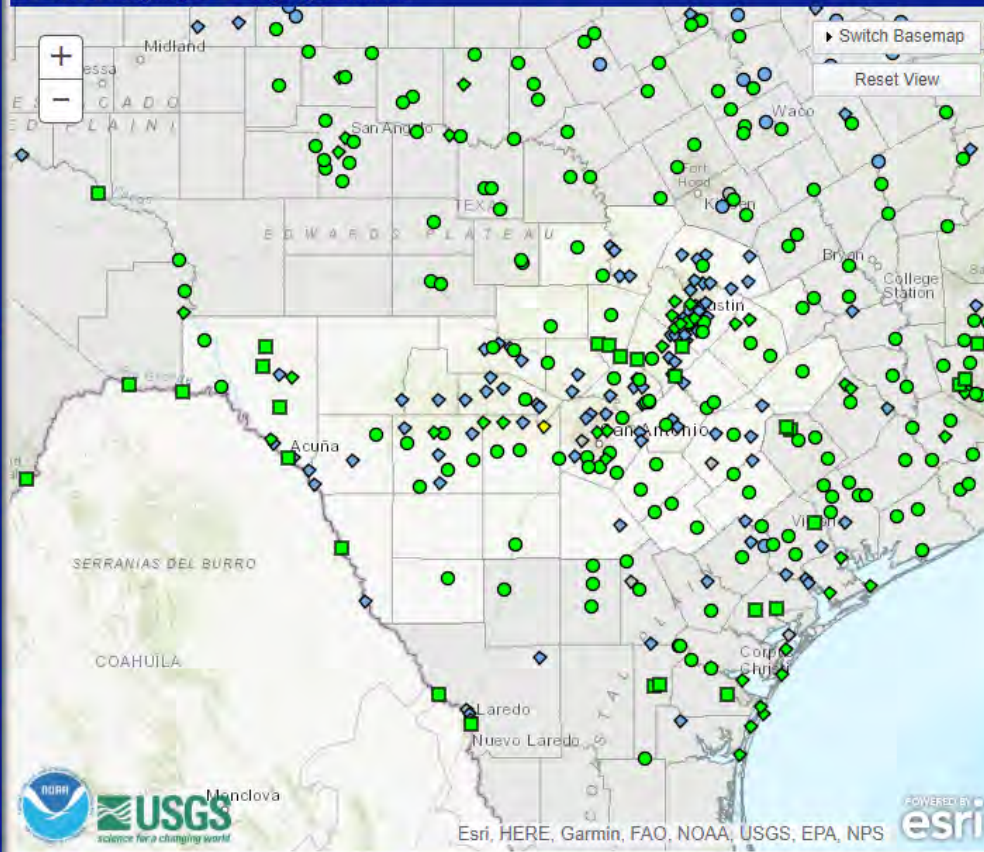


Print this map

Permalink

BOOKMARK

367 total gauges 0 gauges in flood



- Forecast available
- Probability and forecasts available
- Observations only available
- Major Flooding
- Moderate Flooding
- Minor Flooding
- Near Flood Stage
- No Flooding
- Observations Are Not Current
- Out of Service
- Flood Category Not Defined
- At or Below Low Water Threshold

Last map update:
07/14/2019 at 04:52:23 am CDT
07/14/2019 at 09:52:23 UTC

What is UTC time?

Map Help

Disclaimer



Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS



Map Overlays





BELOW CRITERIA

Impact: Water is within the banks of the river with no impacts to the surrounding area. Flow speeds may still be high during rainfall or releases which could impact recreational activities

ACTION

Impact: Water is over the banks and into the flood plain, but not a threat to structures or roadways. Some action may be required such as moving farm equipment or increasing awareness

MINOR

Impact: Typically water is impacting areas inside of floodplain which can vary by location. Some low water crossings covered by water, agricultural flooding, water approaching public areas (parks, sidewalks etc.). Areas frequently flooded can expect to be impacted

MODERATE

Impact: Water now reaching areas only impacted by significant rain events. Structures can be inundated, several roads covered with water, water may cut off certain areas, widespread agricultural flooding.

MAJOR

Impact: Water is near the highest it's ever been representing rare flooding and significant widespread impacts. Most roads will be covered by water in the area cutting off if not completely flooding subdivisions, rivers can be several miles wide in areas. Homes and structures underwater, bridges inundated and in danger of being hit by debris. Impacts may be greater than ever experienced.

Understanding River Criteria Levels

- Local weather forecast by "City, ST"
- City, ST Go
- National Conditions
- Rivers
- Satellite
- Climate
- Observed Precip
- Local Conditions
- Warnings
- Weather
- Forecast
- Radar
- HPS Documentation
- User Guide
- User Brochure
- What is AHPS?
- Facts
- Our Partners
- Feedback/Questions
- Provide Feedback
- Ask Questions
- WHEN FLOODED TURN AROUND DON'T DROWN
- FLOODSMART.GOV
- USA.GOV

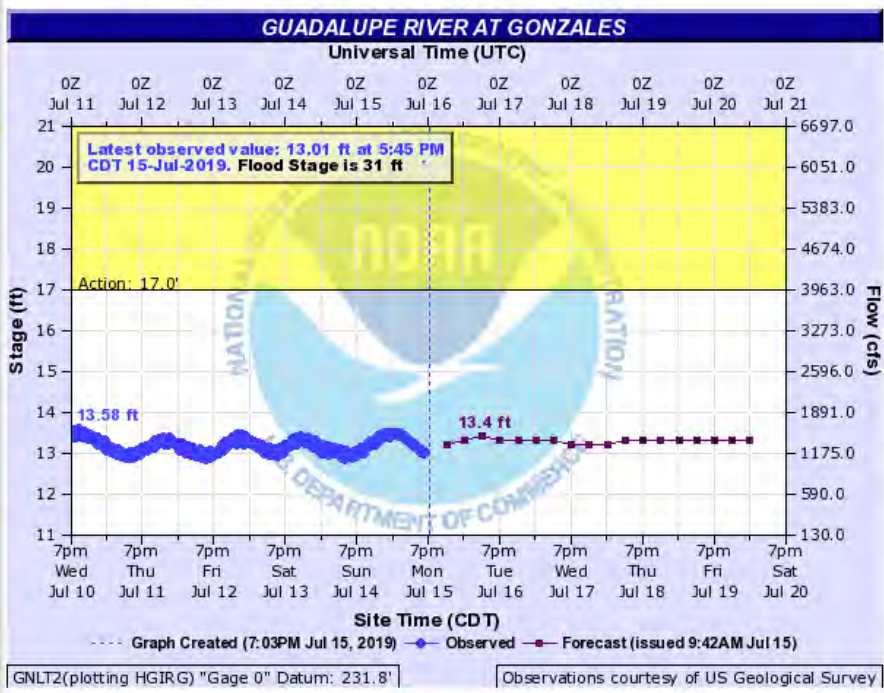
National Observations | WFO Observations | Hydrograph

Weather Forecast Office Austin/San Antonio, TX | West Gulf River Forecast Center

Special Weather Statement

Hydrograph | River at a Glance | Download | Probability Information

Auto Refresh: OFF



- Printable Image
- About this graph
- Tabular Data (UTC)
- Tabular Data (CDT)
- XML**
- RSS**
- Datum: Not Available
- Metadata

NOTE: River forecasts for this location take into account past precipitation and the precipitation amounts expected approximately 24 hours into the future from the forecast issuance time.

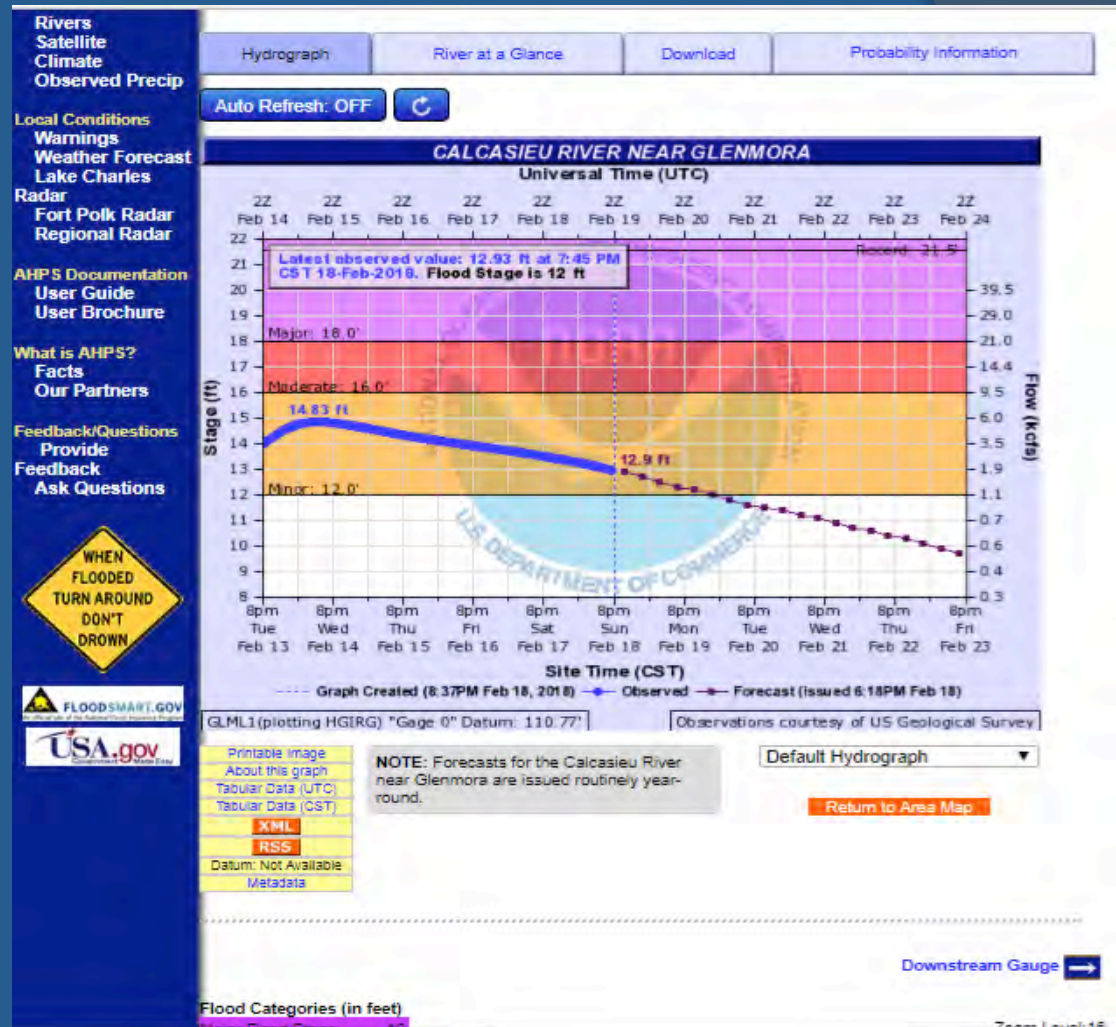
NOTE: Forecasts for the Guadalupe River at Gonzales are issued routinely year-round.

Default Hydrograph



Forecast Location

- ✓ Observations with at least 5 day forecast.
- ✓ Forecast period is longer for larger river systems.
- ✓ Deterministic forecast based on 24-72 hour forecast rainfall depending on confidence.



← Upstream Gauge

Flood Categories (in feet)

Major Flood Stage:	27
Moderate Flood Stage:	23
Flood Stage:	17
Action Stage:	15

Historic Crests

- (1) 40.15 ft on 10/31/2013
 - (2) 39.22 ft on 10/30/2015 (P)
 - (3) 38.00 ft on 09/09/1921
 - (4) 38.00 ft on 07/03/1869
 - (5) 36.50 ft on 11/16/2001
- [Show More Historic Crests](#)

(P): Preliminary values
subject to further review.

Recent Crests

- (1) 20.69 ft on 05/09/2019
 - (2) 26.99 ft on 05/04/2019
 - (3) 19.16 ft on 08/27/2017 (P)
 - (4) 25.13 ft on 05/27/2016
 - (5) 21.19 ft on 05/20/2016
- [Show More Recent Crests](#)

(P): Preliminary values
subject to further review.

Low Water Records

Currently none available.



For more information on your flood risk go to www.floodsmart.gov.

Show FEMA's National Flood Hazard Layers



Gauge Location

[Disclaimer](#)

Latitude/Longitude Disclaimer: The gauge location shown in the above map is the approximate location based on the latitude/longitude coordinates provided to the NWS by the gauge owner.

If you notice any errors in the below information, please contact our Webmaster

- 54 Height of instruments inside gauge house.
- 47 Catastrophic flooding in neighborhoods of Onion Creek, with depths of 8 to 10 feet in Timber Creek, 10 to 15 feet in Onion Creek Forest, 10 to 12 feet in Yarrabee Bend, 2 feet in Onion Creek Plantations, 10 feet on the southeast side of Silverstone, 6 to 10 feet in Perkins Valley, and 5 to 10 feet in Onion Creek Club. The US Highway 183 bridge over Onion Creek and McKinney Falls Parkway are flooded. Major flooding of the south side of ABIA, including portions of FM 973. USGS 500 year storm floodplain.
- 41 Major flooding in Onion Creek neighborhoods, with depths up to 6 feet in Onion Creek Plantations, 6 to 9 feet in Onion Creek Forest, 6 to 8 feet in Yarrabee Bend, 7 feet on the east side of Silverstone, and 4 to 11 feet in Timber Creek near Pearce Lane. Onion Creek Club, Perkins Valley neighborhood, Pleasant Valley Road, Pearce Lane, FM 973, Burleson Road, and Emma Browning Avenue are flooded. The south access to ABIA is flooded as is the South Austin WWTP. Flood of record is 40.15 on October 31, 2013.
- 38 Major flooding in Onion Creek neighborhoods with depths up to 5 feet in Onion Creek Forest, 3 to 10 feet in Timber Creek near Pearce Lane, 4 feet in Onion Creek Plantations, 1 to 2 feet in Perkins Valley, and 2 to 3 feet in Yarrabee Bend. Access to the Onion Creek neighborhoods is now limited. Flooding of the South Austin WWTP is imminent. Much of FM 973 and parts of Burleson Road are flooded. The 6100 block of East William Cannon Drive and Pleasant Valley Road are flooded.
- 35 Major flooding. Water enters homes in portions of several Onion Creek neighborhoods with 2 to 5 feet of water in parts of Onion Creek Plantations, Onion Creek Forest, Yarrabee Bend, Silverstone, and Perkins Valley. Up to 8 feet of water impacts homes in Timber Creek near Pearce Lane. FM 973, Burleson Road, William Cannon Drive, and Pleasant Valley Road are flooded, and the south Access to ABIA is blocked.
- 32 Major flooding begins to flood the homes lower portions of Timber Creek, and the homes along Pinhurst Drive and Champions Lane. Vehicle access becomes limited to portions of Onion Creek Plantations, and street flooding begins to impact the Perkins Valley subdivision. Major portions of Brandt Road, Bluff Springs Road, and William Cannon Drive are flooded. Richard Moya Park is severely flooded, and water is spilling onto Burleson Road.
- 29 Major flooding impacts several neighborhoods along Onion Creek. Homes on Pinehurst Drive and Champions Lane are threatened by flood waters. Portions of Timber Creek, Onion Creek Forest, Onion Creek Plantations, and Yarrabee Bend South subdivisions are flooded. Major portions of Bluff Springs Road, East William Cannon Drive and Brandt Road near Onion Creek are flooded, and Burleson Road begins to flood near Richard Moya Park.
- 28 Major flooding impacts several neighborhoods along Onion Creek. Homes on Dixie Drive near Foyt Ct. are close to flooding. Homes on Pinehurst Drive and Champions Lane are surrounded by flood waters, but structures are not expected to be flooded at this level. Low portions of Timber Creek, Onion Creek Forest, Onion Creek Plantations, and Yarrabee Bend South subdivisions are flooded. Portions of Bluff Springs Road, East William Cannon Drive and Brandt Road near Onion Creek are flooded and impassable.
- 27 Major flooding impacts several neighborhoods along Onion Creek. The Timber Creek neighborhood is starting to flood, and lowland areas in the Onion Creek Forest, Onion Creek Plantations, and Yarrabee Bend South subdivisions begin to flood. The 6100 block of East William Cannon Drive, and the 3100 block of Brandt Road may be flooded and impassable. Bluff Springs Road near the bridge at Onion Creek may also begin to flood. Much of Richard Moya Park is flooded.
- 23 Moderate lowland flooding is well into the flood plain. Richard Moya Park on Burleson Road is flooded. Water is out of banks near Champions Lane, but no residential structures in neighborhoods along Onion Creek are impacted at this level.
- 20 Minor lowland flooding threatens secondary roads, but neighborhoods along Onion Creek are not affected. Upstream, the 12000 block of Old San Antonio Road is likely flooded and impassable.
- 17 The 12000 block of Old San Antonio Road upstream may be flooded. Neighborhoods along Onion Creek are not affected.
- 15 Flow exceeds lowest sections of the banks. Low street crossings and bridges are threatened.



Resources

- [U.S. Geological Survey \(USGS\) Data and Site Info for US 183](#)

Resources Collapse

Hydrologic Resources

- ▶ [Text Products](#)
- ▶ [Past Precipitation](#)
- ▶ [Forecast Precipitation](#)
- ▶ [River Forecast Centers](#)
- ▶ [River Stage Summary](#)
- ▶ [Rainfall Frequency Atlas Maps](#)
- ▶ [Hydrometeorological Prediction Center](#)
- ▶ [Inundation Mapping Locations](#)

Additional Resources

- ▶ [Area Hydrographs](#)
- ▶ [NWS Precipitation and River Forecasting](#)
- ▶ [AHPS Iframes for Developers](#)
- ▶ [Mobile iNWS for emergency management](#)
- ▶ [West Gulf River Forecast Center](#)
- ▶ [Lower Colorado River Authority](#)
- ▶ [Guadalupe Blanco River Authority](#)
- ▶ [San Antonio River Authority](#)
- ▶ [Edwards Aquifer Authority](#)
- ▶ [Nueces River Authority](#)
- ▶ [International Boundary and Water Commission](#)
- ▶ [Snow Information](#)

Collaborative Agencies Collapse

The National Weather Service prepares its forecasts and other services in collaboration with agencies like the US Geological Survey, US Bureau of Reclamation, US Army Corps of Engineers, Natural Resource Conservation Service, National Park Service, ALERT Users Group, Bureau of Indian Affairs, and many state and local emergency managers across the country. For details, [please click here](#).

NWS Information

National Weather Service
Austin/San Antonio Weather Forecast Office
2090 Airport Rd.
New Braunfels, TX 78130
(830) 629-0130

[Ask Questions/Webmaster](#)

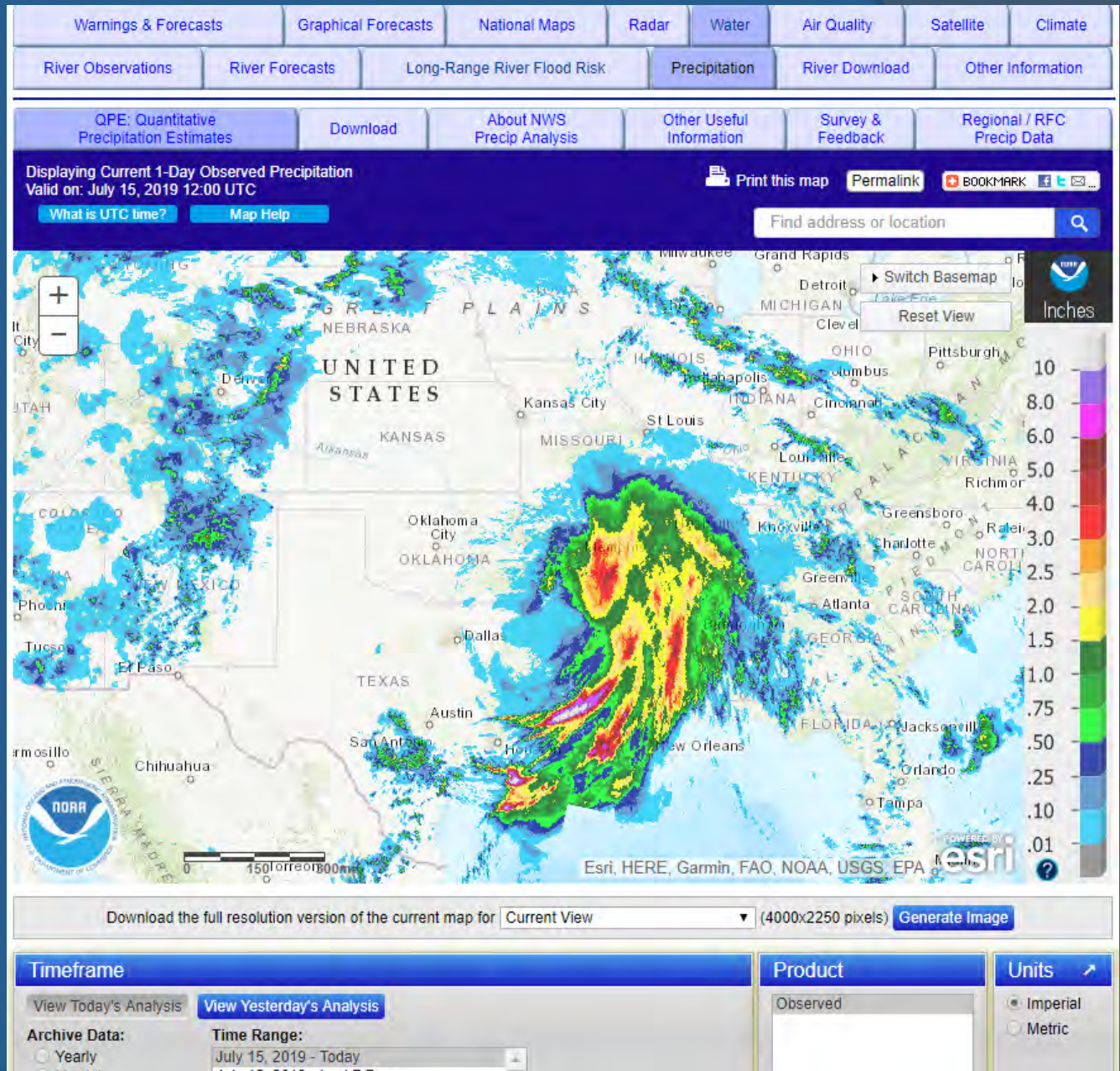
Page last modified: 1-Mar-2019 12:34 AM

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[Credits](#)
[Glossary](#)

[Privacy Policy](#)
[About Us](#)
[Career Opportunities](#)



Rainfall is constantly QC'd by looking at radar and rain gauge observations on an hourly basis.



Warnings & Forecasts

Graphical Forecasts

National Maps

Radar

Water

Air Quality

Satellite

Climate

River Observations

River Forecasts

Long-Range River Flood Risk

Precipitation

River Download

Other Information

Auto Refresh: OFF

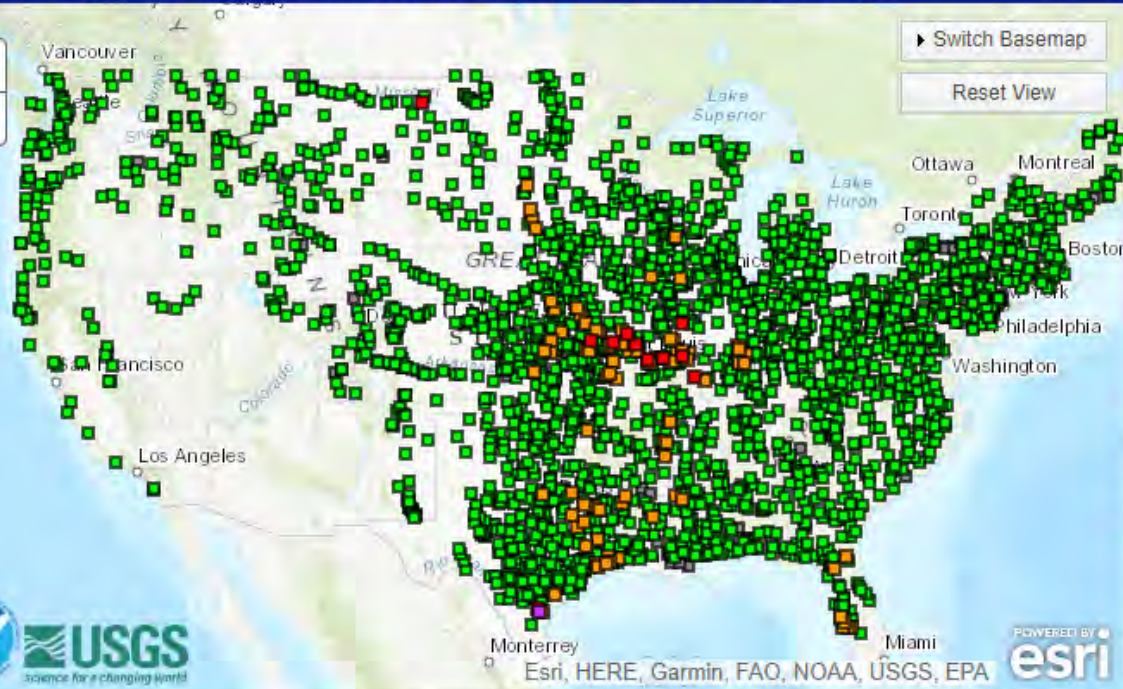
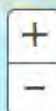


Print this map

Permalink

BOOKMARK

Greater than: 50% chance of exceeding river flood levels during Jul-Aug-Sep



Click on the map or select one of the data views below:

- United States
- NWS Weather Forecast Offices
- NWS River Forecast Centers
- Water Resources Regions

2626 total gauges
Show locations with 50% or greater chance of flooding during Jul-Aug-Sep (99)

- 1 Gauges: > 50% Major Long-Range Flood Risk
- 12 Gauges: > 50% Moderate Long-Range Flood Risk
- 86 Gauges: > 50% Minor Long-Range Flood Risk
- 2415 Gauges: < 50% Long-Range Flood Risk
- 112 Gauges: No forecast within selected timeframe

Show all locations

Last map update:
07/15/2019 at 02:46:24 pm EDT
07/15/2019 at 18:46:24 UTC



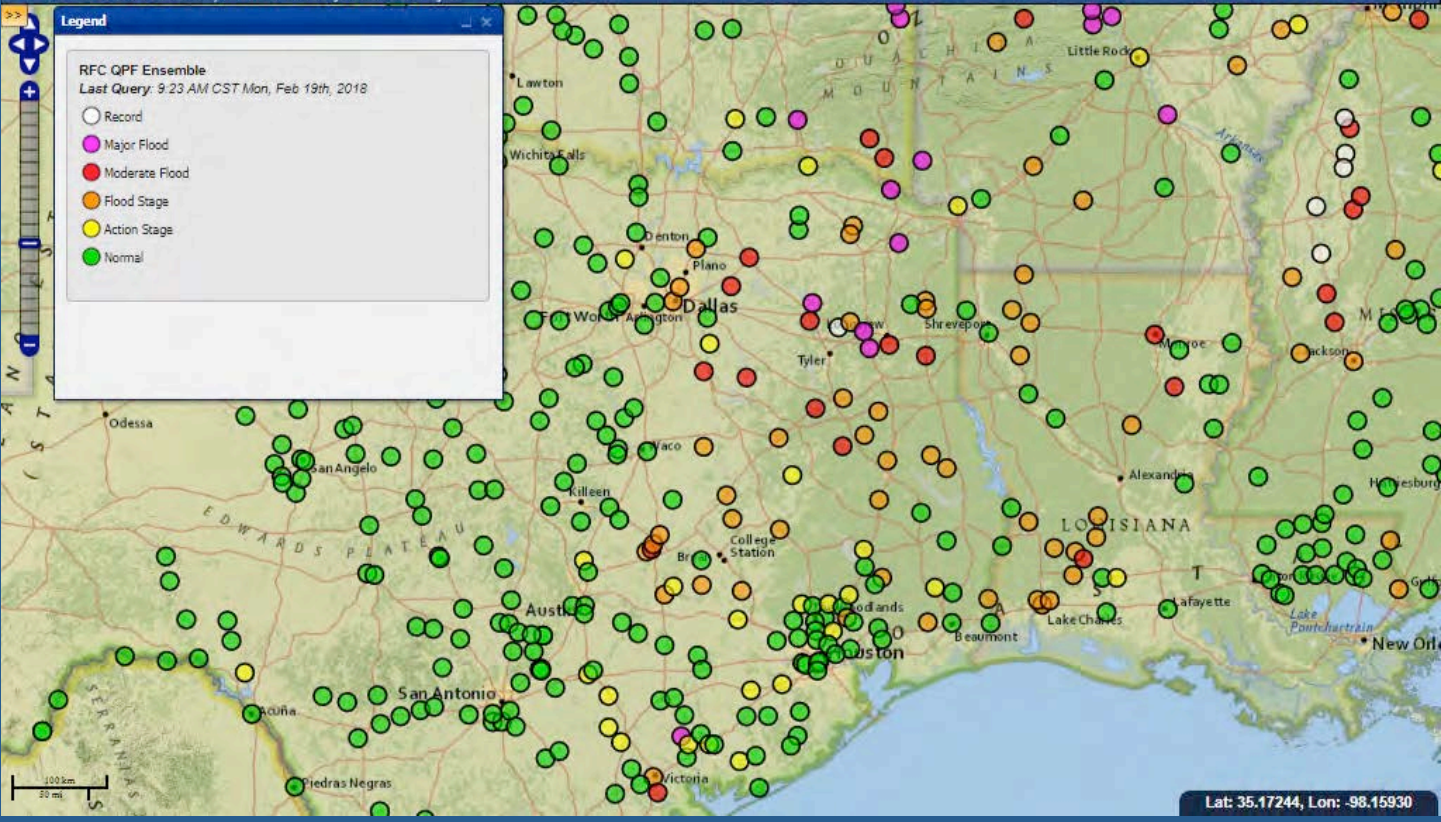
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

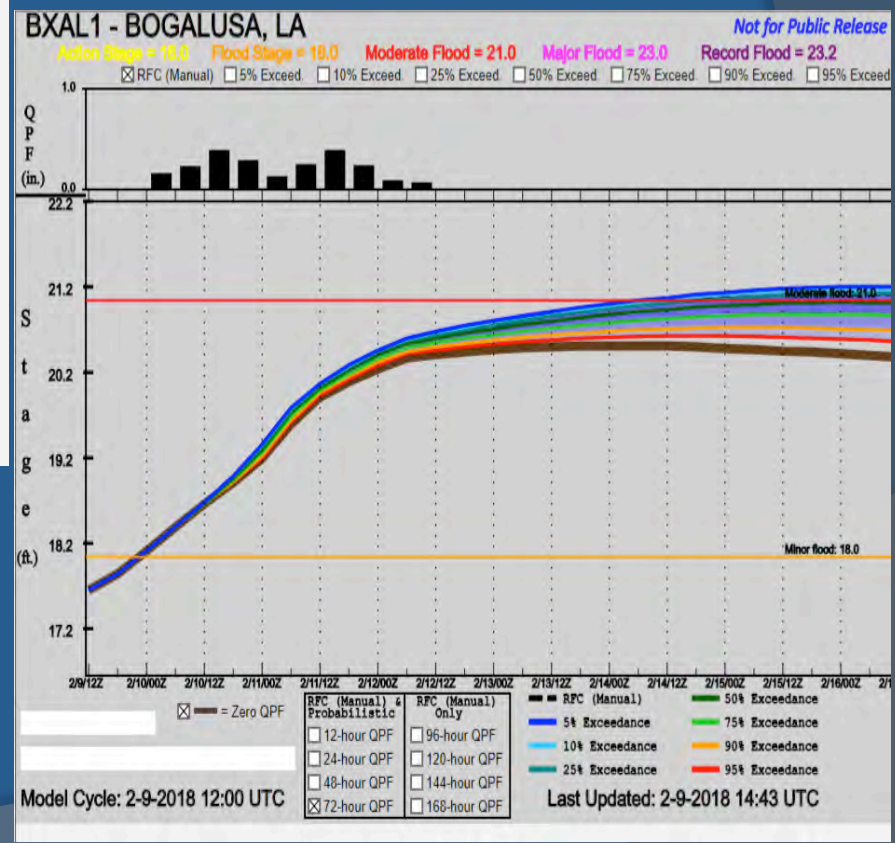
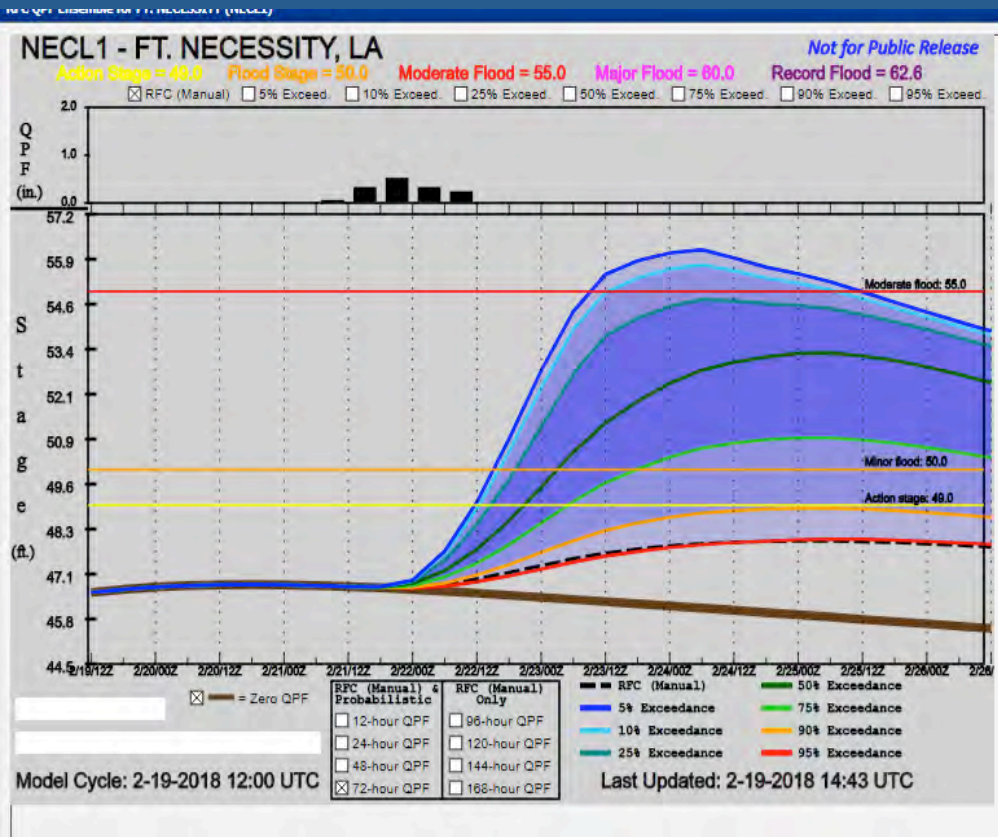


Short Term Probabilistic Forecast based on Rainfall Only

- Rainfall forecast is the largest error to flood forecasting.
- To account for this the WGRFC produces ensemble rainfall forecast that are put into the hydrologic models to see the potential responses based on different scenarios. From 5-95% exceedance.
- Does not account for uncertainty in hydrology.

preview.weather.gov/edd





Gridded Hydrologic Modeling on National Scale

- Increases the number of forecast locations.
- Path towards dynamic flood inundation mapping on a national level instead of static maps at a few locations.
- Calibration will take some time.

water.noaa.gov



Current River Forecast Points (~3,600)



NWM Streamflow Output Points (~2.7 mil)



Analysis & Assimilation

Short-Range

Medium-Range

Long-Range

Cycling Frequency

Hourly

Hourly

4 x Day at 00Z, 06Z, 12Z, 18Z

Daily Ens (16 mem)

Forecast Duration

- 3 hrs

0-18 hours

0-10 days

0-30 days

Forecast Latency (latency of external forcing data accounts for most of delay)

1 hour

1 hour 45 mins

6 hours

19 hours

Meteorological Forcing

MRMS blend/ HRRR/RAP bkgnd.

Downscaled HRRR/RAP blend

Downscaled GFS

Downscaled & bias-corrected CFS

Spatial Discretization & Routing

1km/250m/NHDPlus Reach

1km/250m/NHDPlus Reach

1km/250m/NHDPlus Reach

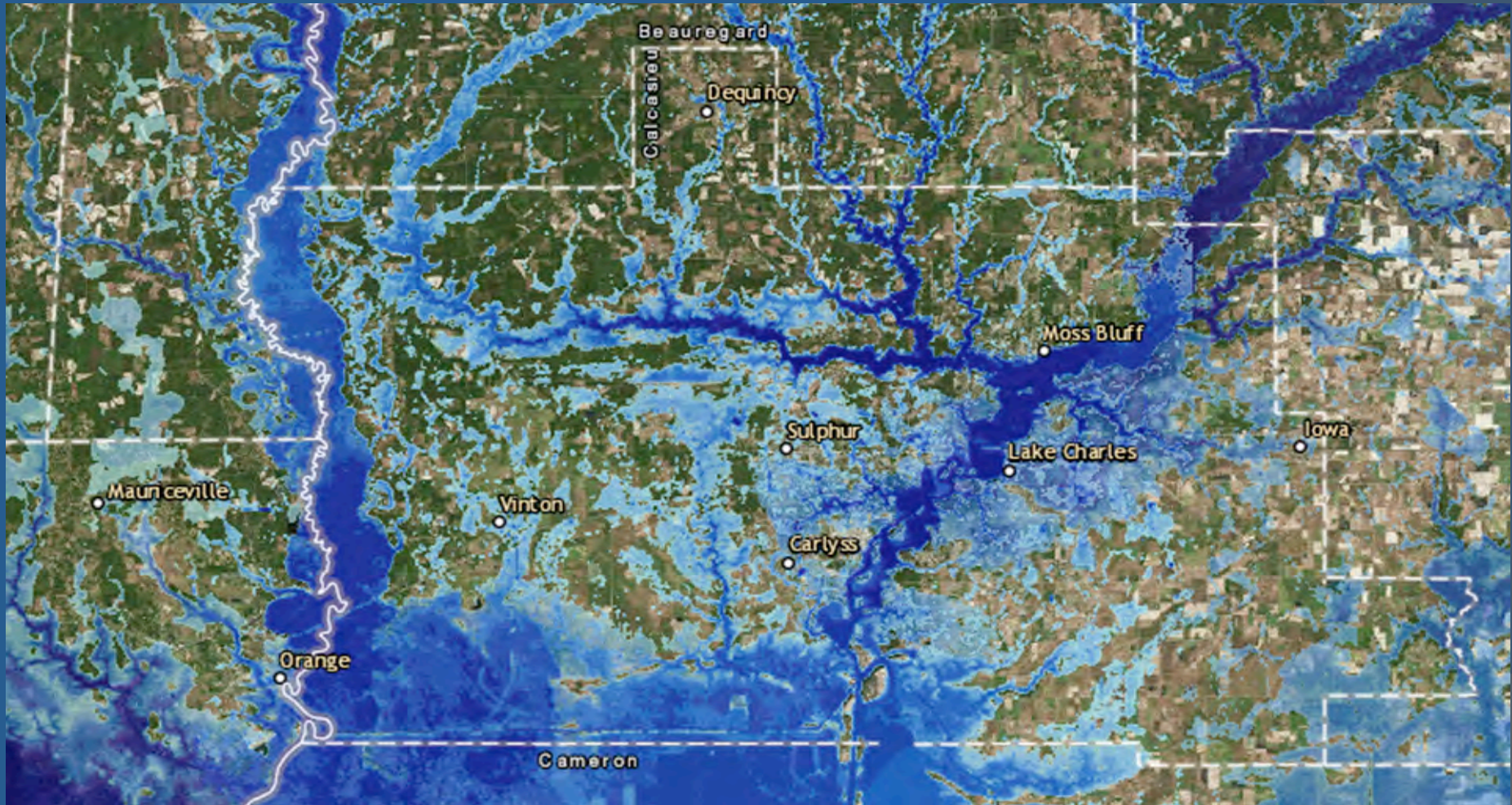
1 km/NHDPlus Reach

Assimilation of ~7,000 USGS Obs

Reservoirs (1260 water bodies parameterized with level pool scheme)

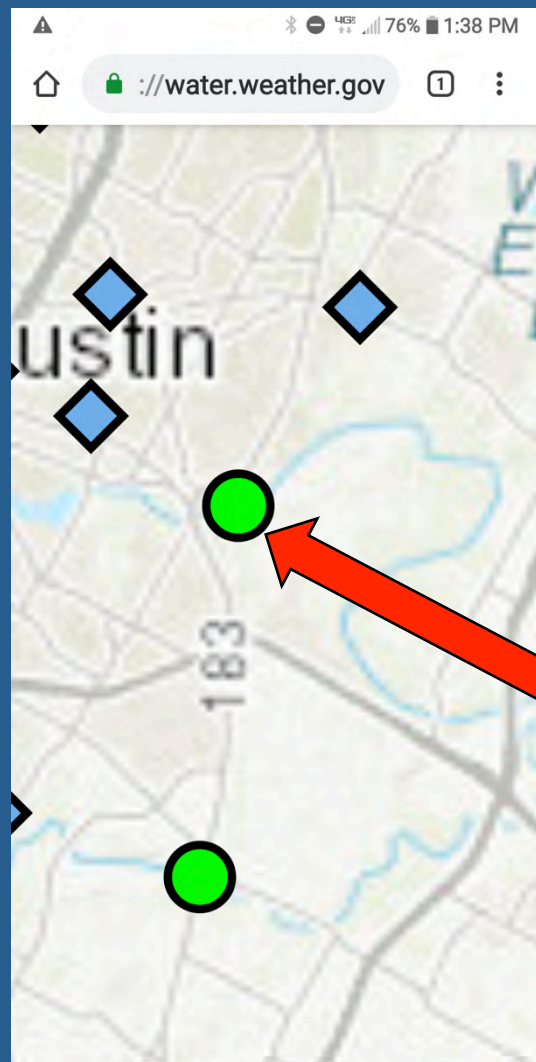
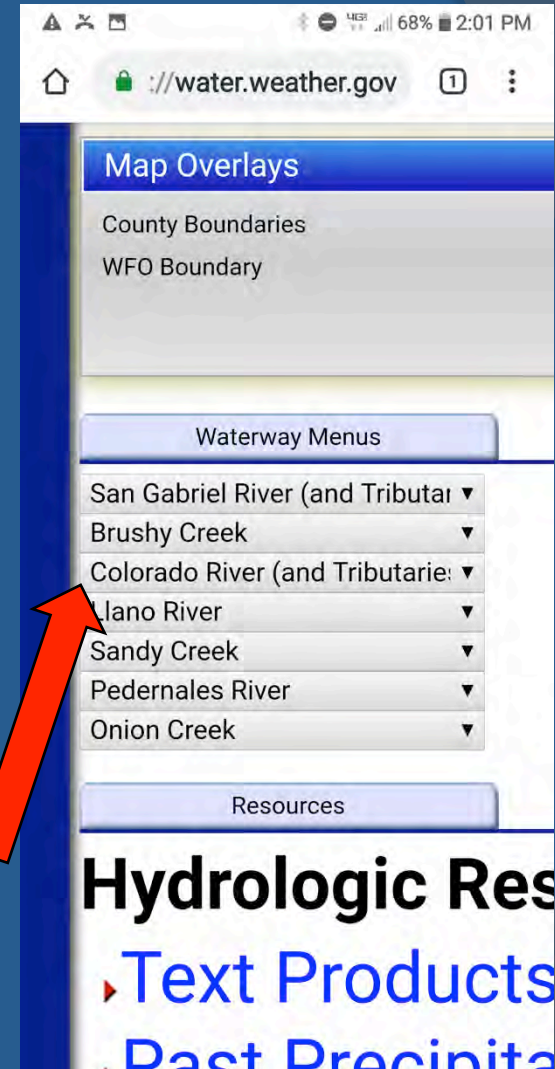


Experimental Output During Harvey



Mobile access to NWS Hydrology Pages

- Web designed for desktop, not smartphones
- NWS does not support effective hydrology-related apps or widgets
- AHPS pages are functional on the better smartphones, but tedious
 - Maps: max zoom for separating densely located points makes gauges hard to distinguish
 - Dropdown menus below the AHPS slightly easier to use



Partner Tools, Websites

USGS science for a changing world

TEXAS WATER DASHBOARD

View over 850 USGS real-time stream, lake, reservoir, precipitation, water quality, & groundwater stations in context with current weather & hazard conditions. Data is refreshed every minute.

Streams

Map layers can be toggled on or off from the Layers menu.

Tools

Settings Layers Help

USGS science for a changing world

WATER on-the-go

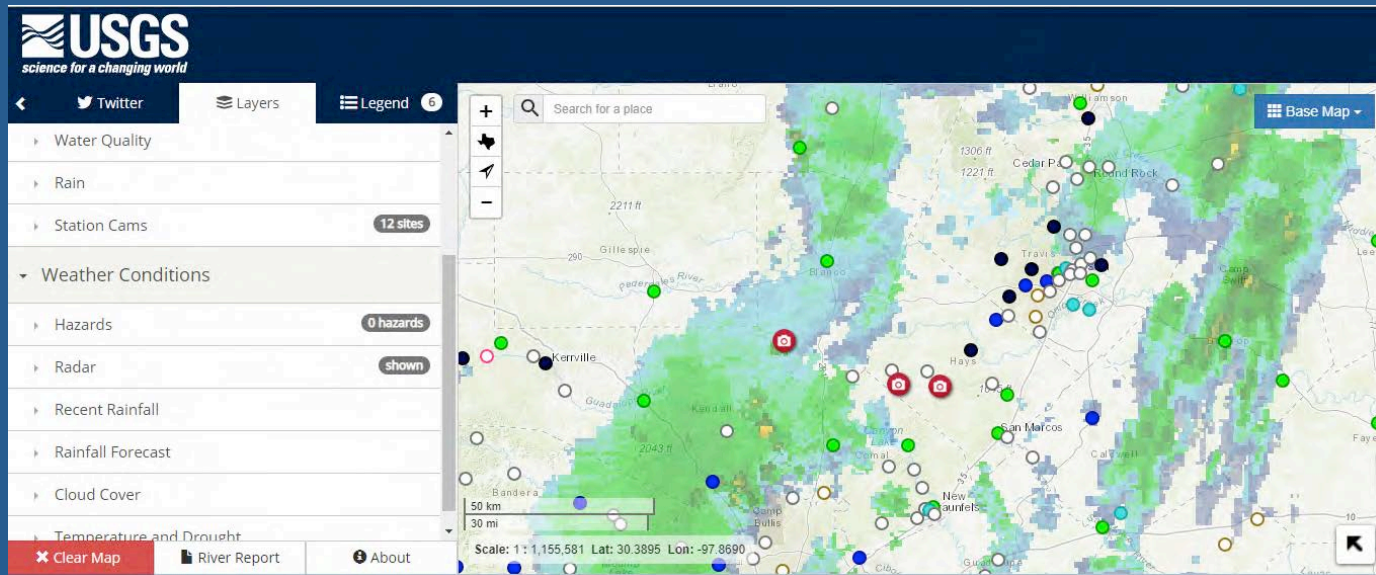
- Click the map to find sites around any location.
- Type a location and find sites around it.
- Display information about the sites found. You can also click a site marker on the map to show information about a site.
- Set search criteria, such as site type, search radius, or the number of closest sites to find.
- View the map legend and adjust map layers.
- Open this quick start guide.

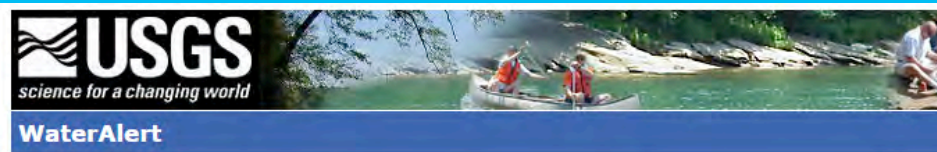
About **OK, Got it!**

Developed and managed by the USGS Texas Water Science Center

Partner Tools, Websites

<https://txpub.usgs.gov/txwaterdashboard/>





USGS Water Alerts

The screenshot shows the USGS WaterAlert website interface. On the left is a search panel with several input fields: "Search by Street Address", "Search by Place Name", "Search by Site Number(s)", "Search by State/Territory", and "Search by Watershed Region". Below these is a "Select Data Type" section with a checked box. At the bottom of the search panel is a "Subscribe to WaterAlert" button, which is highlighted with a red box. The main area is a map of The Woodlands, Texas, with numerous grey gauge location markers. One marker is circled in red. A "Site Information" pop-up window is open over the circled marker, displaying the following details:

Site Information

Site Number: 08069500
Site Name: W Fk San Jacinto Rv nr Humble, TX
Site Type: Stream
Agency: USGS
Access Data

Streamflow: 7260 ft³/sec
on 2018-04-02 at 22:15 CDT (TSID 229383)
Stage: 42.78 ft
on 2018-05-07 at 06:45 CDT (TSID 140334)

- Set alerts when a gauge reaches certain water surface elevations.
- Identify the gauge nearest you
- Click on the gauge and select "Subscribe to WaterAlert"
- Define how you want to receive the information:
 - Email or phone
 - Frequency
 - Stage or Discharge
 - Stream Elevation(s)
- Note: Use Internet Explorer

USGS Water Alerts:

<https://maps.waterdata.usgs.gov/mapper/wateralert/>
Subscription Form

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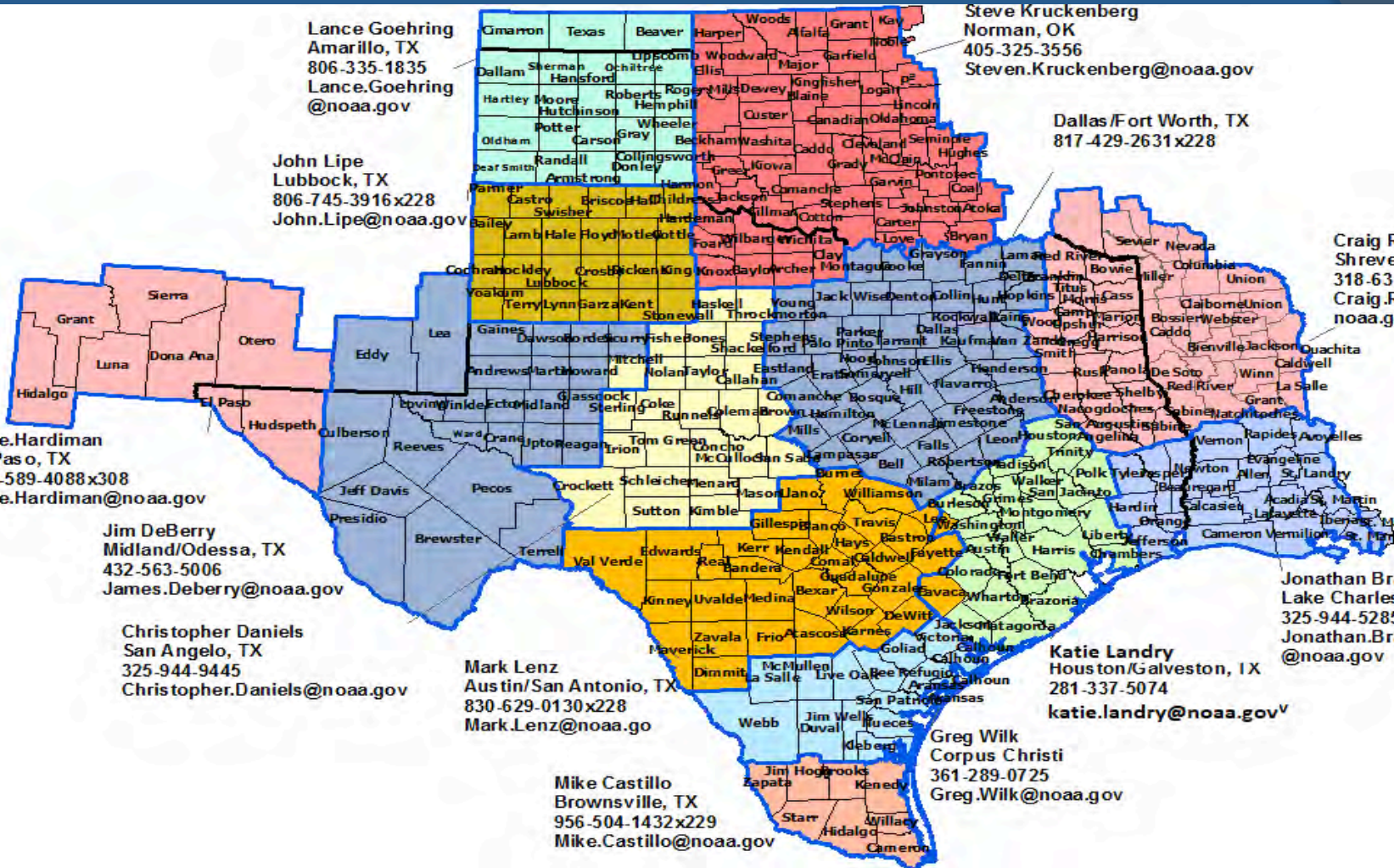
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United States Department of Agriculture



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Emergency Watershed Protection Program (EWP) for Floodplain Easements (FPE)

Rob Ziehr, NRCS Temple, TX

2019

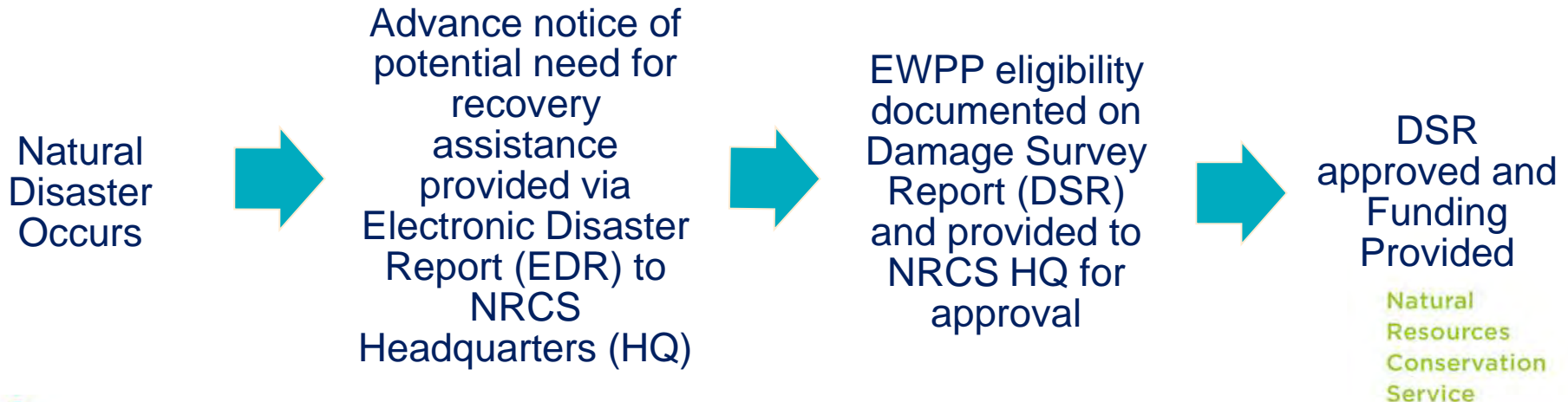
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Emergency Watershed Protection Program (EWPP)

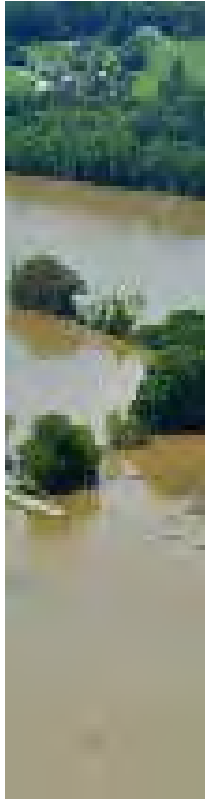
The purpose of the EWPP is to assist sponsors implement recovery measures to relieve imminent hazards to life and property created by natural disasters that have caused a sudden impairment of a watershed.

EWPP Process



EWP Floodplain Easements

- **The Emergency Watershed Protection Program (EWP) for Floodplain Easements (FPE) provides an alternative measure to traditional EWP recovery (7 CFR Section 624.10).**
- **FPEs can be administered in locations where:**
 - Stafford Act (Presidential) Disaster Declaration has been made
 - Identified and funded through Congressional legislation.



Types of FPE Projects



1) Agricultural Lands and Other Lands Without Residences or Other Structures



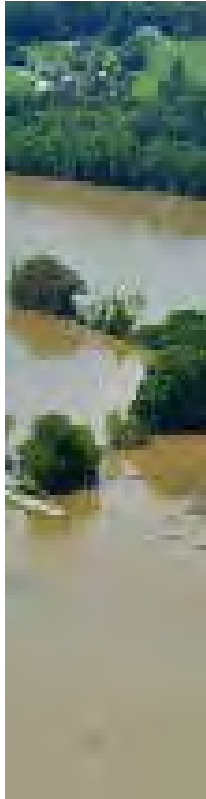
2) Residential Properties With Structures Present



FPE Project Details

Agricultural Lands and Other Lands Without Residences or Other Structures

- NRCS administers the program and handles all steps, from outreach, application to easement closing and restoration.
- United States holds the easement and the landowner retains fee title ownership of the property.



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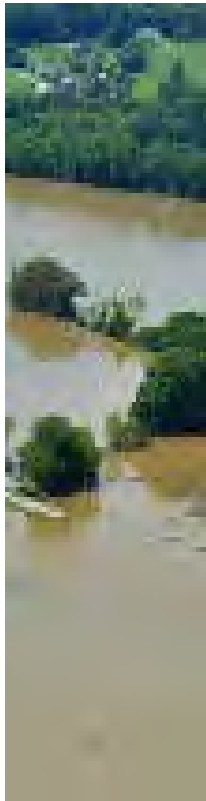


FPE Project Details



Non-Agricultural Lands With Residences or Other Structures

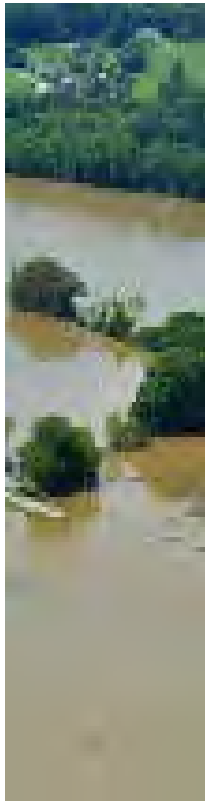
- FPE easements on non-agricultural lands with residences or other structures must be part of a broader strategy that will result in the restoration of an entire floodplain reach.
- In situations where an impacted floodplain reach contains multiple structures – such as a subdivision, all landowners must apply for participation in FPE to allow for removal of all structures and complete restoration of the floodplain reach.



Lands Eligible For FPE

NRCS may determine land is eligible for FPE if any of the following apply:

- 1) The floodplain lands were damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous 10 years.
- 2) Other lands within the floodplain are eligible, provided the lands would contribute to the restoration of the flood storage and flow, provide for control of erosion, or that would improve the practical management of the floodplain easement.
- 3) Lands would be inundated or adversely impacted as a result of a dam breach.



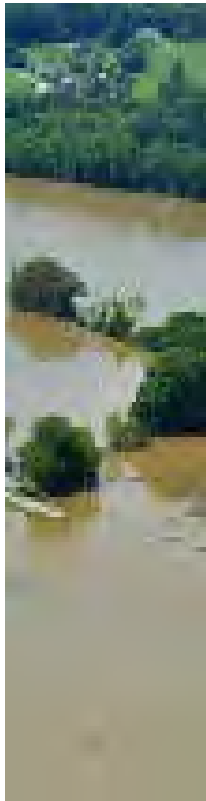


Landowners Eligible for FPE

FPE is not a Farm Bill Program, meaning landowner AGI, HEL and Wetland Compliance are not required.

To be eligible, landowners must be willing and able to—

- 1) Comply with the terms of the easement.
- 2) Comply with all terms and conditions of any associated agreement.
- 3) Convey title to the easement that is acceptable to NRCS and warrant that the easement is superior to the rights of all others, except for exceptions to the title that are deemed acceptable by NRCS.



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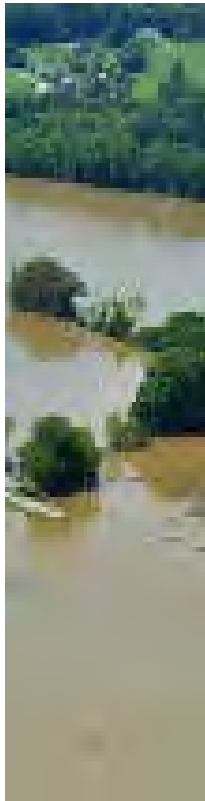
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FPE Easement Compensation

Agricultural or Other open Lands

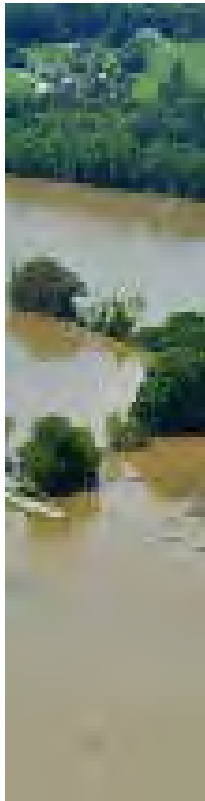
- Easement compensation will be based on the lowest of:
 - fair market value – as determined by appraisal using an appraisal an areawide market analysis or survey.
 - landowner offer – a voluntary written offer by the landowner at the time of application (ranking points should be awarded for reduce easement cost resulting form landowner offer).
- If the easement application involves a farmstead that includes a residence or other structure, an appraisal is required.



FPE Easement Compensation

Non-Agricultural Lands With Residences or Other Structures

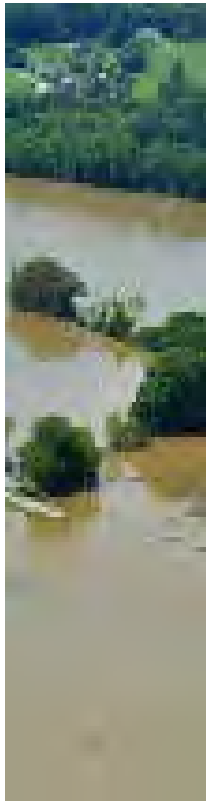
- The FPE easement purchased by the United States from landowner then project sponsor becomes landowner by purchasing remaining fee-title value from applicant.
- Easement compensation is based on an appraisal or landowner offer, whichever is less.
- Appraisal is based on pre-disaster condition of the property, including residential or other structures.



FPE Restoration

Restoration on floodplain easements will:

- Restore the floodplain functions and values to their natural conditions to the greatest extent practicable.
- Result in a close approximation of the conditions and functions that existed prior to land being converted for current use.
- Include both structural and nonstructural conservation practices to restore functions and values including:
 - water storage and flow,
 - erosion control,
 - vegetative and biological communities,
 - practices to improve the practical management of the easement.
- Include demolition and removal or relocation of structures to location outside the 100-year floodplain.



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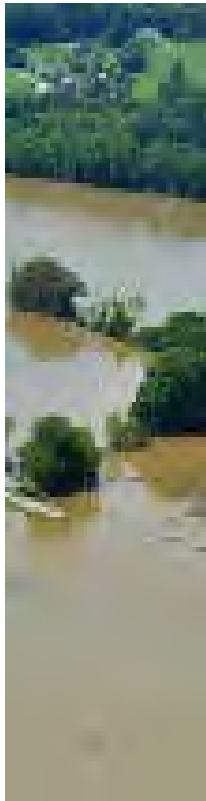
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FPE Monitoring and Enforcement

All FPE easements will be:

- Monitored annually in accordance with the current NRCS easement policy.
- Managed in accordance with the current NRCS management, compatible use, prohibited and noncompatible uses policies and procedures.
- Enforced in accordance with the NRCS violations and enforcement policy and procedures.

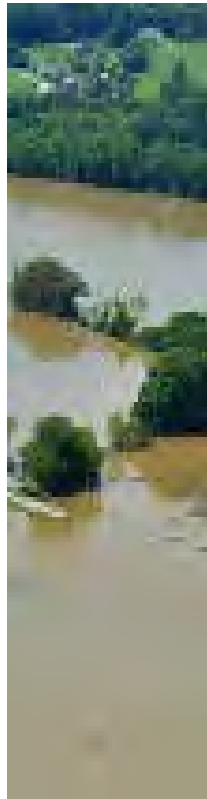




Who Can Be an FPE Project Sponsor?

An eligible project sponsor is:

- Any legal subdivision of a State government or a State agency, including the following:
 - Cities, Counties or Parishes, Towns, Municipal authorities, Townships, Soil and Water Conservation Districts
- Entity chartered under State law.
- Any Native American Tribe or Tribal organization as defined in section 4 of the Indian Self Determination and Education Assistance Act (25 U.S.C. Section 450b).



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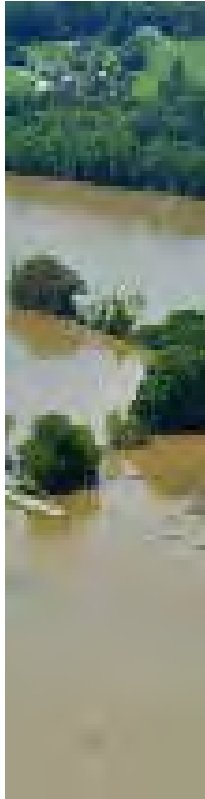
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What Criteria Must be Met to be an FPE Project Sponsor?

To act as a project sponsor, an entity must:

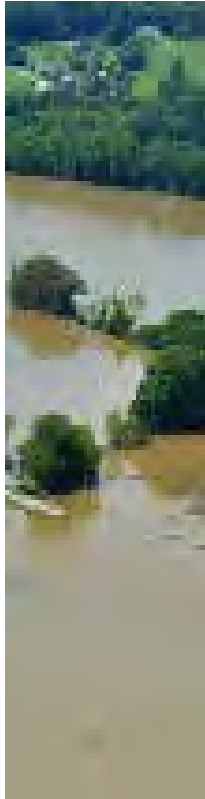
- Have a legal interest in, or responsibility for, the areas threatened by a watershed emergency.
- Have a local presence and staff available to assist in the implementation of the program.
- Be capable of obtaining necessary land rights and required permits.
- Be capable of performing all required operation and maintenance (O&M) responsibilities.
- Administer contracting when part of a local agreement.



What is FPE Project Sponsor Responsible For Before and During Sign-Up?

The FPE Project Sponsor must agree to:

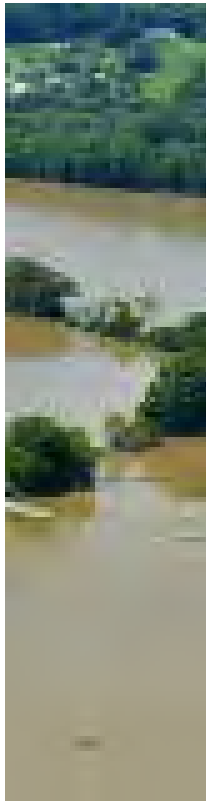
- Assist with public dissemination of program availability to affected residents in the community.
- Conduct application signups and accept applications for EWP-FPE.
- Conduct public meetings and a public information campaign concerning availability of the program.
- Identify properties needed to ensure the restoration of the entire floodplain reach and help identify strategies that will be implemented to secure all needed properties.



What is an FPE Project Sponsor Responsible For Following Sign-Up and Easement Closing?

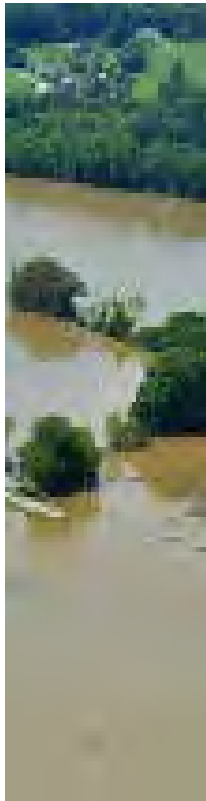
The FPE Project Sponsor must agree to:

- Purchase fee-title ownership from applicant.
- Administer restoration or other activities as identified in the Sponsorship Agreement.
- Ensure restrictions and terms of the FPE Warranty Easement Deed are adhered to and, if not, remedy the violation immediately.
- Monitor the condition of the easement to ensure the goals and objectives of the program are being met.
- Be familiar with the easement restoration plan in order to ensure installed conservation practices are performing as planned and providing floodplain habitat as intended.





QUESTIONS?



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Contact Information

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ALL OTHER EASEMENTS

Claude Ross

USDA-NRCS

Claude.Ross@usda.gov

254-742-9822





Guide to the Federal Surplus Personal Property Donation Program



Putting Tax Dollars to Re-Use
www.gsa.gov/propertydonations



Benefits of Using Federal Government Surplus

Certain nonfederal organizations are eligible to acquire surplus personal property from the federal government. Surplus personal property, including furniture and hardware, is free of charge, with the donee paying only shipping and related costs. If you become a donee, you can examine surplus property at a State Agency for Surplus Property (SASP) warehouse or, if authorized by the SASP, review the complete inventory of federal surplus property available for transfer on the GSAXcess® website at www.gsaxcess.gov. By working through the SASP in their state, eligible organizations can often obtain needed items with substantial savings.

Though some surplus items made available for donation are in new or unused condition, most items have been used and may be in need of repair. All donated property is offered on an “as is” basis without warranty. As such, making the necessary repairs is the responsibility of the donee, not of the federal government. It is common practice among donees to repair and refurbish items, usually at a dramatically lower cost than acquiring new property.



BENEFITS

About Federal Surplus Personal Property Donation

The Federal Surplus Personal Property Donation Program enables eligible non-federal organizations to obtain surplus personal property no longer required by the federal government.

▪ Legal Authority

The primary authority for the Federal Surplus Personal Property Donation Program is Title 40 of the United States Code (U.S.C.), Section 549. Implementing regulations are contained in Title 41 Code of Federal Regulations, Section 102-37.

▪ Personal Property Defined

Personal property includes all types and categories of property, except land or other real property, certain naval vessels, and records of the federal government. Examples of surplus personal property are

- Communications and electronic equipment, including computers
- Furniture
- Motor vehicles
- Clothing
- Medical supplies and equipment
- Hand and machine tools
- Appliances
- Hardware
- Construction equipment
- Boats
- Airplanes
- Office machines and supplies



Eligible Nonfederal Organization Defined

SASPs determine eligibility in accordance with the applicable federal statutes and regulations. The Federal Surplus Personal Property Donation Program is operated by SASPs established by law in each state, the District of Columbia, the U.S. Virgin Islands, Guam, American Samoa, the Commonwealth of Puerto Rico, and the Commonwealth of the Northern Mariana Islands. A listing of SASP points of contact can be found at www.nasasp.org.

Typically Eligible Organizations

Organizations are eligible; individuals are not. The major categories of eligible participants in the Federal Surplus Personal Property Donation Program include public agencies, nonprofit educational or public health institutions, nonprofit and public programs for the elderly, veterans organizations, service educational activities, and public airports.

▪ Public Agencies

Broad categories of public agencies include

- States
- Local governments
- Instrumentalities of a state or local government
- Indian tribes on state reservations



▪ Nonprofit Educational or Public Health Institutions

A nonprofit organization is one exempt from federal income tax under section 501 of the Internal Revenue Code (26 U.S.C. 501). Examples of public agencies and nonprofit educational or public health institutions are

- Medical institutions, hospitals, clinics, and health centers
- Drug- or alcohol-abuse treatment centers
- Providers of assistance to homeless individuals and impoverished families or individuals
- Schools, colleges, and universities
- Schools for the mentally or physically disabled
- Child care centers
- Radio and television stations licensed by the Federal Communications Commission (FCC) as educational radio or educational television stations
- Museums attended by the public
- Libraries that serve all residents of a community, district, state, or region free-of-charge
- Historic light stations

▪ Nonprofit and Public Programs for the Elderly

Section 213 of the Older Americans Act of 1965, as amended (42 U.S.C. 3020d), authorizes donations of surplus property to state or local government agencies or nonprofit organizations or institutions that receive federal funding to conduct programs for older individuals.

▪ Veterans Organizations

Eligible veterans organizations are those whose membership substantially comprises veterans and whose representatives are recognized by the Secretary of Veterans Affairs under 38 U.S.C. 5902. SASPs are authorized to donate property to veterans organizations for purposes of providing services to veterans (as defined in 38 U.S.C. 101).



▪ Service Educational Activities (SEAs)

SEAs are educational activities of special interest to the Department of Defense (DoD). Established national organizations that are SEAs include

- American Red Cross
- Armed Services YMCA of the USA
- Big Brothers Big Sisters
- Boy Scouts of America
- Boys & Girls Clubs of America
- Camp Fire USA
- The Center for Excellence in Education
- Corporation for the Promotion of Rifle Practice and Firearms Safety
- Girl Scouts of the USA
- Little League Baseball, Inc.
- Marine Cadets of America
- Marine Corps League
- National Association for Equal Opportunity in Higher Education
- National Ski Patrol System
- United Service Organizations, Inc.
- United States Olympic Committee
- U.S. Naval Sea Cadet Corps
- Young Marines of the Marine Corps League



Schools with military training programs – such as military junior colleges, military institutes, high schools with a Junior Reserve Officer Training Corps unit or a National Defense Cadet Corps unit, naval honor schools, and state maritime academies – may also qualify as SEAs.

Only DoD-generated property may be donated to SEAs. General information concerning the designation of schools or organizations as SEAs can be obtained from:

Defense Logistics Agency (DLA-J349)
8725 John K. Kingman Road, Suite 4222
Fort Belvoir, VA 22060-6221
(703) 767-2578

▪ Public Airports

Generally, public airports are eligible to qualify as donees through SASPs. Additionally, under a separate authority, GSA can approve donations to public airports from a Federal Aviation Administration (FAA) program. For eligibility under the FAA authority, public airports should contact

- The applicable FAA regional office and
- Federal Aviation Administration
Office of Airport Planning and Programming (APP)
800 Independence Ave., SW
Washington, DC 20591



ELIGIBILITY



Finding and Obtaining Surplus Property

You can find out what is available by contacting your SASP. If your SASP maintains a warehouse, you can visit it to view and inspect property available to donees. If what you need is not at the SASP warehouse, you can submit a “want list” to the SASP. In turn, the SASP will search for the property you requested by visiting federal installations that generate surplus property or by searching GSAXcess®. Your SASP may elect to give you authorization to access GSAXcess, which would enable you to conduct computer screening to find out what property is available for transfer. Although you may search for property on your own, the request for property must be made by your SASP.

Costs

There is no charge for surplus property received through the Federal Surplus Personal Property Donation Program. However, most SASPs operate on a self-sustaining basis, which necessitates charging recipients for handling, shipping, and administrative expenses. Usually, the charges are considerably less than the original acquisition cost of the property.



Donee Restrictions

Generally, the donee must agree to place the property into use within their state and within one year of the acquisition and to continue the property's use for

- One year – for property with a unit acquisition value of less than \$5,000,
- Eighteen months – for passenger motor vehicles or any item of property having a unit acquisition value of \$5,000 or more,
- Five years – for aircraft and vessels 50 feet or more in length, and
- In perpetuity – for combat-configured aircraft and firearms.

The donee must also agree to operate in compliance with applicable federal nondiscrimination statutes.

A clear title to donated property is not granted until all restriction criteria are met. Violations of any of the conditions or restrictions may require return of the property to the SASP or reimbursement of the fair market value if the property is unable to be recovered.

For Additional Information

For more information on the Federal Surplus Personal Property Donation Program, visit our website at www.gsa.gov/propertydonations.

To locate your State Agency for Surplus Property, visit www.nasasp.org.

To speak with a GSA Area Property Officer, please visit www.gsa.gov/apo.



For more information, visit
www.gsa.gov/propertydonations.

www.gsa.gov
January 2016
5-16-00098

View, download, and order publications at gsa.gov/cmls.

An aerial photograph showing a vast area of flooding. A narrow, green, grassy path or road winds through the water, which is a muddy brown color. In the background, there are some trees and a small cluster of buildings. The sky is a pale blue with some light clouds. The overall scene depicts a significant flood event in a rural or semi-rural area.

DRAFT

Feather River Region

**Regional Flood Management
Plan**

May 16, 2013

**Feather River Region
Draft Regional Flood
Management Plan**

Rev. May 13, 2013

Funded by the California Department of Water
Resources

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Attachments

Acronyms and Abbreviations

ASA-CW	Assistant Secretary of the Army for Civil Works
Board	Central Valley Flood Protection Board
cfs	cubic feet per second
CMP	Corridor Management Plan
Conservation Strategy	Central Valley Flood System Conservation Strategy
CVFPP	Central Valley Flood Protection Plan
CVIFMS	Central Valley Integrated Flood Management Study
Delta	Sacramento-San Joaquin Delta
DWR	California Department of Water Resources
EAD	expected annual damages
ETL	Engineering Technical Letter
F-BO	Forecast-Based Operations
F-CO	Forecast-Coordinated Operations
Feather River Region	The 302,000-acre planning area encompassing the floodplains of the lower Feather River, Yuba River, and Bear River protected by SPFC Levees as shown in Figure 1 of this report
FEMA	Federal Emergency Management Agency
FloodSAFE	FloodSAFE California
FPZ	Flood Protection Zone
Framework Agreement	California’s Central Valley Flood System Improvement Framework Agreement
ft	feet
GIS	geographic information system
HEC-FDA	USACE Hydrologic Engineering Centers Flood Damage Analysis
LMA.....	Local maintaining Agency
LCM	Life Cycle Management
PGL	Policy Guidance Letter
Proposition 1E	Disaster Preparedness and Flood Prevention Bond Act of 2006
Proposition 84	Safe Drinking Water, Water Quality and Supply, Flood Control,

River and Coastal Protection Bond Act of 2006

RAMP	Regional Advance Mitigation Planning
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RFMP	Regional Flood Management Plan
SPA	System-wide Planning Area
SPFC	State Plan of Flood Control
SSIA	State System-wide Investment Approach
State	State of California
USACE	U.S. Army Corps of Engineers

Executive Summary

1 Introduction

1.1 Purpose of Report

The Yuba County Water Agency (YCWA), Three Rivers Levee Improvement Authority (TRLIA), Marysville Levee Commission (MLC), and Sutter Butte Flood Control Agency (SBFCA) have partnered with the State of California Department of Water Resources (DWR) to develop this Feather River Regional Flood Management Plan (“RFMP” or “Plan”). This Plan reflects the flood management priorities of the Feather River Region (Figure 1), while at the same time aligning with the recently adopted 2012 Central Valley Flood Protection Plan (CVFPP) to the extent feasible. By clearly establishing regional flood management priorities, this Plan will facilitate future funding and implementation of much-needed flood risk reduction projects.

Although funded by DWR, this plan is being shaped by the concerns and priorities of the communities in the Feather River Basin, including local agency representatives, LMAs, elected officials, property owners, businesses, interested individuals, small community representatives, native tribes, and non-governmental organizations. Accordingly, the planning process is founded on a strong strategic stakeholder outreach effort. Concurrent goals of the outreach effort are to strengthen inter-agency working relationships, engender region-wide understanding of integrated flood management goals, objectives, and needs, and promote a sustainable partnership structure to facilitate future implementation of mutually-beneficial projects.

1.2 The Planning Process

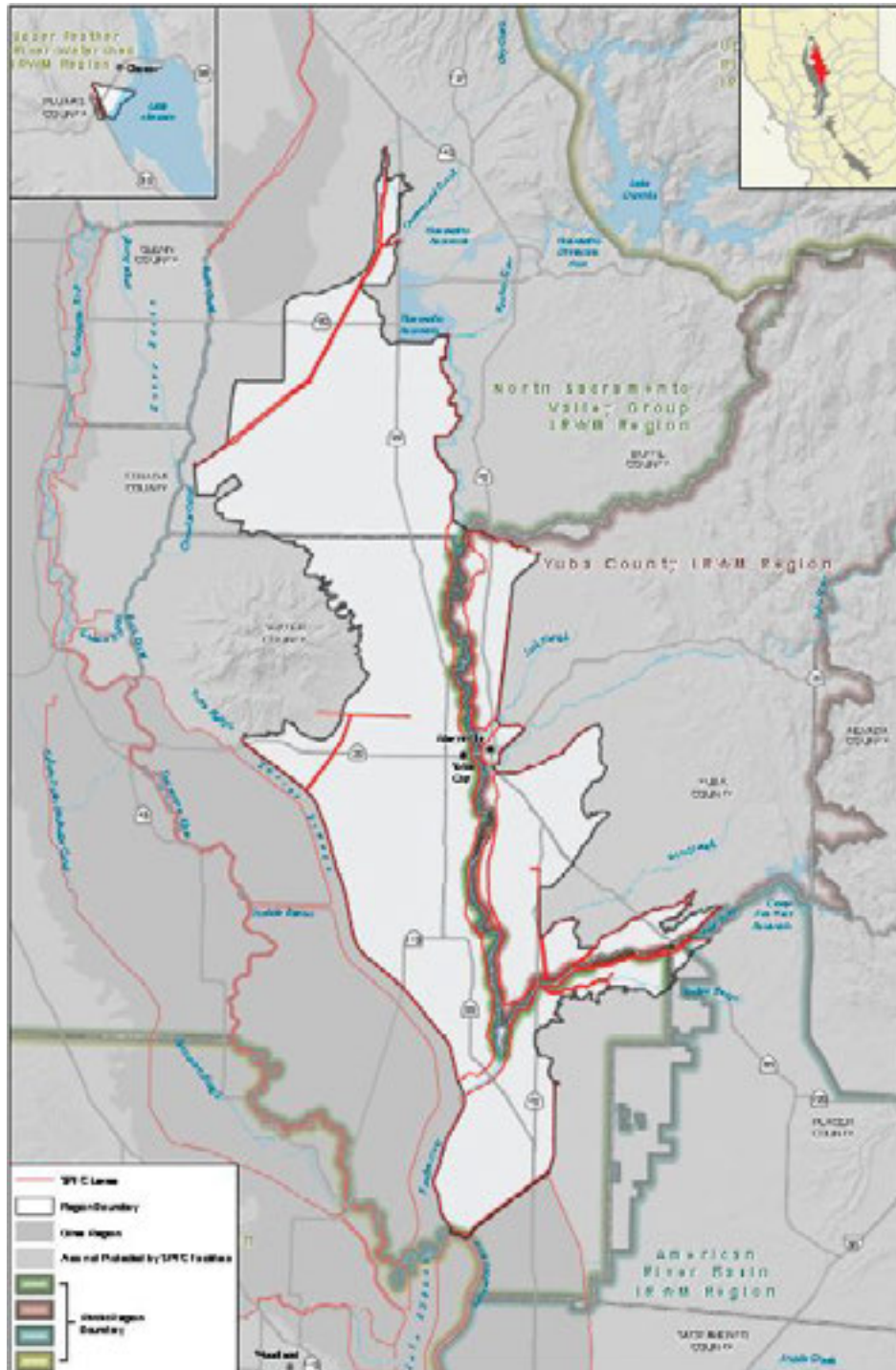
The plan formulation tasks focus on developing a description of the current state of flood management within the region, identifying opportunities for improving flood management while achieving multiple objectives, setting priorities, and developing a feasibility level financing plan. Together, these plan elements will define the long-term vision for flood risk reduction in the region.

The proposed approach involves a structured public outreach process, supported by available engineering, environmental, and financial analyses, leading to the incremental formulation of the RFMP. A website (<http://frfmp.com/>) and hotline (530-845-5988) were established in March 2013 to provide ready access to the planning team and the evolving documents compiled in the course of the planning process. The schedule of activities, meeting notices and summaries, briefing materials, the draft and final report, and supporting documents are posted on the website as they become available. In addition, the website includes links to key agencies and other planning processes.

These materials are also distributed via email to all interested parties. A link to register as an interested party is available under the “Contact” link on the website.

In order to provide opportunities for effective input in the planning process without creating an undue burden on the communities in the planning area, planning meetings are aligned with existing public meetings of the various involved agencies to the extent feasible. These include reclamation districts, cities, counties, and communities, supported by a few workshops specifically devoted to this plan formulation effort.

Figure 1. Feather River Region Flood Management Planning Area (DWR 2012)



1.3 Relationship with the Central Valley Flood Protection Plan

The Central Valley Flood Protection Plan (CVFPP) is a critical document to guide California's participation (and influence federal and local participation) in managing flood risk along the Sacramento River and San Joaquin River systems. The CVFPP proposes a system-wide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control (SPFC). The CVFPP will be updated every five years, with each update providing support for subsequent policy, program, and project implementation.

The California Department of Water Resources (DWR) conducted planning and investigations for the 2012 CVFPP from 2009 through 2011, representing the most comprehensive flood evaluations for the Central Valley ever conducted by the State. The CVFPP was adopted by the Central Valley Flood Protection Board (Board or CVFPB) on June 29, 2012.

Given its vast scope, the CVFPP could not incorporate the level of detail needed to delineate in detail likely system-wide improvement alternatives, nor did it include a detailed discussion of local flood risk reduction priorities. Instead, it provides a broad vision to help guide regional- and State-level financing plans to guide investments which may be in the range of \$14 billion to \$17 billion over the next 20 to 25 years.

In order to bring that process to fruition with the necessary level of detail and opportunity for full local participation in the planning process, the 2017 update to the CVFPP will be informed by regional flood management plans, such as this one, and two basin-wide feasibility studies.

The regional planning effort has been subdivided into the regions shown in Figure 2. At the request of the involved regional agencies, several of the original nine regions were consolidated into six. The regional plans are intended to clearly define local and regional flood management needs, priorities, and financing capabilities.

The two Basin-Wide Feasibility Studies (BWFS) will cover the Sacramento Valley and the San Joaquin Valley, respectively, as shown in Figure 3. They will primarily focus on the long-term needs of the SPFC to provide trans-regional benefits and improvements to the capacity, flexibility, and resiliency of the Central Valley Flood Management system.

DWR has indicated that it will prioritize State cost sharing funding for elements of the regional flood management plans to the extent that these elements are compatible with the vision, guiding principles, and elements of the CVFPP.

The Feather River Basin Regional Flood Management Plan formulation process is an integral part of the CVFPP process. It provides an opportunity for the region to bring into focus flood management issues of local concern, devise solution options, set priorities, and explore local financing mechanisms to help pay for planning, design, construction, and operation. This effort, while coordinated with the larger CVFPP, will build on the successes of projects implemented in the region since the 1986 flood, and to attract State and federal cost sharing to the maximum extent feasible. It is especially important that the region expedite the planning process to take advantage of remaining Proposition 1E and Proposition 84 bond funds, which were authorized in 2006, but expire in 2016. It is anticipated that compatible portions of the evolving Feather River Regional Flood Management Plan will be incorporated into the Sacramento Valley BWFS and the CVFPP, which will facilitate future State and federal cost sharing contributions to these elements.

Figure 2. Regional Flood Management Planning Areas (DWR 2012)



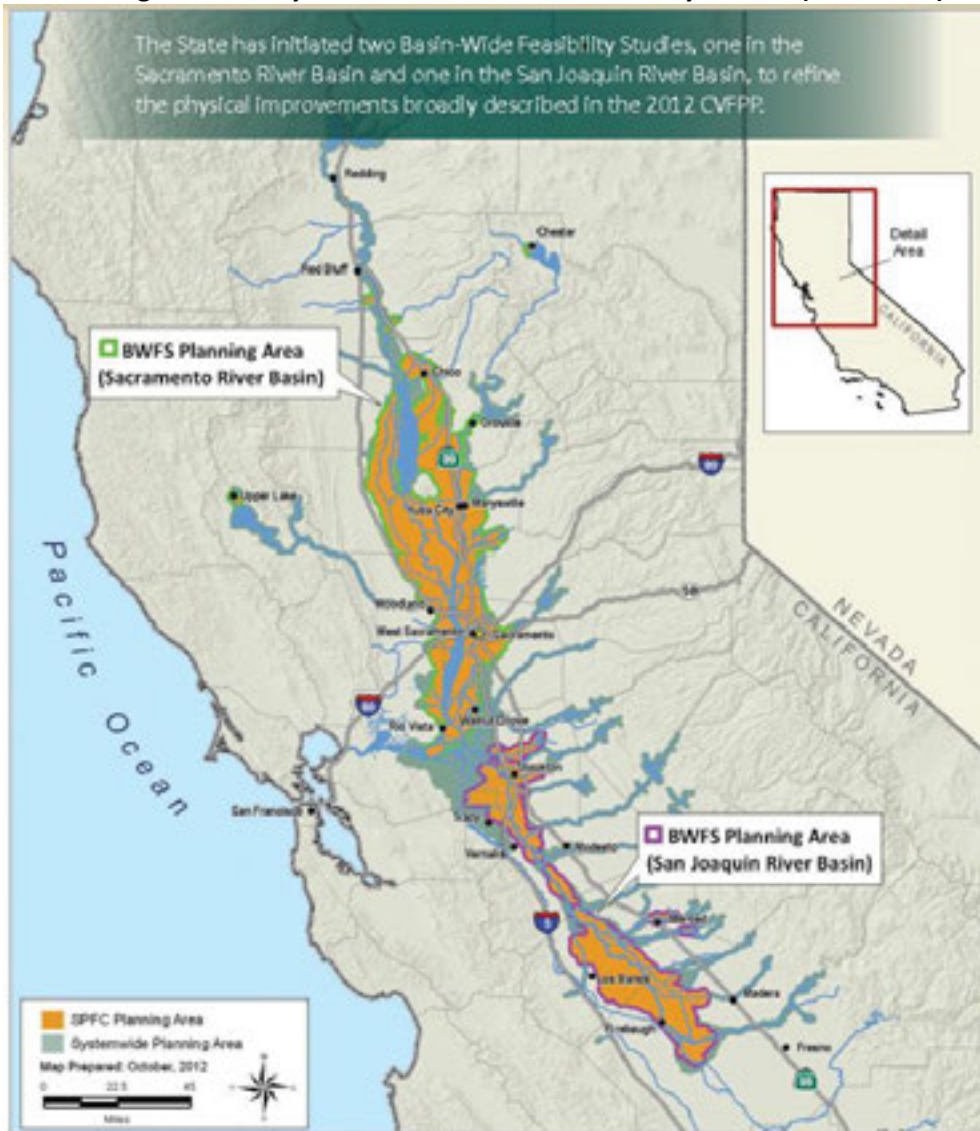
1.4 Use of Existing Information

Accordingly, the regional planning process is intended to move forward swiftly, with an anticipated duration of about 12 to 18 months. It will rely primarily on existing information provided by local agencies, property owners, businesses, interested individuals, native tribes, non-governmental organizations, as well as State and federal agencies. In particular, the process will rely heavily on the detailed operational knowledge of the flood system of the Local Maintaining Agencies (LMAs), the voluminous results of DWR’s CVFPP formulation efforts over the past five years, and USACE planning and construction documents. Some limited additional technical studies may be conducted to help in the plan formulation process as needed.

Existing State documents of particular importance in this plan formulation process include:

- Central Valley Flood Protection Plan (2012), including attachments and CVFPB Resolution 2012-25,
- Flood Control system Status Report (2010)
- State Plan of Flood Control Descriptive Document (2010)
- CVFPP Regional Conditions Report (March, 2010)
- Feather River Region Flood Atlas—Draft (2012)
- Regional Flood Management Planning Initiative, Guidelines for Directed Funding to Prepare Regional Flood Management Plans (2012)

Figure 3. Study Areas for Basin-Wide Feasibility Studies (DWR 2013)



1.5 Organization of the Planning Team

The Yuba County Water Agency (YCWA), Three Rivers Levee Improvement Authority (TRLIA), Marysville Levee Commission (MLC), and Sutter Butte Flood Control Agency (SBFCA) executed a Memorandum of Understanding (MOU) on September 12, 2012 to establish local cooperation and coordination in the regional plan formulation process. Under the MOU, the agencies created a Coordinating Committee, with six members selected to represent them in the plan formulation process, established a governance structure for the Committee, and appointed SBFCA to act as administrator of the funding agreement with DWR.

The partnering local agencies and the Coordinating Committee are supported by a consultant team, comprised of consultants selected to provide the range of technical expertise required to successfully complete the planning process.

1.6 Organization of this Report

This report is organized to reflect the natural chronological sequence of the planning process. Beginning with a description of background information and the regional setting, the report describes the identified problems and opportunities. With this foundation, potential management actions which can solve these problems are identified. Alternative solutions can be assembled through combinations of such actions. The alternatives are then evaluated in terms of potential benefits, costs, and impacts. The means and opportunities for financing proposed alternatives are formulated and described. Based on all of these elements, a locally determined set of action priorities is formulated and documented. Technical appendices provide documentation and additional detail regarding the planning process and the substance of the RFMP.

1.7 Regional Goals and Objectives

The overarching goal for the Feather River Region Flood Management Plan is to collaboratively develop a regional plan of action to reduce the risks of flooding, enhance economic stability, and improve environmental quality. Key objectives include:

- Provide 200-year flood protection for urban and urbanizing areas of the region, including Marysville, Yuba City, Biggs, Gridley, Live Oak, RD 784 and Wheatland;
- Provide 100-year flood protection for the small communities in the region, including Rio Oso, Nicolaus and Sutter;
- Improve flood protection for the rural agricultural areas within the region;
- Improve the flexibility and sustainability of the regional flood management system in light of climate change, rising operation and maintenance costs, and tightening regulatory constraints;
- Formulate the regional plan in such a way that it supports and strengthens the regional economy, primarily founded on highly productive farmland and a thriving agricultural economy;
- Identify opportunities to achieve habitat objectives through preservation and/or modification of agricultural practices;
- Modify State and federal regulatory frameworks to support continued productive agricultural use of the regional floodplains;

- Incorporate multiple objectives such as environmental restoration, improved water quality, open space, and recreation, to the extent such objectives are compatible with existing land uses;
- Maximize consistency with the CVFPP, where compatible with local flood management priorities;
- Maximize State and federal cost sharing; and
- Execute high priority projects, consistent with the Regional Plan, as rapidly as feasible.

The proposed regional plan will achieve these goals and objectives through both structural and non-structural means, as described in subsequent sections of the Plan.

2 Regional Setting

2.1.1 *Area and Boundaries*

The Feather River Region, as defined in this Plan, lies in the east-central portion of the Sacramento Valley, a broad, gently sloping valley that drains into the Sacramento-San Joaquin Delta (Delta). It incorporates an area of approximately 302,000 acres of levee-protected lands within Sutter County, Butte County, Yuba County, and a very small portion of Placer County along the Bear River near Wheatland (Figure 1). Except for the flood channels themselves, the entire Region is protected by levees which are included in the State Plan of Flood Control. The region extends about 56 miles from north to south and between 5 and 17 miles from west to east.

From north to south the western boundary of the region follows the vicinity of Cherokee Canal from the Junction of Highway 99 and Highway 149 to the base of the Sutter Buttes, the eastern base of the Sutter Buttes to the Sutter Bypass, and then along the east levee of the Sutter Bypass to the Feather River, and then the east levee of the Feather River to the Natomas Cross Canal north levee.

From north to south the eastern boundary of the Region follows the west levee of the Feather River from Thermalito Afterbay to Marysville, encompassing the floodplain east of the Feather River, including the lower Bear River and Wheatland, to the Natomas Cross Canal north levee.

The seven mile-long Natomas Cross Canal north levee constitutes the southern boundary of the region.

The rivers, bypass channels, creeks, and their floodplains which lie between the project levees in the region and convey its flood waters downstream are not included in the planning area because these areas are designated for flood conveyance, and thus are not protected by the levees. Nevertheless, their characteristics, in terms of their conveyance capacity, fisheries and wildlife habitat quality, other resource benefits, and restoration opportunities are important and are considered in the planning process.

2.1.2 *Population and Land Use*

Within this region, approximately 76 percent is actively farmed agricultural land, 16 percent native vegetation and grazing land, and 8 percent is urban and built up land.

Based on 2010 census data, the Region has a population of 135,300, with most residents concentrated in the urban areas of Yuba City, Marysville, Wheatland, Gridley, Live Oak, and Biggs. Table ___ shows the populations of these communities.

Table 1. Populations of Cities and Communities in the Feather River Region

City or Community	County	Population ¹
Yuba City	Sutter	63,328
Linda	Yuba	17,773
Olivehurst	Yuba	13,656
Marysville	Yuba	12,073
Live Oak	Sutter	8,392
Gridley	Butte	6,584
Tierra Buena	Sutter	4,587
Wheatland	Yuba	3,456
Sutter	Sutter	2904 ³
Biggs	Butte	1,707
Rio Oso	Sutter	356 ³
Nicolaus	Sutter	280 ²

¹ U.S. Census, 2010,

²Population Sign in Nicolaus, CA

³U.S. Census, 2012

Major north-south State highways include Highways 70, 99, 65 and 113. Major east-west State highways include Highways 162 and 20.

2.1.3 Key Infrastructure

Two Union Pacific Rail lines, the Valley and Sacramento Sub-lines, pass through the region from north to south through Biggs, Gridley, Live Oak, Yuba City, Linda, Olivehurst, Marysville, and Wheatland along the way. These lines cross at Binney Junction in northern Marysville and accommodate XX trains per day average.

The Sutter County Airport and the Yuba County Airport are located near each other, in the southern portion of the Yuba City-Marysville metropolitan area, on the west side and east side of the Feather River, respectively.

2.1.4 Historical Context

Prior to the 1848, when the Gold Rush set off a huge, rapid influx of settlers, the region was occupied by Native American tribes, which lived by subsistence off of the abundant and diverse resources in the valley and foothills, including various runs of salmon, waterfowl, deer, elk, and

acorns. The Native Americans adapted to the natural landscape and climate (Brewer, 1966), although records indicate that thousands died in a large flood at the beginning of the nineteenth century (USACE, 2011).

The low-lying portions of the valley were occupied by vast tule marshes, with riparian forests growing on the low, natural levees lining the meandering channels. At the higher elevations these marshes and riparian forests gave way to grasslands and oak woodlands (Brewer, 1966).

With its Mediterranean climate, the region is characterized by a well-defined cool wet season lasting generally from October through April, followed by a dry hot summer. With the Sierra Nevada Mountains to the east, and the exposure to the influence of storms sweeping in from the Pacific Ocean, the Region can be subjected to rapid, extreme, and persistent flooding. The watersheds of the Feather River, the Yuba River, the Bear River, are capable of generating extreme peak flows when warm Pacific storms sweep in from the west or southwest, with high winds and ample moisture and release torrential rains as they are lifted over the mountains (Kelley, 1989), especially when combined with large snowmelt volumes from the Sierra Mountains.

Large floods were frequent in the nineteenth century, with high water events recorded for the Sacramento Valley in 1850, 1852, 1853, 1861-62, 1866-67, 1868, 1872, 1873, 1875, 1881, 1889, and 1892-93 (Kelley, 1989). Large floods have continued into the twentieth century as well, including 1902, 1907, and 1909, 1928, 1937, 1940, 1942, 1950, 1955, 1964, 1986, and 1997 (Thompson, 1989 and USACE 2011).

European settlement began in the Region around 1850 with the development of highly productive farms in the Marysville-Yuba City area. After the devastating floods of 1852 and 1853, the people of Marysville and surrounding areas adjacent to the Feather and Yuba Rivers began to build levees to protect their property from future flood events (USACE, 2011).

By the spring of 1867 a privately constructed levee extended along the west bank of the Feather River from its mouth to Star Bend, a distance of seven miles. Following flooding in April 1867 the people of Yuba City and the Sutter Basin determined to close off Gilsizer Slough and other overflow channels to the basin by constructing a levee from there to Star Bend, a distance of 20 miles (Kelley, 1989). The partially completed levee, constructed of mounded up dirt, was breached by floodwaters in December of the same year. This set the pattern for the following decades, wherein the levee system was incrementally improved, yet inadequate to reliably hold back the enormous flows emanating from the Feather, Yuba, and Bear rivers.

The flood threat was greatly exacerbated by hydraulic mining, which sent millions of cubic yards of gravel, sand, and clay downstream to choke the channels of the Feather, Yuba and Bear rivers, and spread deep layers of sterile sediment over the fertile floodplains adjacent to the river channels where they emerged from the foothills. The hydraulic mining, which began in 1853 near Nevada City, rapidly expanded to include Mother Lode gravels along much of the Central Sierra Nevada. It was largely halted as a result of the Woodruff vs. North Bloomfield decision, rendered in 1884 (Kelley, 1989, Rohe 1985).

In 1893 Congress passed the Caminetti Act, which created the California Debris Commission (CDC) and allowed hydraulic mining to resume as long as the mining debris could be contained at or near the mine sites. Crib dams constructed for this purpose proved unreliable, and much of the infrastructure to support hydraulic mining had been destroyed in the flood of 1891, so hydraulic mining activity did not resume on a large scale (Kelley, 1989). Multiple failures of the west levee of the Feather River flooded the communities of Biggs, Gridley and Live Oak dating back to the early 1900's, including deadly failures of the Hazelbush levee near Biggs in 1907 and the 1955 Shanghai Bend levee near Yuba City (Appeal Democrat).

The CDC, which was eventually consolidated with USACE, constructed three important mining debris retention dams, including Dauterre Point Dam on the Yuba River about 11 miles upstream from Marysville in 1906 and Englebright Dam on the Middle Fork of the Yuba River near Smartville in 1941 (USACE, 2012). It also isolated the vast hydraulic mining debris fields from the main Yuba River channel by contracting with gold dredgers to dredge the main channel and construct gravel training walls (Kelley, 1989).

The Jackson Plan, a comprehensive plan for flood protection for the Sacramento Valley was proposed by USACE in 1910. Based on the flows recorded in the floods of 1907 and 1909, the plan relied on a system of levees along existing streams, supplemented by overflow weirs and bypasses to convey excess flood flows. The State Reclamation Board (renamed the Central Valley Flood Protection Board in 2007) was created the next year to carry out the plan, subsequently supported by the federal authorization of the Sacramento River Flood Control Project in 1917 (CVFPB, 2012). The State and federally authorized Project, which was substantially completed by 1958, includes the levees along the Sacramento River, the Feather River, Yuba River, Bear River, Cherokee Canal, the Sutter Bypass, Tisdale Bypass, Wadsworth Canal (and the West Intercepting Canal and East Intercepting Canal, which feed into it).

As described by the Yuba County Water Agency (Be Prepared Yuba, 2013), multiple levee failures since the 1800s put residents and the communities at grave risk. Moreover, many of these failures occurred due to sudden, catastrophic failure of the levee or foundation, rather than conveyance capacity. For example, while the west bank of the Feather River alone sustained dozens of failures since 1907, at least 6 and as many as 10 of these failures occurred when the water surface was below the levee crest (JRP study by SBFCA).

In 1950 the mining interests constructed a barrier across the low flow channel of the Yuba River to divert flows so the main channel could be mined. An early season flood caught the miners unprepared and on November 21, 1950, the south bank of the Yuba River broke near the town of Hammonton, inundating 43,200 acres, flooding the town of Hammonton and also inundated portions of southern Yuba County, causing over \$4 million (in 1950 dollars) in damage (USACE 2011).

In 1955 as every watershed in California was hit by tropical storms, the Yuba became a raging torrent that choked its mountain channel, poured over the dams at Bullards Bar and Englebright Reservoir and ripped into the valley. The December 1955 flood was the most damaging flood recorded to date, based on loss of lives and damages. The peak flow on the Feather River was estimated at 180,000 cfs, and a peak flow of about 155,000 cfs was measured at the Marysville gage on the Yuba River. There was no upstream storage for flood waters on either the Feather or

the Yuba at this time. Simultaneous peaks occurred on both the Feather and Yuba Rivers. The Feather River levee at Yuba City broke on the right bank about 2 miles downstream of the mouth of the Yuba River at Shanghai Bend. The left bank levee of the Feather River also broke near Nicolaus. Marysville's levees were threatened. About 100,000 acres of land were inundated, including 95 percent of Yuba City. Thirty-eight people were killed in the Yuba City area, and two were killed in the Nicolaus area. About 3,300 homes were flooded; 6,000 cattle were killed; and more than 30,000 people were evacuated. Flood damage was estimated at \$50.5 million (in 1955 dollars). The flooded communities were disrupted for several months (USACE 2011).

DWR constructed Oroville Dam and Reservoir in the period 1964 to 1967 as part of the massive State Water Project. Despite being partially completed, Oroville Dam helped control the flood of December 1964, limiting damage in the Region. During the December 1964 flood, the peak inflow into the nearly completed Oroville Reservoir was 253,000 cfs. Outflow from the partially constructed Oroville Dam was reduced to 158,000 cfs. Peak flows on the Yuba River reached 180,000 cfs and encroached into the levee freeboard. The flood inundated about 25,000 acres of agricultural land in the Feather River floodway and within the Yuba River levees, causing damages of about \$5 million (in 1964 dollars). Flood storage in the Oroville Reservoir reduced the flow in the Feather River when the Yuba River peaked, which reduced the combined flows from the Feather and Yuba Rivers downstream of the confluence. As a result, the upstream backwater effect and the downstream peak flows were reduced.

In response to the 1955 flood, the State Legislature created the Yuba County Water Agency in 1959, which, in cooperation with USACE and the State, constructed the multi-purpose New Bullards Bar Dam and Reservoir. In large part financed by local revenue bonds, the dam construction began in 1966 and was completed in 1969. It provides up to 170,000 acre-feet of flood control storage October 31 through March 31 of each year.

The February 1986 flood was created by an intense persistent storm system, characterized by a rapidly moving, warm, moist stream of air from the subtropics, which carried a series of large, closely spaced rain storms into Northern California. Peak flows on the Yuba River during the February 1986 flood were about 111,900 cfs. Oroville Reservoir on the Feather River had peak inflows of 198,900 cfs and made controlled releases of 147,400 cfs. There was little time between storms to make releases to regain flood storage space. Both Oroville and New Bullards Bar Reservoirs were almost filled to flood storage capacity and nearly had to make releases of total inflow. On February 20, 1986, while the Feather River and Yuba River were receding, a section of the Yuba River left bank levee failed just upstream of the Feather River (USACE 2011).

Water quickly inundated the towns of Linda and Olivehurst. More than 3,000 homes were damaged and 895 were destroyed. Flood waters were 10 feet high in some places. Losses were estimated at \$22 million. In the years immediately following, millions were spent by the US Army Corps of Engineers and the state to improve the area's levees and correct problems.

The January 1997 flood was probably the largest in northern California since measured records began in 1906. The flood was notable in the sustained intensity of rainfall, volume of floodwater, and areal extent – from the Oregon border to the southern end of the Sierra Nevada. New flood records were set on many of the major Central Valley Rivers. Over the 3-day period

around New Year's Day, warm moist winds from the southwest blowing over the Sierra Nevada poured more than 30 inches of rain onto watersheds that were already saturated by one of the wettest Decembers on record. Most of the large dams in northern California were full or nearly full within the first days in January.

A break in the Feather River levee near the community of Arboga occurred on January 2, 1997, prompting the evacuation of about 15,000 people from Linda and Olivehurst. Homes closest to the breaks were destroyed by the force of the rushing water, with some reports indicating flood depths of 30 feet. Farther from the levee breaks, many homes were damaged beyond repair due to water depths of 10 feet (Be Prepared Yuba, 2013). Three people lost their lives, and nearly 50,000 inhabitants of Yuba City, Marysville, and surrounding areas were evacuated because of fears over possible additional levee breaks. Two relief cuts were made in the Feather River levee further downstream of the levee break to drain the floodwaters accumulating in the southern portion of RD 784. Two additional breaks occurred on the right bank levee of the Bear River near the Highway 70 Bridge which aided in draining the floodwater (USACE 2011).

Portions of the communities are still trying to recover today, more than 20 years later. In the course of the flood 1,000 acres of residential land, 15,500 acres of agricultural land, and 1,700 acres of industrial land were flooded. 322 homes were destroyed and 407 suffered major damage. The estimated cost of the flooding exceeded \$300 million (Be Prepared Yuba 2013).

The Gulf Coast devastation caused by Hurricane Katrina in 2005, particularly the flooding of New Orleans, brought into sharp focus the need for improved flood protection in California. Proposition 1E and Proposition 84, approved by California voters in November, 2006, authorizes the State to expend about \$5 billion in bond funds for improved flood protection. As a result, DWR has been able to substantially accelerate flood risk reduction projects, launch the FloodSAFE initiative, and implement numerous improvements in California flood management. Local agencies as well have once again taken a leadership role in formulating and executing flood protection for major urban centers in the Central Valley, including the Sacramento Area Flood Control Agency, West Sacramento Area Flood Control Agency, the Three Rivers Levee Authority, and the Sutter Butte Flood Control Agency.

2.2 The Regional Flood Management System

2.2.1 Structural Elements

The flood management system which currently provides protection to the Feather River Region includes upstream reservoirs with active flood control space, levees along the major flood control channels, and drainage facilities which pump interior runoff and seepage from levee protected areas back into the flood control channels. It is part of a vast system of multi-purpose reservoirs, leveed stream channels, weirs, and overflow structures which has been constructed to reduce flooding in the Sacramento Valley over the past 160 years (Figure 4).

Figure 4. State Plan of Flood Control Facilities, Sacramento River Basin (DWR 2011)



Reservoirs in the Region with an active flood control function include Lake Oroville on the Feather River, operated by DWR and New Bullards Bar Reservoir, on the Yuba River, operated by YCWA. Camp Far West Reservoir on the Bear River, operated by South Sutter Water District, does not provide any dedicated flood control storage and is typically full and spilling during flood events. However, the existence of the water supply facility does serve to attenuate a portion of the peak flow as it passes through the surcharged reservoir.

SPFC levees line the Cherokee canal north of the Sutter Buttes, the Feather River downstream of Thermalito Afterbay, the perimeter of Marysville, the Yuba River north of the Yuba Goldfields, the lower Bear River, Yankee Slough, the Western Pacific Railroad Interceptor Canal, the Sutter Bypass, Wadsworth Canal, (and the West Intercepting Canal and East Intercepting Canal which feed into it).

Figure 5 shows these levees and the design capacities of the channels enclosed by the levees.

Figure 5. Feather River Basin Flood Management Facilities and Capacities

2.2.3 Non-Structural Elements

Non-structural flood risk management elements include a wide range of measures which limit the risk of flood damage primarily by avoiding or reducing the exposure to damaging flood waters rather than by confining those flood waters with larger and stronger hydraulic structures. These elements include raising and waterproofing structures so that they will be above anticipated flood levels or unharmed by flood waters, purchasing and relocating at-risk structures, limiting development in floodplains through the acquisition of agricultural conservation easements, open space easements, regulatory constraints, and incentive programs. Restoration of flood plains where feasible, to provide additional flood channel storage and conveyance capacity, is often regarded as a non-structural element because it reduces, rather than increases, the confinement of floodwaters in existing channels.

The most significant non-structural flood risk reduction program is FEMA's National Flood Insurance Program, which includes mapping flood hazard areas nationwide, and requiring that homes and other structures with federally backed mortgages must carry flood insurance if the flood risks warrant it, and by requiring minimum construction standards within the floodplain.

Senate Bill 5 and companion legislation passed by the State Legislature in October 2007 establishes flood protection requirements for urban areas and small communities and requires that further floodplain development be accompanied by appropriate levels of flood protection.

2.2.4 Involved Local, State, and Federal Agencies

Historically, major flood management initiatives in California have been undertaken by local, State, and federal agencies in an evolving cooperative relationship. Beginning in the 1850's, levee improvements were initiated as entirely local undertakings, with sporadic efforts to provide State coordination and oversight.

State oversight of flood control efforts in the Sacramento Valley began in 1911, with the creation of the Central Valley Flood Protection Board (formerly the State Reclamation Board). Federal participation in California flood management, which was first authorized in the Caminetti Act of 1893, was firmly established with authorization of the Sacramento River Flood Control Project in 1917. From 1917 to 2006 USACE has played a lead role in planning, authorizing, financing, constructing, and inspecting flood system improvements in the Sacramento Valley, incorporating and improving upon the levee system originally constructed by local agencies (Kelley, 1989).

Since 2006 DWR and local agencies have played more prominent roles, providing leadership on major levee improvement projects in the Region. The various roles of the involved agencies can be expected to continue to shift in response to political and policy changes, funding availability, interest, and leadership. The roles of the key local, State, and federal agencies involved in providing and permitting flood management projects and programs are summarized below:

2.2.4.1 Local Agencies and their Responsibilities

Local agencies play a key role in providing flood protection for the region.

Yuba County Water Agency

The Yuba County Water Agency operates New Bullards Bar Dam and Reservoir on the Yuba River for flood control, water conservation, and power generation. Since its creation in 1959 it has played a strong leadership role in enhancing regional flood protection. In addition to operating New Bullards Bar Dam and Reservoir for flood control, water supply, power generation, and other purposes, it has provided support and leadership for levee improvement projects in Yuba County and the Region.

South Sutter Water District

Camp Far West Irrigation District was created in 1924 to construct Camp Far West reservoir on the Bear River and Rock Creek and distribute its waters for irrigation. In 1954 the South Sutter Water District was created and subsequently joined with the Camp Far West Irrigation District to construct and operate the New Camp Far West Reservoir, with a capacity of 104,000 acre feet and 7 megawatts of generating capacity which was completed in 1964 (SWRCB, 1958). In addition to its primary functions of providing irrigation water and generating electricity, the facility also provides a minor amount of flood peak attenuation through reservoir surcharge.

Levee Maintaining Agencies (LMAs)

Local levee districts, reclamation districts, and State maintenance areas, known collectively as Levee Maintaining Agencies (LMAs), regularly patrol, maintain, repair, and conduct flood fights as needed on the levees within their jurisdictions. The LMAs have given assurances to the Central Valley Flood Protection Board (CVFPB) that they will operate and maintain the Project levees within their respective jurisdictions (see Table ___ and Figure 6 in perpetuity in accordance with criteria established by the U.S. Army Corps of Engineers (USACE).

Table 2. Local Maintaining Agencies for State Plan of Flood Control Levees in the Feather River Region

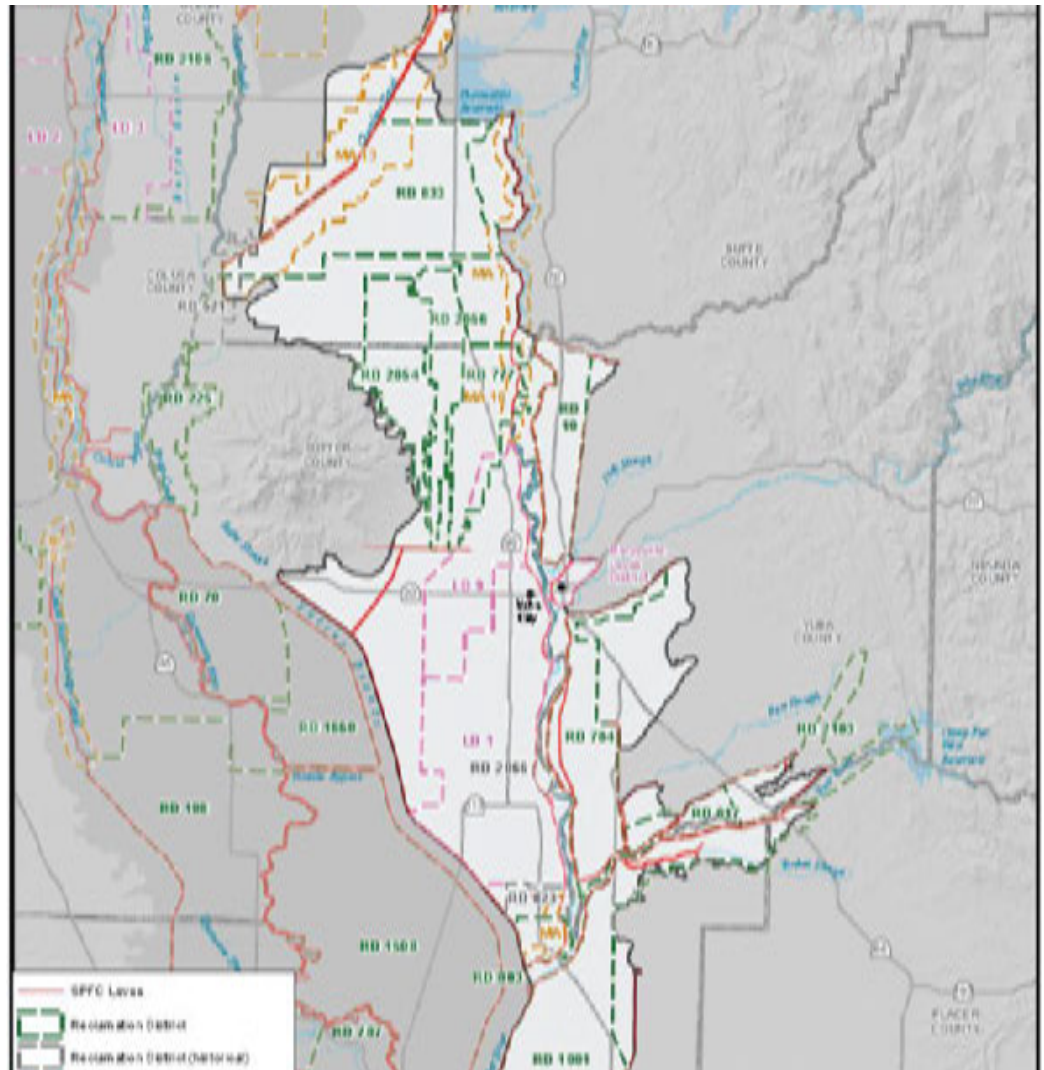
Local Maintaining Agency	County	Stream	Miles
Levee District No. 1	Sutter	Feather River	
Levee District No 9	Sutter	Feather River	
Reclamation District No. 10, Honcut	Yuba	Feather River and Honcut Creek	
Reclamation District 784, Plumas Lake	Yuba	Yuba River LB, Feather River LB, Bear River RB , and Western Pacific Interceptor Canal	
Reclamation District 817, Carlin	Yuba and Sutter	Bear River RB and Dry Creek	
Reclamation District 1001, Nicolaus	Sutter	Bear River LB, Yankee Slough, Feather River LB, and Natomas Cross Canal	
Reclamation District 2103, Wheatland Vicinity	Yuba	Bear River RB and Dry Creek	
Marysville Levee District	Yuba	Feather River, Yuba River, and Jack Slough	

DWR Maintenance Area 3 ¹	Sutter	Feather River and Sutter Bypass	
DWR Maintenance Area 7 ¹	Butte and Sutter	Feather River	
DWR Maintenance Area 13 ¹	Butte	Cherokee Canal	
DWR Maintenance Area 16 ¹	Sutter	Feather River	

¹ Maintenance provided by the Sutter Maintenance Yard, DWR

Two regional flood management agencies have been created to improve flood protection for the Region over the past nine years.

Figure 6. Levee Maintaining Agencies, Districts, and State Maintenance Areas



The Three Rivers Levee Improvement Authority (TRLIA)

The Three Rivers Levee Improvement Authority (TRLIA), a joint powers agency, was established in May 2004 by the County of Yuba and Reclamation District 784 to finance and construct levee improvements in south Yuba County. TRLIA’s mission is to provide 200-year flood protection to the Three Rivers area, bounded on the north by the Yuba River, on the west by the Feather River, on the south by the Bear River, and the southeast by the Western Pacific Interceptor Canal levee. Four work phases were identified to achieve that goal along the Yuba, Feather, and Bear Rivers and the Western Pacific Interceptor Canal (TRLIA, 2013).

The Sutter-Butte Flood Control Agency (SBFCA)

The Sutter-Butte Flood Control Agency (SBFCA), a joint powers agency formed in 2007 by the Counties of Butte and Sutter, the Cities of Biggs, Gridley, Live Oak and Yuba City, and Levee Districts 1 and 9. The agency has the authority to finance and construct regional levee improvements. It is currently working to improve the levees protecting the Sutter Basin, with the initial phases of work focused on the Feather River west levee (SBFCA, 2013).

2.2.4.2 Relevant State Agencies and their Responsibilities

The local agencies are supported in their flood management missions by key State agencies.

Central Valley Flood Protection Board (CVFPB)

The CVFPB, with regulatory authority over the SPFC levees, has given assurances to the U.S. Army Corps of Engineers that the federally authorized Project levees will be operated and maintained in accordance with those criteria. It serves as the non-federal sponsor for capital improvement projects for levees in the Region, regulates encroachments, and works to assure that the various components function as a system.

California Department of Water Resources (DWR)

DWR, primarily acting through the Division of Flood Management, is responsible for State-level flood management in the region, including cooperating with USACE in project planning, design, and funding, cooperating with the National Ocean and Atmospheric Administration (NOAA) in flood and water supply forecasting, operating the Flood Operations Center, providing flood fight assistance for local agencies, and maintaining portions of the system. DWR's levee maintenance responsibilities include portions of the system designated for State maintenance in the California Water Code (CWC §8361(f)), and operating Maintenance Areas (MAs) when local agencies cannot, or choose not to meet the maintenance obligations established under the assurances given to the CVFPB and USACE (CWC §12878 et. seq.). Under these authorities the DWR Sutter Maintenance Yard maintains MA 3, 7, 13, and 16, as shown in Figure 6, as well as the east levee of the Sutter Bypass, the West Interceptor Canal, the East Interceptor Canal, Wadsworth Canal, and Sutter Basin drainage pumping facilities. The Sutter Maintenance Yard is located in the town of Sutter, along Highway 20.

Oroville Dam and Reservoir, completed in 1967, are operated by DWR's Division of Operation and Maintenance in accordance with criteria established by USACE.

California Office of Emergency Services (Cal OES)

The California Office of Emergency Services (Cal OES) has overall State emergency response management authority, which among other things, includes assuring that State and local agencies operate in accordance with the Standardized Emergency Management System (SEMS).

California Department of Fish and Wildlife (CDFW)

The California Department of Fish and Wildlife (CDFW) administers State laws and regulations regarding the protection of fish and wildlife resources, and as such exerts permitting authority over flood control project construction, operation, and maintenance activities, as well as managing State wildlife areas in the region.

State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Board, Central Valley Region (RWQCB)

The State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Board, Central Valley Region (RWQCB), administer State water rights and water quality laws and regulations. The SWRCB, given its authority over water rights, including stream diversions,

may exert regulatory authority over flood control or environmental restoration projects that result in new diversions from existing channels. The RWQCB requires that construction projects, such as levee improvement projects, avoid injurious discharges from worksites to streams by preparing and adhering to Stormwater Management Plans and following Best Management Practices for chemicals, diesel fuel, drilling fluid, and other typical construction fluids. The RWQCB also works closely with USACE when it issues Section 404 permits, which must include a certification by the RWQCB that water quality will not be impaired (Section 401 permit).

California Department of Conservation (DOC)

The California Department of Conservation is responsible for administering the California Surface Mining and Reclamation Act (SMARA) of 1975. It assures that local governments, such as cities and counties, adopt and administer ordinances compliant with the law. SMARA is an important consideration for most flood control projects, as it applies to any projects which disturb more than one acre of land or move more than 1,000 cubic yards of material. SMARA compliance involves formulating projects which do not result in injurious discharges from the disturbed area during the mining operation, followed by a reclamation plan which restores the mined land to beneficial use (DOC, 2013).

DOC also administers the Williamson Act, enacted in 1965, designed to help preserve agricultural land through property tax incentives and long-term contracts. It was enhanced in 1998 with the addition of Farmland Security Zone (FSZ) provisions, which offers additional incentives to extend the contract period from the normal ten-year period to twenty years. Butte County, Sutter County, and Placer County participate in the Williamson Act program. Placer County also participates in the FSZ provisions as well. Yuba County does not participate in the program. The DOC also administers various grant programs for the acquisition of agricultural and open space preservation. (DOC, 2013) Such programs may work synergistically with non-structural flood management projects, which may improve flood system capacity, reduce long-term risks to life and property, and improve resiliency through actions such as agricultural conservation easements, open space easements, levee setbacks and floodplain restoration, where locally supported and feasible.

The California Air Resources Board (ARB)

The California Air Resources Board, established in 1967 with the passage of the Mulford-Carrell Act, has consistently set air quality standards for California which are more stringent than the national standards. It oversees 35 local and regional air pollution control districts, which are responsible for regulating air quality within their districts. Within the Region, the Butte County Air Quality Maintenance District, the Feather River Air Quality Maintenance District, and the Placer County Air Pollution Control District regulate air quality. These districts review and exert permitting authority over flood control project construction activities. In practice, the primary constituents of concern are fugitive dust and diesel exhaust, which can be limited through the application of best management practices (Air Resources Board, 2013).

State Historic Preservation Office (SHPO)

The extensive ground disturbing activities associated with levee reconstruction may affect archaeological and cultural resources, which are protected by both federal and State law. The State Historic Preservation Office (SHPO) must approve construction activities which have the potential for disturbing such resources. Mitigation for the potential impacts on archaeological and cultural resources include pre-construction surveys, designing projects to avoid impacts where feasible, construction monitoring, and protection of such resources if discovered during the course of construction. It is very important to coordinate with the Most Likely Descendants (MLDs) of resources in the project area throughout the planning and construction process.

2.2.4.3 Federal Agencies and their Responsibilities

U.S. Army Corps of Engineers

At the federal level, USACE is primarily responsible for planning, designing, and constructing federally authorized flood management facilities, including dams, levees, and other structures. It also develops the operational rules for federally funded flood control reservoirs, which includes most of the major reservoirs on Central Valley streams. USACE also administers 33 U.S.C. 408 (*Section 408*) to permit others to alter and modify an existing USACE project under certain circumstances; this is an important permission for State or locally-led projects. Following the Hurricane Katrina Gulf Coast disaster of 2005 USACE has implemented a National Levee Safety Program, promulgated strict vegetation management guidelines, and strengthened its national levee inspection program.

National Weather Service (NWS)

The National Weather Service (NWS), a part of the National Oceanic and Atmospheric Administration, operates centers throughout the United States which monitor and forecast climate, weather, severe storms, and runoff. In California the NWS weather forecasting centers are supplemented by the California Nevada River Forecast Center (CNRFC) which cooperates with DWR to issue flood and water supply forecasts (CNRFC, 2013). These forecasts are critically important to the Region, because under winter storm conditions, the Feather, Yuba, and Bear rivers can rapidly generate enormous flows, creating conditions of extreme peril for residents and damageable property in the levee-protected areas of the Region. Accurate and timely flood forecasts are an important component of the Region's flood risk management system.

NOAA Fisheries

NOAA Fisheries is responsible for the protection of anadromous fisheries, including salmon and steelhead, which migrate through, and spawn in channels of the Feather, Yuba, and Bear rivers, as well as some local creeks. NOAA Fisheries plays an important role in the flood project planning process, providing guidance on ways to design and operate flood control works to minimize impacts and enhance fisheries habitat. USACE and other project proponents must consult with NOAA fisheries in all phases of federal flood management project planning, design, and construction which have the potential for impacting the species of concern which NOAA Fisheries administers. In administering various federal statutes and regulations protecting migratory species of concern, NOAA fisheries may also impose conditions on the operation of

multi-purpose dams and reservoirs with federal participation, including the major reservoirs protecting the region (NOAA Fisheries, 2013).

U.S. Fish and Wildlife Service (USFWS)

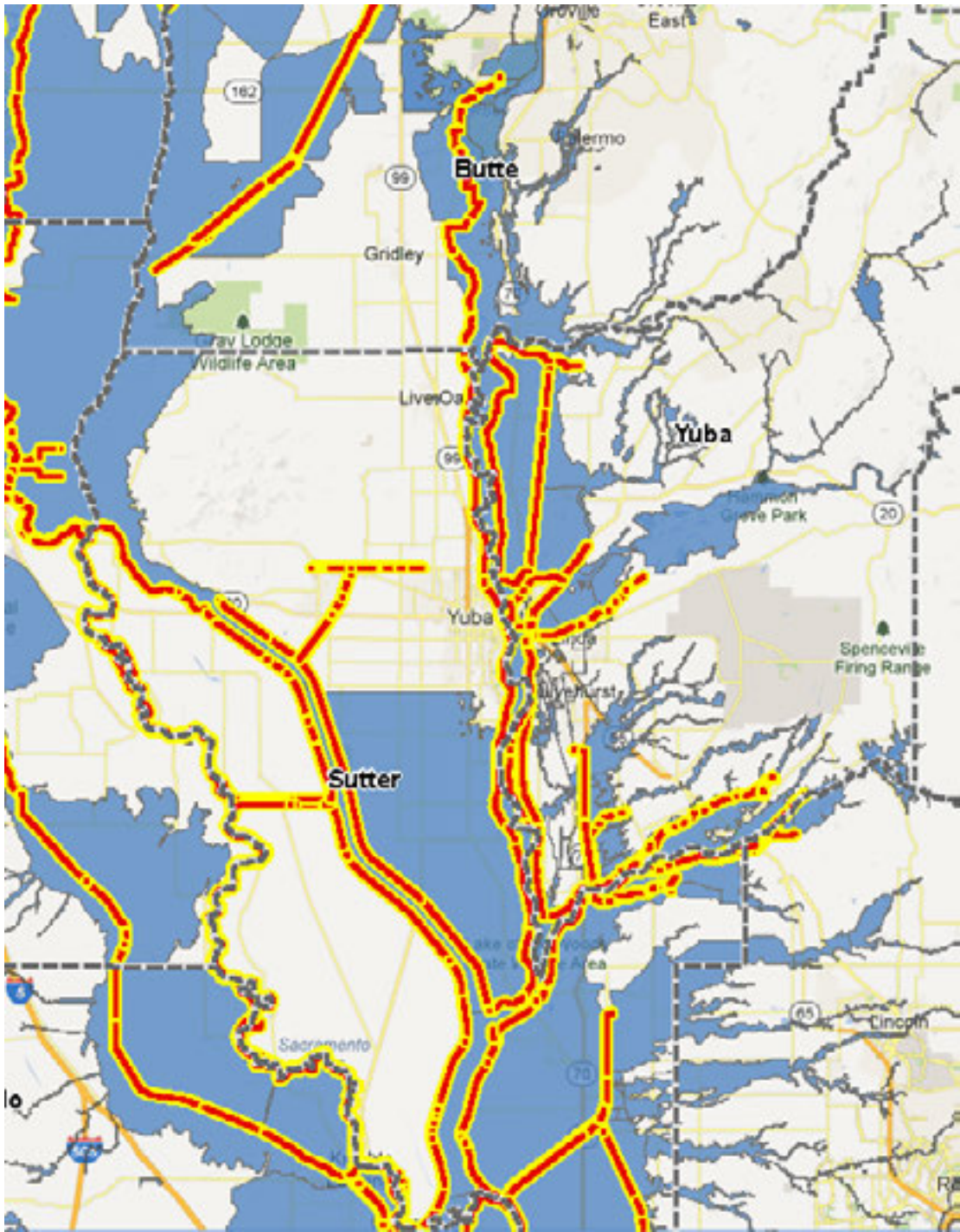
The USFWS plays a similar role as that of NOAA Fisheries, with a focus on terrestrial, avian, and resident fish species and their habitats. In the Region some of the key species of concern are the Giant Garter Snake (GGS), the Swainsons Hawk, and the Valley Elderberry Longhorn Beetle. USFWS plays an important role in the flood project planning process, providing guidance on ways to design and operate flood control works to minimize impacts and enhance fish and wildlife habitats. USACE and other project proponents must consult with NOAA fisheries in all phases of federal flood management project planning, design, and construction.

The Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency plays a multitude of flood management roles, including managing the National Flood Insurance Program (NFIP), which includes mapping of and classification of flood hazards in the Region (Figure 7). FEMA administers the Disaster Mitigation Act of 2000 (DMA 2000), which requires that local communities evaluate the natural hazards within their boundaries and develop mitigation plans for those hazards in order to maintain eligibility for its Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Programs (HMGP). FEMA also provides federal disaster recovery assistance in the event of federal emergency declarations or disaster declarations.

Federal emergency management efforts are structured in accordance with the National Incident Management System (NIMS).

Figure 7. FEMA 100-Year Flood Hazard Zones(in Blue) (DWR 2013)



3 Flood Management Problems and Opportunities

The Regional flood management system as we know it today consists of many inter-related elements, which work together to reduce the risk of flooding. While portions of the Regional system, such as the levees, have been constructed and improved upon over a period over 150 years, other elements, such as reservoirs, flood insurance, and environmental regulations, have been more recent. Improvements in any portion of the system may improve its overall function, but a comprehensive evaluation is needed to identify the most cost effective and reasonable combinations of actions. While the Regional flood management system was initially constructed with local resources, without any centralized control, the system is now highly regulated, funded from multiple sources, and involving the participation of a multitude of agencies.

This chapter focuses on the various components of the Regional flood management system, first identifying the general issues and concerns associated with each component, then describing specific problem areas in the Region. The Regional flood management system includes the flood control structures in the region, including levees, channels, drainage facilities, and reservoirs. It also includes the multitude of State and federal agencies, programs, policies, and procedures which profoundly affect how future Regional flood management elements are designed, financed, and constructed, how the system is operated and maintained, and how the economic stability and environmental quality of the region are improved over time.

3.1 The Regional Levee System

Simply put, a levee is intended to confine channel flows from spreading out over former floodplains, which can then be put to a variety of beneficial uses. To accomplish this simple function, a levee must remain structurally intact throughout the duration of high water. However, during high water events, a levee may be subjected to the erosive power of flowing water, internal erosion of levee and foundation materials, the destabilizing effects of seepage and uplift, the failure of penetrations such as drainage pipes, the destabilizing or seepage effects of encroachments, rodent damage and seismic events. A small weakness in any given location can be catastrophic; once water is flowing through, over or under a levee, materials susceptible can be quickly washed away, or the weakened levee and/or foundation can become unstable, resulting in catastrophic failure, such as occurred in two locations on the Feather River levees in 1955, the Yuba River south levee in 1986, and the Feather River east levee in 1997.

To withstand all of these challenges, a levee must be constructed with appropriate materials and designs suited to these materials. They must have sound foundations which will limit seepage and uplift pressures during high flows. They must have adequate cross section and side slopes so they will be stable when saturated and under pressure from high water. They must be protected from erosion. They must be free of rodent holes, be accessible for patrols, and be sufficiently clear of vegetation to facilitate inspection and flood fighting.

Unfortunately, the Regional levee system was built over many years using the sands, silts, clays, and soils, including organic soils that were conveniently available, often poorly compacted over

permeable foundations. In early levee construction the foundation characteristics were simply ignored, except for the evolving practice of constructing a shallow inspection trench. Portions of the levee system suffer from seepage, erosion, settlement, structural instability, inadequately designed or defective penetrations, excessive vegetation, rodent damage, and encroachments.

Each major damaging flood event has prompted a re-examination of the levee system and subsequent improvements in understanding, solution technologies, and facilities. For example, the 1986 flood event prompted a cooperative USACE-DWR led re-evaluation of the Sacramento River Flood Control Project, with subsequent investments in a five-phased re-evaluation and reconstruction program, including improvements in Phase II to Marysville and Yuba City Area and the Mid-Valley Project. The 1986 flood also prompted a Federal reconnaissance study and subsequent authorization of the Yuba River Basin Project in 1999. This authorized project resulted in re-evaluation and significant advance work by DWR, TRLIA, and Yuba County interests in RD 784. The last construction element is currently underway by the Corps of Engineers to provide greater than 200-year protection to the Marysville Ring Levee.

The 1997 flood prompted a re-evaluation of the importance of levee foundation underseepage, leading to the implementation of deep cutoff walls, seepage berms, and relief wells.

The levee system offers a multitude of opportunities for improvement, with direct and quantifiable reductions in flood risk. They include fixing known localized deficiencies, regional levee improvement programs such as implemented by TRLIA and SBFCA, changes in management practices and implementation of new technologies.

3.2 Channels

The historical practice of constructing levees close to the river channels to induce sediment scour and to take advantage of the natural levees deposited by the rivers, has, in many cases, interfered with the natural stream meandering process. Where meandering channels begin to erode levee slopes, erosion protection is required to protect the integrity of the system. Stream banks require costly, ongoing maintenance and repairs. The Sacramento River Bank Protection Project has provided the authority and mechanism for placing the majority of rock revetment along SPFC facilities, including the main channels of the Feather, Yuba, and Bear rivers.

Vegetation growing within the banks of the river channels increase channel roughness and reduce its flood carrying capacity. Whereas vegetation removal by burning, snagging, cutting, and bulldozing was freely practiced in the past, these practices are now severely curtailed, primarily because of the recognition of the importance of the habitat values offered by this vegetation (see below). Local agencies are deeply concerned about the cumulative effects of vegetation growth on flood capacity and the increasing difficulty of performing channel maintenance.

Improved collaboration among maintaining and regulatory agencies, combined with flood corridor planning, offers the opportunity to optimize the channel benefits of flood conveyance and habitat, while reducing long-term maintenance costs.

3.3 Reservoirs

Multi-purpose reservoirs in the Region such as Lake Oroville and New Bullards Bar Reservoir are operated throughout each year to best meet the needs of flood protection, water supply reliability, power production, fisheries, and recreation. While they have greatly reduced the

threat of flooding in the region, recent history has demonstrated that with the current flood storage and release capacities and operational criteria, storms that are larger than the 1997 flood would likely result in flows that exceed channel capacities.

From a Regional plan perspective, the greatest short-term opportunities involve refining operations to achieve greater concurrent benefits. Forecast-Coordinated Operations involves careful coordination of releases from different reservoirs to reduce downstream flood peaks, thus improving the overall system reliability. Forecast-Based Operations involves relying more heavily on hydrologic forecasts as the art and science of forecasting becomes more reliable, which could lead to greater reservoir releases prior to a big storm than allowed under current operational criteria and encroaching on flood storage space to save water if forecasts anticipate minimal runoff for the forecast period.

There may also be opportunities to cost share with State and federal agencies to upgrade facilities, including gates, spillways, and power plants to improve reliability, efficiency, and performance.

3.4 Fisheries and Wildlife Habitat

The latter half of the twentieth century has been marked by a growing awareness of the effects of the levee system and the multipurpose reservoirs on the environmental health of the Central Valley's rivers and streams and their associated seasonal wetland and riparian habitats. The geographic extent, quality, and connectivity of native habitats along Central Valley rivers have all declined. Today, less than 4 percent of the historical riparian forests that lined valley streams remain, with a significant portion of this forest growing on, or close to, levees of the SPFC.

The reduction of these habitats to accommodate the levee system and the reservoirs has impacted the populations of salmon, steelhead, sturgeon, Swainson's hawks, bank swallows, giant garter snakes, and many other wildlife species in the Central Valley. As a result, preservation and enhancement of the valley's remaining wetland and riparian habitat has become an increasingly important consideration in the design, construction, operations, and maintenance of the flood management system.

Regional Habitat Conservation Plans and River Corridor Management Plans offer potentially effective solutions to the current piecemeal approach to mitigating effects on fisheries and wildlife habitats.

3.5 Operations and Maintenance Constraints

Faced with limited funding, increasing regulatory constraints, and changing expectations for the multiple uses of the flood management system, it is increasingly difficult for local agencies in the region to maintain levees and channels. This has jeopardized eligibility for federal levee rehabilitation funds under Public Law 84-99, administered by USACE, and levee accreditation under the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program.

A recent change in the USACE (beginning in 2006) approach towards woody levee vegetation also poses new challenges for those who operate and maintain the existing system of levees. Since the levee system failures along the Gulf Coast caused by Hurricane Katrina in 2005, USACE has taken the position that no woody vegetation should be tolerated on or near federal

project levees and, through a series of administrative actions, has moved to promulgate and enforce this approach. Woody vegetation is of great ecological and aesthetic value and would be extremely costly for local agencies to remove.

Operations, maintenance and repairs of the flood management system are difficult to execute and often deferred for many reasons. Among the most significant constraints are the cost and difficulty of navigating the regulatory process and the constricted time windows in the year when maintenance work can be carried out.

Local maintaining agencies have been working with State and federal agencies, as well as non-governmental groups to explore opportunities for addressing these problems.

- Existing laws set relatively short time limits for some environmental permits given that flood management systems need to be managed in perpetuity. With better science, cooperation, and management experience there may be opportunities to modify these laws in such a way that the desired protection is achieved in a more efficient way.
- Increased partnering and leveraging of multiple funding sources will expand the opportunities for implementing multi-benefit projects.
- Refining work windows that meet the needs for species protection and flood activities, both of which can be very constrained by seasonal events and conditions, will support integrated management of the flood system.
- Improving habitat in ways that reduce, or at least do not substantially increase, needs for maintenance of flood facilities will be important.

3.6 Water Quality

There are several important connections between flood management and water quality. Most importantly, floods are capable of mobilizing enormous sediment loads and their contaminants, carrying them downstream, and then sorting and re-depositing them. The rivers and streams of the Region were heavily impacted by gold mining in the Feather, Yuba, and Bear River basins. As a result, large amounts of mercury were released into the stream system, mainly due to its use in capturing gold from sluice boxes during the Gold Rush. Mercury poses major obstacles to sediment management and ecosystem restoration where it occurs in large concentrations. The potential for mobilization of mercury is a consideration for any channel modification or levee construction project in the region.

When levees fail, the inundation of homes, farms, businesses, and industries often results in the release and dispersion of highly toxic chemicals, which can have far reaching health and economic effects. All of these water quality concerns will continue to affect flood management programs by requiring that contaminants and toxics be addressed in the planning, design, construction, and maintenance phases of flood management projects, most likely intensifying in the future.

3.7 Increasing Flood Risks

Although the Regional flood management system has prevented millions of dollars in flood damages since its construction, a better understanding of the risk assessment and engineering standards has made it clear that some of the regional levee segments face an unacceptably high

chance of failure. This, combined with growth in the Region has increased the estimated level of flood risk. While the chance and frequency of flooding have decreased since construction of the Region's levees and multipurpose reservoirs, the damages that would occur if a levee were to fail in one of these areas are much greater, resulting in a net long-term increase in cumulative damages if no further action is taken to improve the flood management system or to limit further development in these areas. In effect, the levees which were originally constructed to protect largely agricultural areas are inadequate to protect developing areas.

3.8 Re-Evaluation of Levee Performance

The methods used by USACE and DWR to estimate flood risk have become more conservative. Since 1995 USACE has been developing implementing its Risk and Uncertainty methods, as well as upgrading its structural design criteria, with the net result that many existing facilities, which were previously rated as substantially adequate to meet project design criteria, have subsequently been downgraded. For example, the Natomas levee system, thought to provide 200-year to 400-year protection when upgraded in 1998, was downgraded to a 30-year rating ten years later. Similarly, the West Levee of the Feather River was thought to have 100-year protection, but under current criteria is understood to provide 10-year level of protection.

3.9 Floodplain Re-Mapping and Levee De-Certification

In the aftermath of the Katrina disaster of 2005, both FEMA and USACE have implemented policies and programs which likely have the effect of increasing the cost of mandatory flood insurance policies for floodplain homes and businesses and increasing the cost of repairs after a levee failure. FEMA's flood risk map digitizing and risk reassessment efforts will result in remapping of much of the region with less than 100-year (1% annual chance) flood protection. As a result, development in these areas will be more expensive, difficult to insure, and subject to flood-proofing or elevation requirements.

USACE has instituted a National Levee Safety Program, including much more thorough and stringent inspections than in the past. Those levees which are deemed unacceptable will no longer be eligible for disaster recovery assistance under PL 84-99. The costs of restoring damaged levees and other flood control infrastructure may fall entirely on State and local agencies.

The passage of Senate Bill 5 has set an even higher threshold for urban areas by requiring that they ultimately be provided with at least 200-year (0.5% annual chance) flood protection as a condition for further development no later than 2025. This will have the likely effect of limiting further floodplain development and increasing the State and local costs of providing the required levels of flood protection.

3.10 Land Ownership and Land Use Conflicts

Land ownership underlying the flood management facilities in the region is a patchwork of private and public parcels. A variety of easements cover many private parcels and these easements have been established for a variety of different and often site-specific purposes. The types and terms of these easements relate to, for example, periodic flooding, conservation of agricultural land, and habitat restoration. This patchwork of land ownership and easement terms

both constrains and complicates the potential for providing flood or environmental improvements over areas greater than individual parcels.

Impacts of modifications to facilities and environmental restoration on adjacent properties must also be carefully considered and mitigated, where feasible. For example, where wildlife habitat is proposed in proximity to existing agricultural lands, the impacts of plowing, spraying, and harvesting of agricultural lands on nearby wildlife habitat and, conversely, the impacts of protected species on agricultural lands, must both be carefully addressed to successfully implement flood risk reduction projects with environmental enhancement components. A major goal of the RFMP will be to develop projects that provide mutual benefits to agriculture and ecosystem functions.

3.11 Funding

Major capital improvement and routine maintenance of the flood management system are primarily dependent on public funding generated by local, State, and federal sources. Flood risk management programs must compete with numerous other pressing funding needs such as education, transportation, health, and welfare. Major infusions of funding for flood risk management have historically followed major floods, when public attention is focused on the catastrophic damages they cause. For example, Propositions 1E and 847, with a combined bond funding capability of \$4.9 billion, were approved by California voters a little more than a year after Hurricane Katrina flooded and destroyed much of New Orleans, killing over 1,200 people. However, flood risk reduction programs and infrastructure need steady, long-term funding to achieve and sustain the requisite level of protection. Governments at all levels struggling with heavy debt burdens, recession-damped revenue projections, and rising construction costs all add uncertainty for fully funding the flood risk management programs and projects described in this report.

Current trends suggest that future federal funding for flood risk reduction projects will be diminishing over time, as the federal government struggles to achieve a balanced budget while facing enormous pressure from nationwide entitlement programs, infrastructure needs, and defense needs.

State bond funds, which are authorized until June 20, 2016, will need to be supplemented by subsequent bond measures or other sources to maintain current levels of State leadership in Central Valley flood risk reduction.

3.12 Future Weather Patterns

Future weather changes may lead to a greater fraction of seasonal precipitation occurring as rain rather than snow. Scientific trends appear to be already established and, if they continue as expected, they will put increasing stress on the Region's flood management system. As weather patterns change, floodplain risk assessments and development constraints will likely be adjusted accordingly. For example, the 100-year and 200-year (1 % and 0.5 % annual chance) flood events, calculated based on historical flood events may become larger for the Feather, Yuba and Bear rivers, with long-term effects on National Flood Insurance Program map ratings, flood insurance costs, floodplain development, and the economic viability in the Region. In addition, if the moderating effects of snowpack on runoff decrease, there will be a need for more water supply storage, putting greater pressure on the multi-purpose reservoirs protecting the Region.

Increased temperatures and altered runoff patterns would also affect agriculture and the health of the Region's remaining ecosystems and habitats. This climate uncertainty requires flexibility in flood management planning.

4 Solution Strategies and Management Actions

4.1 Levees

Levees can be improved in their reliability and rated level of protection in a number of ways. Experience with the regional flood management system suggests that the following management actions can address the range of concerns described in the previous chapter:

Raise crown elevation: Increasing the height of the levee system provides additional freeboard, or elevation difference between the water surface and the levee crown. Overtopping of levees often results in catastrophic failure due to the erosive effect of the overtopping flow.

Increase levee cross section and improve its geometry: Even with poor levee materials such as sand and clay, a sufficiently wide levee with mild slopes can function well, as its sheer mass provides gravitational resistance to uplift, the mild slopes minimize the risk of structural failures, and the long seepage paths reduce the risk of piping. Incremental improvements in levee geometry which result in greater width and milder slopes are helpful, but may need to be augmented with controlled seepage layers to prevent pressure from building up in the levee.

Provide waterside berms and erosion protection on the water side: Where levees are subject to the erosive effects of river currents and wave wash, erosion protection by various means will improve levee reliability. Management actions include planting appropriate erosion resistant vegetation such as willow, placing rip-rap layers or berms on the water side, or using combinations of vegetation, soil, and rip-rap to create a highly erosion resistant, but habitat friendly, layer along the stream bank

Provide cutoff walls, seepage berms, or interceptor wells: These management actions can be used to control the effects of seepage through the levee or through its foundation. Cutoff walls can be constructed of a variety of materials, including bentonite clay slurry mixed with sand and silt or Portland cement mixed with clay, sand, and silt. Currently cutoff walls can be constructed as deep as about 85 feet with long-stick excavators and to about 130 feet with deep soil mixing technology. Seepage berms can be constructed on the land side of levees to help counteract the uplift pressure of seepage in the foundation, to slow the rate of seepage, or to intercept it safely without loss of embankment/foundation materials. Interceptor wells simply relieve the hydraulic pressure under and near the levee by providing safe pathways for the seepage water to flow to the surface. Filter media and stainless steel screens in the wells prevent the movement of foundation materials as the internal seepage pressure is relieved.

Reconstruct deficient levees in place or construct levee setbacks: With a limited footprint reconstruction in place with competent materials can greatly improve its reliability. Constructing a setback levee in its stead can provide additional channel storage and conveyance capacity and reduce the risk of levee overtopping and erosion failures. While it is expensive to rebuild a levee in place with new materials, it may offer a solution where other options prove difficult to implement. Levee setbacks can be difficult undertakings, due to the need for large quantities of

materials and the impacts on land use and agriculture in the vicinity. Where locally supported, however, this management option offers multiple resource benefits, such as improved fisheries and wildlife habitat, while improving flood carrying capacity and reducing the risks of failure.

Provide Off-stream Transitory Storage: This includes providing means for controlled inundation of adjacent uninhabited agricultural lands to attenuate peak flows by providing temporary storage of flood waters. This action, where supported by affected landowners and consistent with local land use plans, can provide multi-purpose benefits in flood control and environmental restoration while minimizing potential agricultural impacts.

Provide improved access and visibility to facilitate inspection and flood fighting activities. This includes improved all-weather patrol roads, additional access ramps, inspection roads at the base as well as the crown of the levee, and an appropriate vegetation management plan that provides for pruning or thinning of vegetation to provide adequate access while preserving habitat benefits.

Remove or improve levee penetrations: Pipes for irrigation and drainage are the primary levee penetrations which are cause for concern. They may be difficult to access and inspect, and like all structures, deteriorate over time. Such penetrations can become points of failure by providing preferred seepage pathways or levee voids where floodwaters can erode the levee. Levee reliability can be enhanced by removing or relocating such pipes. To the extent feasible such pipes should be relocated above the design flood elevation.

Provide overflow protection: Levee system resilience can be enhanced in areas where channel capacity and levee freeboard may be exceeded by providing protection to prevent levee failure if design capacity is exceeded and levees are overtopped. Such overflow protection may be provided by the placement of erosion resistant mats, vegetation, or rock on the land side of the levee, such that overflow does not erode the levee section.

Provide root barriers: While the risks associated with tree roots are not well quantified at this time, root barriers of sufficient depth may address this concern where warranted. Although steel sheet piles have been available for a long time, less expensive approaches to creating a complete root barrier are now under consideration. Such barriers could potentially be included with cutoff walls as they are installed.

Most of the levee improvement actions described above have been employed in the region to improve levee reliability and level of protection. The selection of the appropriate combination of actions is dependent upon the specific field conditions to be addressed, the project objectives, and available funding.

4.2 Channels

Erosion protection: Although the Sacramento River Bank Protection Project has provided the authority and mechanism for placing the majority of rock revetment along SPFC facilities, including the main channels of the Feather, Yuba, and Bear rivers, it is unlikely that this program will continue to be available at previous levels of funding and authority. The program has been funded through USACE and DWR, with 75 percent and 25 percent cost shares, respectively. The remaining authority to perform additional work is currently less than xxx feet. State and

local projects will likely need to fill the gap. As described in the previous section, there are various approaches available. Given the concerns about the cumulative impacts of traditional rip-rap erosion protection on fish and wildlife resources, multi-objective erosion protection projects which incorporate habitat enhancements in the design and operation of new erosion protection are likely to be more implementable and cost effective in the long run.

Channel Vegetation Management: Improved collaboration among maintaining and regulatory agencies, combined with flood corridor planning, offers the opportunity to optimize the channel benefits of flood conveyance and habitat, while reducing long-term maintenance costs. The Feather River Corridor Management Project is an example of this evolving multi-objective approach.

4.3 Reservoirs

Forecast-Coordinated Operations (FCO): This involves careful coordination of releases from different reservoirs to reduce downstream flood peaks, thus improving the overall system reliability.

Forecast-Based Operations (FBO): involves relying more heavily on hydrologic forecasts as the art and science of forecasting becomes more reliable, which could lead to greater reservoir releases prior to a big storm than allowed under current operational criteria, and encroaching on flood storage space to save water if forecasts anticipate minimal runoff for the forecast period.

FCO has been incorporated into the operations of Lake Oroville and New Bullards Bar Dam.

Structural Improvements: There may also be opportunities to cost share with State and federal agencies to upgrade facilities, including gates, spillways, and power plants to improve reliability, efficiency, and performance.

4.4 Fisheries and Wildlife Habitat

Regional Habitat Conservation Plans and River Corridor Management Plans offer potentially effective solutions to the current piecemeal approach to mitigating effects on fisheries and wildlife habitats. The RFMP will consider all opportunities to improve ecosystem benefits, as feasible, to improve overall quality of habitat for all species in the region.

4.5 Operations and Maintenance Constraints

- Existing laws set relatively short time limits for some environmental permits given that flood management systems need to be managed in perpetuity. With better science, cooperation, and management experience there may be opportunities to modify these laws in such a way that the desired protection is achieved in a more efficient way.

Increased partnering and leveraging of multiple funding sources will expand the opportunities for implementing multi-benefit projects.

Refining work windows that meet the needs for species protection and flood activities, both of which can be very constrained by seasonal events and conditions, will support integrated

management of the flood system. Improving habitat in ways that reduce, or at least do not substantially increase, needs for maintenance of flood facilities will be important.

5 Alternatives Formulation

This section will provide a list of management actions and projects for the region.

6 Alternatives Evaluation, Comparison, and Priorities

This section will develop criteria and provide an evaluation to prioritize the various management actions and projects of the region.

7 Residual Risk Management

This section will consider operation and maintenance enhancement, emergency operations and response, as well as land use considerations of the RFMP in an effort to address the perpetual risk that exists no matter how much structural protection is provided.

8 Financial Planning

The financial plan will include a list of ranked proposed improvements, including estimated costs and benefits, amounts to be funded by federal vs. state vs. local cost shares, and local agencies' plans to finance their share of each project's costs. It will also include a high level feasibility analysis of potential local funding sources and the capacity of those sources to cost-share identified projects.

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Regional Flood Management Plan Outline Template

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 - a. List of Tables, Figures, Acronyms and Abbreviations
 - b. Executive Summary
 - c. Regional Goals and Objectives
 - d. Primary Goals
 - e. Supporting Goals
 - f. Regional Setting & Demographics
 - g. Flood Management System
 - h. Flood Management Challenges & Constraints
 - i. Alternatives Formulations, Evaluation, Comparison and Prioritization
 - j. Financial Plan – Formulation
3. Introduction
 - a. Purpose of the Report
 - b. The Planning Process – Details/examples
 - c. Partnership? Plan
 - d. Use of Existing Information
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 - f. Regional Goals and Objectives
4. Regional Setting & Demographics
 - a. Areas & Boundaries/Jurisdiction
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 - d. Ecological Setting
 - i. Wetlands, Grasslands, Riparian Habitat, Riverine Aquatic Habitat (as applicable)
 - e. Historical Context
 - f. The Regional Flood Management System
 - i. Elements, Structural, Operational, Non-Structural, Involved Partners, Local, State, Federal Agencies
5. Flood Management Challenges & Constraints (Note: If Levee System exists)
 - a. Regional Levee System
 - b. Channels
 - c. Reservoirs
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4.0 Assessment of Flood Hazards Region 2: Flood Frequencies, Deficiencies, Assets and Risks

a. Introduction

Ex: Supporting Sections; Frequencies & Duration Analysis, Effect of Reservoirs on Flood Frequency, Water Surface Profiles, Levee Vulnerability/Structure Failure, Models.]

b. Reservoirs

c. Regional Levees

d. Channels and Floodplains

5. Solution Strategies & Management Actions

6. Integration of Flood Management w/Agricultural Land Preservation, Habitat Enhancement & Restoration

Ex: Integrated Approaches to Flood Management, Habitat Enhancements & Restoration, Environmental Compliance and Mitigation Solutions

7. Recreation

Ex: Recreation Resources & Opportunities Plan, Need, Setting, Opportunities, Site-Specific

8. Structural and Operational Alternatives Formulation

Ex: Basin – Description of on-going, planned and potential actions

9. Risk Management Alternatives Enhanced Flood Emergency Response

Ex: Purpose, Financial Aid, Coordination Plan, Status of Regional Flood Emergency Response Planning – Preparedness, etc., Flood Insurance Program, Development Impact Fee Plan – If Needed.

10. Alternative Evaluation, Comparison and Priority Evaluation, Comparison and Prioritization (and Metrics)

Ex: Financial Feasibility, Implementation Feasibility, Flood Risk Reduction Benefits, Comparative Effectiveness, Costs, etc.

11. Regional Financial Plan – Regional Economic Profile

Ex: Counties in the Flood Region, Flood Region Specifics Characterization, Future Growth, Economic Profile Findings, Funding – Federal, State, Local Area Specific Funding, Funding Needs, Conclusion and Recommendations.

12. References

Regional Flood Management Plan Outline Template

1. Cover Page
2. Table of Contents
 - a. List of Tables, Figures, Acronyms and Abbreviations
 - b. Executive Summary
 - c. Regional Goals and Objectives
 - d. Primary Goals
 - e. Supporting Goals
 - f. Regional Setting & Demographics
 - g. Flood Management System
 - h. Flood Management Challenges & Constraints
 - i. Alternatives Formulations, Evaluation, Comparison and Prioritization
 - j. Financial Plan – Formulation
3. Introduction
 - a. Purpose of the Report
 - b. The Planning Process – Details/examples
 - c. Partnership? Plan
 - d. Use of Existing Information
 - e. Planning Team – Organization – connectivity
 - f. Regional Goals and Objectives
4. Regional Setting & Demographics
 - a. Areas & Boundaries/Jurisdiction
 - b. Population & Land Use
 - c. Key Infrastructure
 - d. Ecological Setting
 - i. Wetlands, Grasslands, Riparian Habitat, Riverine Aquatic Habitat (as applicable)
 - e. Historical Context
 - f. The Regional Flood Management System
 - i. Elements, Structural, Operational, Non-Structural, Involved Partners, Local, State, Federal Agencies
5. Flood Management Challenges & Constraints (Note: If Levee System exists)
 - a. Regional Levee System
 - b. Channels
 - c. Reservoirs
 - d. Fisheries & Wildlife Habitat
 - e. Operation & Maintenance
 - f. Water Quality
 - g. Increasing Flood Risks
 - h. Re-evaluation of Levee Performance
 - i. Evolving Levee Standards
 - i. USACE Standards
 - ii. State Standards
 - iii. Rural Levee Criteria

- j. Floodplain Re-mapping & Levee Development
- k. Land Ownership & Land Use Conflicts
- l. Funding
- m. Future Climate Change

4.0 Assessment of Flood Hazards Region 2: Flood Frequencies, Deficiencies, Assets and Risks

a. Introduction

Ex: Supporting Sections; Frequencies & Duration Analysis, Effect of Reservoirs on Flood Frequency, Water Surface Profiles, Levee Vulnerability/Structure Failure, Models.]

b. Reservoirs

c. Regional Levees

d. Channels and Floodplains

5. Solution Strategies & Management Actions

6. Integration of Flood Management w/Agricultural Land Preservation, Habitat Enhancement & Restoration

Ex: Integrated Approaches to Flood Management, Habitat Enhancements & Restoration, Environmental Compliance and Mitigation Solutions

7. Recreation

Ex: Recreation Resources & Opportunities Plan, Need, Setting, Opportunities, Site-Specific

8. Structural and Operational Alternatives Formulation

Ex: Basin – Description of on-going, planned and potential actions

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Ex: Purpose, Financial Aid, Coordination Plan, Status of Regional Flood Emergency Response Planning – Preparedness, etc., Flood Insurance Program, Development Impact Fee Plan – If Needed.

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11. Regional Financial Plan – Regional Economic Profile

Ex: Counties in the Flood Region, Flood Region Specifics Characterization, Future Growth, Economic Profile Findings, Funding – Federal, State, Local Area Specific Funding, Funding Needs, Conclusion and Recommendations.

12. References

A Human Service Leader's Quick Guide to Disaster Response & Recovery

Updated April 24, 2019



Q: How can I help my programs, staff, & clients be more prepared for emergencies and disasters?

1. Meet & know your State emergency managers. Get on their contact/distro list
2. Request emergency planning and recovery assistance from your ACF program contacts
3. Develop a Continuity of Operations Plan (COOP). Here's a template for nonprofits:

<http://enla.org/wp-content/uploads/2011/06/Non-Profits-Continuity-and-Recovery-Plan.pdf>

Q: How do Local/State Emergency Managers assess and respond to early Disaster Response needs?

Federal, State, and local emergency managers use the same National Response Framework (NRF) which is broken out into 16 different Emergency Support Functions (ESFs). Each ESF is activated only if needed, so they need to be aware of your needs early on. https://www.fema.gov/media-library-data/1466014682982-9bcf8245ba4c60c120aa915abe74e15d/National_Response_Framework3rd.pdf

Q: Where Does Human Service Response fit in short term State/local Response Plans?

Human/Social services and children are in ESF#6 (Mass Care, Emergency Assistance, Housing, and Human Services) <https://www.fema.gov/pdf/emergency/nrf/nrf-esf-06.pdf> Public Health/Medical is ESF#8.

Q: Where Does Human Service Recovery fit in long term State/local Recovery Plans?

The National Disaster Recovery Framework (NDRF) is a growing FEMA/State Emergency Management structure to coordinate local, Tribal, State, & Federal agencies and nongovernmental/private sector partners, to better assess recovery needs and leverage recovery resources.

<https://www.fema.gov/national-disaster-recovery-framework> NDRF Recovery Support Functions are:

1. Community Planning and Capacity Building
2. Economic Recovery
3. **Health and Social Services Recovery Support Function (includes Early Childhood and Education)**
<https://www.phe.gov/about/oem/recovery/Pages/hss-rsf.aspx>
4. Housing Recovery
5. Infrastructure Systems Recovery
6. Natural and Cultural Resources Recovery

Q: What disaster resources should I be aware of & ask State emergency management about?

Because every disaster has different impacts, resources aren't requested unless a specific need is identified. ACF and your local/State emergency managers need to hear from you quickly to request program flexibility/waivers and recovery resources before deadlines for facilities, staff, families, and kids.

HHS' Disaster Distress Hotline (always open) <https://www.samhsa.gov/find-help/disaster-distress-helpline>
Multi-lingual phone or text crisis counseling for disaster survivors, anytime during or after a disaster.

Voluntary Organizations Active in Disasters (VOADs): Emergency Managers and ESF #6 work with National, State and local VOADs, which are non-governmental groups that coordinate volunteers and donations, clean up debris, evacuate and shelter people & animals, feed survivors, provide transportation, and can even provide respite child care. Red Cross & Save the Children are VOADs. Your State VOAD contacts are here: <https://www.nvoad.org/voad-members/stateterritory-members/>

Philanthropic and Private Sector Fundraising/Donations/Grants for Children's Recovery: These opportunities can look very different from disaster to disaster and change quickly. State emergency managers need to know your needs so they can connect you with human service recovery networks.

FEMA Individual Assistance (IA): A federal disaster declaration for Individual Assistance allows recovery assistance to survivors who register at <https://www.disasterassistance.gov/> Can include housing and unemployment grants or loans, legal services, crisis counseling, disaster case management, and more.

FEMA Public Assistance (PA): A federal disaster declaration for Public Assistance can provide grants to governments and certain private nonprofits for debris removal, life-saving emergency protective measures, and to repair, replace, or restore eligible disaster-damaged facilities. The Federal govt. reimburses at least 75% of eligible PA costs. The State splits the rest among eligible local applicants.

Emergency Management Assistance Compact (EMAC): An agreement that, during governor-declared states of emergency, allows states/territories to send personnel, equipment, and commodities to help disaster relief efforts in other states. <https://www.emacweb.org/index.php/human-services>

Disaster Supplemental Nutrition Assistance Program (D-SNAP): For counties/parishes federally declared for FEMA Individual Assistance (IA), a State's SNAP agency can request D-SNAP from USDA's Food and Nutrition Service. D-SNAP provides expedited food assistance to eligible disaster survivors.

Disaster Case Management (DCM): When requesting a federal IA Declaration, governors can request DCM support. FEMA may help fund either a State or Federal DCM mission (or both) when a State or local area needs extra help supporting struggling disaster survivors with multiple and complex needs.

Crisis Counseling Program (CCP): FEMA/HHS can grant CCP through State Emergency Management. CCP can fund outreach, peer to peer training, and group psycho-educational support. State Behavioral Health typically writes the proposal and administers it, but may need to be reminded to specify children-specific activities in the plan. CCP is not therapy, but can help identify/refer survivors to local providers.

COMMUNITY RECOVERY CHECKLIST

The Community Recovery Checklist is designed to assist local officials and recovery specialists in tracking progress toward recovery goals by identifying relevant indicators to monitor changes over time.

The checklist's goals and activities were derived from a study conducted through a joint effort by the University of North Carolina at Chapel Hill's U.S. Department of Homeland Security Coastal Hazards Center of Excellence and Texas A&M University.

The research team analyzed 57 publications related to post-disaster recovery to identify goals and indicators that can be used to assess community recovery progress. To validate and further refine the resulting list of recovery metrics for inclusion in the checklist, the researchers analyzed 87 disaster recovery plans from local communities, conducted case studies of two recovering communities, interviewed 21 key informants, and held two focus groups.

These analyses resulted in a checklist of 79 metrics in 10 Recovery Focus Areas organized within four themes. The checklist also provides potential data sources, a glossary of terms, and crosswalked focus areas.

ACKNOWLEDGEMENTS

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ADDITIONAL INFORMATION

Additional information about the Coastal Hazards Center and its work can be found at <http://hazardscenter.unc.edu>.

Additional information about the Institute for Sustainable Coastal Communities and its work can be found at <http://www.tamug.edu/iscc>.

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INTRODUCTION

Community recovery from a disaster is a key capability for federal, state, and local governments. To effectively support this capability, as well as to promote the systematic collection and sharing of data to inform future recovery efforts, practitioners need useful and validated methods to measure changes in relevant community characteristics over time.

This document walks through the development of measurable, validated indicators to assess long-term recovery and describes ways communities can use these indicators to facilitate their evaluation of recovery outcomes. For example, communities can use recovery indicators to:

- Track progress toward recovery.
- Conduct pre- and post-disaster comparisons using baseline and current data.

Ultimately, communities can use this information to prioritize recovery goals and activities.

DEVELOPING THE INDICATORS

The development of the recovery indicators began with a seemingly straightforward question: “How do we know when a community is recovered?”

A key element of answering this question is being able to measure recovery. Hence, there is a need to establish measurable, validated indicators to assess long-term recovery in the real world, both pre- and post-disaster.

The development of any indicator is based on a well-defined process, typically including three phases: 1) defining the objectives of the indicator; 2) identifying a guiding framework; and 3) selecting specific metrics through the consensus of experts. The most valuable and defensible indicators are easy to assess, cost effective, and useful for decision making in practice, research, or policy settings.

The process of developing the recovery indicators began with a review of the academic and practice literature on disaster recovery. The outcome of this was a consolidated list of 90 recovery metrics identified in the literature. The research team then validated these metrics through a review of 87 state and local disaster recovery plans from counties and municipalities along the U.S. Atlantic and Gulf Coasts, as well as two case studies of communities recovering from recent disasters (New Hanover County, North Carolina and Hoboken, New Jersey). Case studies also were used to identify sources for both baseline and current status data.

Following the development and validation of the metrics, researchers conducted focus groups and key informant interviews with researchers, practitioners, and planners to gain feedback on the metrics. In addition, a demonstration of the metrics was conducted in four communities affected by 2012's Superstorm Sandy. The outcome of these activities was a validated list of 79 metrics.

To enable communities to use and apply the metrics, the research team translated them into a user-friendly Community Recovery Checklist (CRC), which lists the 79 validated metrics communities can use to assess long-term recovery progress.

USING THE COMMUNITY RECOVERY CHECKLIST

The Community Recovery Checklist (CRC) was created to assist practitioners, government agencies, and citizens in tracking recovery in their community following a disaster. To develop the CRC and ensure ease of use, we used the list of baseline aggregate indicators developed in the first stages of this project, along with feedback provided from practitioners in key informant interviews and focus groups, to develop achievement-oriented goals, supplemented by measurable actions and metrics that may aid in the accomplishment of a jurisdiction's recovery goals. The CRC includes 79 validated metrics that communities can use to assess long-term recovery progress within each of four themes and 10 Recovery Focus Areas (Box 1). The Recovery Focus Areas are based on the FEMA Recovery Support Functions and Recovery Mission Area Core Capabilities as described in the National Preparedness Goal, developed under Presidential Policy Directive 8: National Preparedness (PPD-8).

Recovering communities have several options for establishing baselines for the metrics listed in the checklist. Public sources of information such as the U.S. Census, Open FEMA, or the Bureau of Labor Statistics can be used to collect some baseline and current status data. In addition, locally developed planning documents, after-action reviews, survey data, and other published reports may be useful sources of information (see Appendix 1 for more suggested data sources). While it is not necessary to record data for all of the metrics in order to benefit from the use of the CRC, more information is likely to provide better results when assessing long-term disaster recovery.

Box 1

THEMES

1. Finance
2. Process
3. Public Sector
4. Social

RECOVERY FOCUS AREAS

1. Business and Economy
2. Disaster and Recovery Management
3. Mobilization of Recovery Funding
4. Communities and Social Services
5. Households
6. Population Characteristics
7. Public Sector Recovery
8. Public Buildings and Infrastructure
9. Cultural Sites and Resources
10. Natural Resources

HOW THE CRC IS ORGANIZED

The CRC is organized into four thematic areas and 10 Recovery Focus Areas. To help users prioritize metrics, each is designated as either a primary or secondary metric. Figure 1 provides an overview of the CRC.

THEMATIC AREAS

Feedback from key informant interviews and focus groups informed the identification of four major thematic areas, serving as an overarching organizing structure for one to three Recovery Focus Areas. The four groups—Finance, Process, Social, and Public Sector—highlight broader recovery goals represented by the Recovery Focus Areas and metrics.

RECOVERY FOCUS AREAS

Metrics have been organized into 10 Recovery Focus Areas including: 1) Business and Economy; 2) Disaster and Recovery Management; 3) Mobilization of Recovery Funding; 4) Communities and Social Services; 5) Households; 6) Population Characteristics; 7) Public Sector Recovery; 8) Public Buildings and Infrastructure; 9) Cultural Sites and Resources; and 10) Natural Resources.

PRIMARY AND SECONDARY METRICS

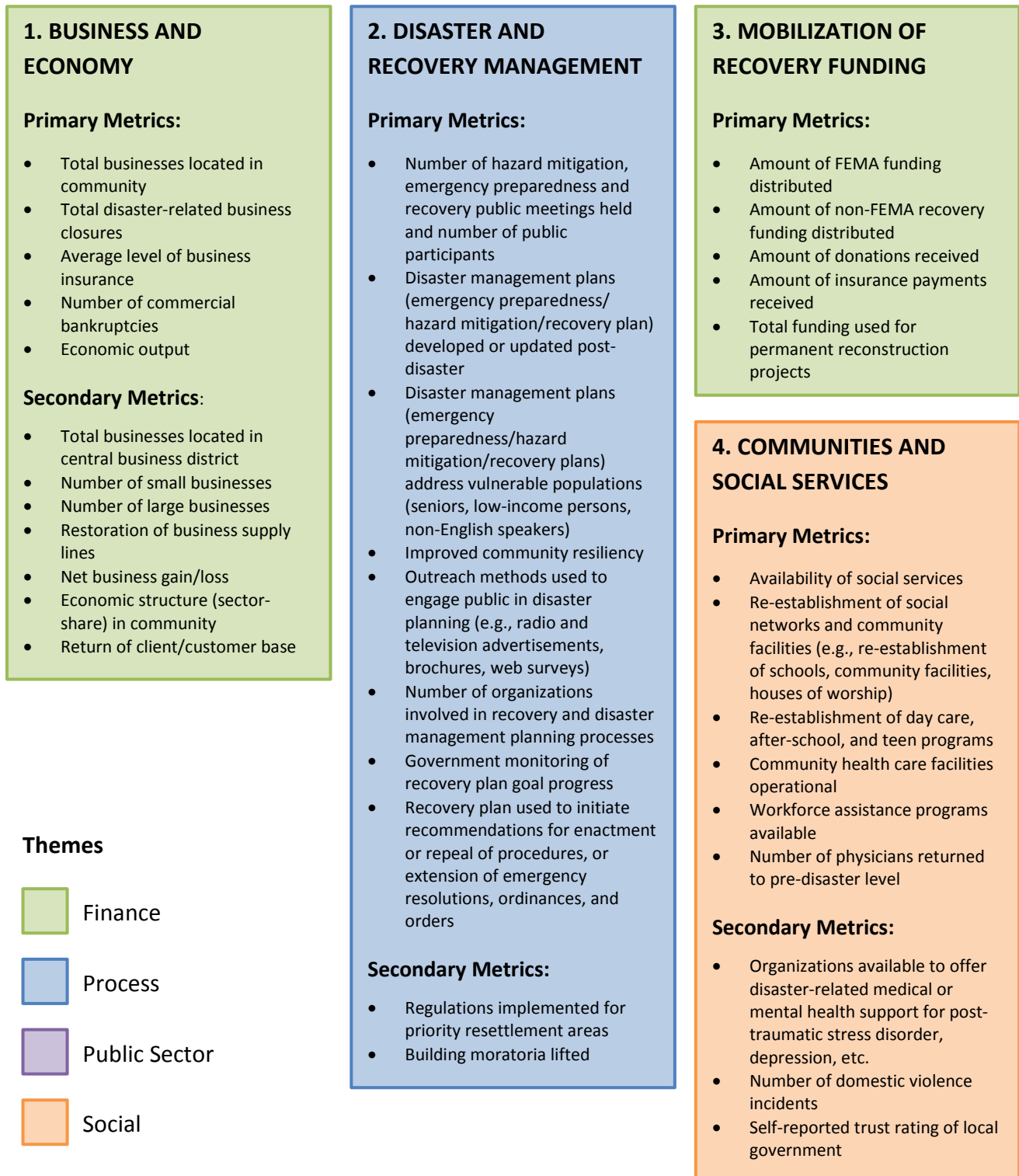
Within some Focus Areas, metrics have been separated into “primary” and “secondary.” Primary metrics are those with more easily identifiable data sources or those demonstrated to more heavily influence the trajectory of a community’s recovery. Users with limited capacity should make these primary metrics their focus.

BENEFITS OF USING THE CRC

In addition to providing useful information for communities as they move through the continuum of recovery, a robust set of recovery indicators with associated quantifiable metrics can support and build the capacity of local practitioners by providing a basis for informed decision making during recovery. Capacity building, particularly at the local level, is a major focus of FEMA’s National Disaster Recovery Framework (NDRF), developed to improve long-term community recovery outcomes. Collecting data for indicators of community recovery, at any point in time, assists in the development of a detailed community fact base critical to the creation of a high-quality recovery plan and supports the development and implementation of a community road map for a safer and more resilient future. Potential benefits of using the CRC include:

- Inspiring the community to think about what needs to be addressed to prepare for a potential disaster and foster a successful recovery following an event.
- Providing a focusing mechanism to keep momentum moving forward during disaster recovery.
- Establishing an “executive playbook” for community decision-making post-disaster, particularly if decision-makers have not received training in emergency management.
- Evaluating community recovery capacity, including pre-disaster self-assessments generated from baseline data, or a means of measuring the adaptive capacity of a community to assess the ability to recover.

Figure 1. Components of the Community Recovery Checklist



5. HOUSEHOLDS

Primary Metrics:

- Average housing tenure
- Owner-occupied and renter-occupied housing units
- Percent of population residing in temporary housing units
- Average level of homeowner's insurance
- Median/mean home value
- Median/mean household income
- Vacancy rates/number of households returned
- Number of abandoned housing units

6. POPULATION CHARACTERISTICS

Primary Metrics:

- Total population
- Disaster-displaced individuals
- Unemployment rate
- Households under poverty rate
- Population without access to a car
- Population over age 65
- Population under age 12
- Population disabled
- Population without high school diploma
- Population non-white
- Population non-English speakers
- Households headed by single mothers

7. PUBLIC SECTOR RECOVERY

Primary Metrics:

- Governing body fully functioning
- Number of civic organizations
- Tax revenue
- Public services available
- Children enrolled in community schools
- Number of voter registrations

8. PUBLIC BUILDINGS AND INFRASTRUCTURE

Primary Metrics:

- Re-establishment of transportation and transit system(s) (local and regional)
- Public transit ridership
- Miles of disaster-damaged roads and bridges repaired
- Damage to critical infrastructure (e.g., utilities, water treatment, gas pipelines) repaired
- Railway and maritime shipping infrastructure repaired
- Damage to public facilities (e.g., municipal buildings) repaired
- Status of debris management

9. CULTURAL SITES AND RESOURCES

Primary Metrics:

- Reconstruction/repair of damaged cultural or heritage sites (e.g., landmarks, artifacts)
- Reconstruction/repair of damaged arts and religious facilities
- Re-establishment of arts and sports organizations
- Religious service attendance

10. NATURAL RESOURCES

Primary Metrics:

- Re-establishment of environmental governance/pollution monitoring
- Restoration of protected natural areas
- Coastlines and wetlands assessed to determine if additional hazard mitigation measures should be implemented
- Damage to coral reefs, shrimp hatcheries or other coastal resources inventoried
- Soil testing at debris management sites
- Rates of erosion
- Incidence of landslides

- Providing early, rough estimates of the level of recovery assistance needed by the community.
- Fostering greater accountability and transparency during disaster recovery.
- Assisting states, counties, and regional planning councils by providing a standard set of metrics to better understand the recovery progress of multiple communities or jurisdictions. A common language spanning municipal borders can help to direct recovery resources where they are most needed while contributing to successful planning and preparation before a disaster strikes.

WHEN TO USE THE CRC

A community may begin to collect and use the CRC data at any time. The use of the CRC ideally begins in the pre-disaster time period, allowing for the determination of a baseline for each metric. If at any point the community should experience a disaster, a baseline will be in place by which to gauge the community's progress toward recovery.

Because a single point in time does not tell a story, it is recommended that metrics be populated on an ongoing basis to allow for the emergence and observation of longer-term trends.

DATA SOURCES

Publically available data (i.e., U.S. Census demographics) can be used to quantify certain metrics; other metrics involve more place-specific details and require the user to engage in local data collection. Some qualitative metrics may require the user to provide a narrative account to document baseline status.

Different communities have different capacities, and these differences will be reflected in data availability, as well. Communities should focus on the metrics that are most important to their individual recovery rather than stretching scarce resources in order to populate every metric. Communities should also be willing to investigate "non-traditional" data sources to acquire data. Suggested potential data sources and proxy measures are provided in Appendix 1.

An online tool that facilitates use of the CRC is available at <http://communityrecoverytool.com>. The online tool allows some metrics to be automatically prepopulated using sources such as the U.S. Census and Open FEMA. This function may reduce the reporting burden on the user, enhancing the overall usefulness of the checklist.

DEVELOPMENT AND VALIDATION OF THE COMMUNITY RECOVERY CHECKLIST

At the start of this project, potential indicators were identified through a systematic review of the literature and categorized by FEMA Recovery Support Functions and Recovery Mission Area Core Capabilities as described in the National Preparedness Goal, developed under Presidential Policy Directive 8: National Preparedness (PPD-8). After aggregating the identified indicators, several methods were used to validate the final aggregated list, including a review of pre-disaster recovery plans from coastal counties and municipalities, two case studies of communities recently affected by disaster, and key informant interviews and focus groups.

LITERATURE REVIEW

To identify potential community recovery metrics, a total of 118 peer-reviewed publications and conference presentations were assessed; 57 of these sources were found to include potential recovery metrics or measurements (see Appendix 6). The 57 sources initially yielded 651 potential metrics of community recovery following a disaster. These metrics were categorized by either one of the six Recovery Support Functions (RSF) identified in the NDRF or by one of two relevant Core Capabilities (Public Information and Warning, Operational Coordination) described in the National Preparedness Goal. The 651 indicators were further consolidated using an inductive process to eliminate duplicates or metrics that shared similar meaning, thereby reducing the total number of metrics to 90.

VALIDATION OF METRICS

To assess the applicability and usability of these 90 potential metrics, the research team conducted three phases of content validation: review of pre-disaster recovery plans, case studies, and key informant interviews and focus groups.

PRE-DISASTER RECOVERY PLANS

Researchers conducted a content analysis of 87 existing pre-disaster recovery plans in cities and municipalities on the U.S. Atlantic and Gulf Coasts. This analysis aimed to elucidate which of the 90 possible metrics resulting from the literature review have actually been used in practice.

CASE STUDIES

To highlight how communities might use the recovery metrics to evaluate recovery in a real-world setting, the research team conducted a retrospective review of two case study communities currently undergoing recovery from recent disasters. Boxes 2 and 3 provide an overview of these communities; Appendix 2 provides additional details on the case study methodology and process.

In both case studies, the baseline conditions that were most readily available included those in the “Economic Recovery” and “Housing Recovery” Recovery Support Functions and the “Operational Coordination” Core Capability (see Table 6 for a full listing of Recovery Support Functions and Core Capabilities used to categorize indicators). Recovery indicators that were most represented in the available media were those falling into the “Economic Recovery,” “Housing Recovery,” and “Infrastructure Systems Recovery” categories.

The least represented recovery indicators and activities in both case studies were those relating to “Natural and Cultural Resource Recovery.” This category includes indicators such as: “Monitoring of Ecosystem Resiliency,” “Monitoring Rates of Erosion,” and “Monitoring of Land Degradation.” Indicators related to natural resource recovery were nearly absent in the available post-disaster media reports.

BOX 2: CASE STUDY OVERVIEW FOR NEW HANOVER COUNTY, NORTH CAROLINA

Home to more than 200,000 residents (U.S. Census Bureau 2014a), New Hanover County is located in southeastern North Carolina, bordering the Atlantic Ocean. Vulnerability indices calculated for the county's 2010 Multi-Jurisdictional Hazard Mitigation Plan Update and used for the prioritization of subsequent mitigation efforts indicate that New Hanover experiences a high hazard risk for the following natural hazards: flood, sea-level rise, hurricane, tropical storm, nor'easter, severe thunderstorm, wildfire, and storm surge.

The case study evaluation focuses on the county's recovery from Hurricane Irene. Hurricane Irene made landfall several times along the east coast of the United States in late August 2011, causing more than \$16 billion in damage to affected areas. The storm made its first U.S. landfall on the Outer Banks of North Carolina, just north of New Hanover County. A major disaster (DR-4019) was declared for a number of coastal counties in North Carolina, including New Hanover, on August 31, 2011 (Federal Emergency Management Agency 2014).

The documents used to determine New Hanover County's pre-disaster baseline condition include: the New Hanover County North Carolina 2010 Multi-Jurisdictional Hazard Mitigation Plan Update (September 2010), the New Hanover County Emergency Operations Plan (August 2011), the Wilmington-New Hanover County 2006 CAMA Plan Update (August 2006), and the U.S. Census (2000 and 2010). Primary resources for current status data include: the North Carolina Department of Public Safety (NCDPS) website and the Wilmington Star-News.

BOX 3: CASE STUDY OVERVIEW FOR HOBOKEN, NEW JERSEY

Hoboken, New Jersey is located directly across the Hudson River from Manhattan. More than 50,000 residents (U.S. Census Bureau 2014b) live in the two square miles of the city that are contained within the boundaries of Hudson County. Hudson County's existing Multi-Jurisdictional Pre-Disaster Mitigation All Hazards Plan (2008) identifies eight natural hazards as "significant hazards of concern," including: coastal storm (nor'easters, tropical cyclones, hurricanes, tropical depressions, tropical storms), drought, earthquake, extreme temperatures, flooding, ground failure, severe storm (windstorms, thunderstorms, hail, tornadoes), severe winter storm (heavy snow, blizzards, ice storms), and wildfire (brushlands).

The case study evaluation focuses on the City of Hoboken's continuing recovery following the late 2012 storm known as "Superstorm Sandy." Hurricane Sandy developed late in the Atlantic tropical cyclone season, reaching a peak intensity of Category 3, before merging with a frontal system off the northeastern coast of the United States. Sandy has proven to be the second costliest hurricane on record, with damage estimated at nearly \$70 billion through June 2013 (National Oceanic and Atmospheric Administration 2012). A major disaster (DR-4086) was declared for all New Jersey counties on October 30, 2012 (Federal Emergency Management Agency 2014).

The documents used to determine Hoboken's pre-disaster baseline condition include: the City of Hoboken Master Plan (Adopted April 2004), the City of Hoboken Reexamination Report (2010), the Multi-Jurisdictional Pre-Disaster Mitigation All Hazards Plan for the County of Hudson, Volumes I and II (September 2008), and the U.S. Census (2000 and 2010). Media resources used to determine current status conditions include: The New York Times (website and archives), The Hudson Reporter (website and archives), and the websites NJ.com and northjersey.com.

Lessons learned based on the case studies include the following:

- A strong, pre-existing, jurisdictional fact base is essential to ensuring the accuracy of recovery goal tracking. Baseline conditions must be inventoried (and updated on at least an annual basis) by the user prior to the occurrence of a disaster.
- Permanent and freely accessible sources of current-status data must be identified, secured, and archived, when possible, prior to the occurrence of a disaster and continuing throughout the recovery period.
- The development of a time-lag between baseline data and current data can be avoided by frequently updating the baseline data contained within the Community Recovery Checklist.

These case studies also revealed that the information provided in existing plan documents (including comprehensive plans and hazard mitigation plans) is often not the same information that is communicated post-disaster. This discrepancy is most apparent in the fact that both “baseline” data and “current status” data for individual recovery goals was rarely discovered. The preparation of a high-quality community pre-disaster recovery plan might help to narrow this information gap.





KEY INFORMANT INTERVIEWS AND FOCUS GROUPS

To solicit feedback on the checklist and further refine it for ease-of-use, researchers conducted interviews with 21 key informants and two focus groups with a total of 10 participants. These activities involved planning and emergency management practitioners at the local, state, and federal level, as well as academic researchers with expertise in disaster recovery. See Appendices 3 and 4 for detailed methods and results for these interviews and focus groups.

METRIC CROSSWALK

Based on the findings of the content validation process, the Recovery Focus Areas were crosswalked to demonstrate the interdependency of the metrics (Table 1). The crosswalk was created to provide additional context and to support practitioners in setting priorities for data collection. Users of the CRC should not interpret that the Recovery Focus Area captures the entirety of their activities in that area.

Table 1. Crosswalked Recovery Focus Areas

Themes:  Finance  Process  Public Sector  Social

FOCUS AREA	FOCUS AREA DEFINITION	CROSSWALKED FOCUS AREA(S)
1. BUSINESS AND ECONOMY	This focus area contains metrics capturing the status of local businesses, economic activity and economic structure.	Mobilization of Recovery Funding; Population Characteristics; Public Buildings & Infrastructure; Natural Resources
2. DISASTER AND RECOVERY MANAGEMENT	This focus area contains metrics quantifying and qualifying the processes of disaster recovery and disaster management. Many of the metrics focus on the planning process and whether or not the recovery is being led by community values, as reflected in the existing plans. It also examines how well communities are capitalizing on the opportunities disaster can create for incorporating hazard mitigation practices into the community's development framework, such as building codes and improved land use practices	Mobilization of Recovery Funding; Public Sector Recovery; Public Buildings & Infrastructure; Natural Resources
3. MOBILIZATION OF RECOVERY FUNDING	This focus area contains metrics examining the amount of recovery-related funds (public and private) allocated and distributed.	Business Recovery & Economic Stabilization; Disaster & Recovery Management; Communities & Social Services; Households; Cultural Sites & Resources; Public Buildings & Infrastructure; Natural Resources
4. COMMUNITIES AND SOCIAL SERVICES	This focus area contains metrics capturing the restoration and availability of health & social services post-disaster.	Mobilization of Recovery Funding; Households; Population Characteristics

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5. HOUSEHOLDS	This focus area examines recovery at the household level through metrics examining housing values, patterns of home-ownership and income levels.	Mobilization of Recovery Funding; Households; Population Characteristics; Public Buildings & Infrastructure
6. POPULATION CHARACTERISTICS	This focus area contains metrics capturing community demographics, including potentially vulnerable populations.	Business Recovery & Economic Stabilization; Communities & Social Services; Households
7. PUBLIC SECTOR RECOVERY	This focus area contains metrics examining whether or not the government and public services are fully operational.	Disaster & Recovery Management; Cultural Sites & Resources; Public Buildings & Infrastructure; Natural Resources
8. PUBLIC BUILDINGS AND INFRASTRUCTURE	This focus area contains metrics examining the state of transportation systems and other critical infrastructure such as roads and utilities.	Business Recovery & Economic Stabilization; Mobilization of Recovery Funding; Disaster & Recovery Management; Cultural Sites & Resources; Public Sector Recovery
9. CULTURAL SITES AND RESOURCES	This focus area examines the state and availability of the community's cultural resources including museums, art galleries, landmarks and other local cultural attractions.	Mobilization of Recovery Funding; Public Sector Recovery; Public Buildings & Infrastructure
10. NATURAL RESOURCES	This focus area examines the recovery of natural resources such as soil, environmental assets and coastal resources.	Business Recovery & Economic Stabilization; Mobilization of Recovery Funding; Disaster & Recovery Management; Public Sector Recovery

CONCLUSIONS

The process of developing and validating the CRC has revealed that utilization of this tool can potentially serve as an effective means to track the recovery of a community or jurisdiction following a major disaster. However, a strong, pre-existing, jurisdictional fact base is essential to ensuring the accuracy of recovery tracking. Baseline conditions must be inventoried (and updated on at least an annual basis) prior to the occurrence of a disaster. The preparation of a high-quality community pre-disaster recovery plan might help to narrow this information gap. To assist users with this task in the meantime, suggested data sources for all metrics have been provided as part of the CRC.

Similarly, permanent and freely accessible sources of current status data must be identified and secured prior to the occurrence of disaster and continuing through the recovery period. Federal, state, and local practitioners involved in the development and validation of the CRC identified this need for data as a potential opportunity to improve collaboration and data sharing among agencies responsible for different aspects of recovery and as a way to determine what new partnerships might be necessary to ensure access to reliable current status data.

The proposed metrics necessarily include a mix of quantitative (n=63) and qualitative measures (n=16). Some recovery activities are difficult to measure or assess using traditional, quantitative means of evaluation. However, the use of the FEMA Recovery Support Functions and Recovery Mission Area Core Capabilities as a framework for the themes, recovery focus areas, and metrics helps ensure that the priorities of the whole community (e.g., federal agencies, non-governmental partners, and other stakeholders) are included in the final CRC. Further research and collaboration with practitioners would help to continue to improve the CRC.

APPENDIX 1. SUGGESTED DATA SOURCES FOR METRICS

METRIC	DATA SOURCES
Total disaster-related business closures	Local organizations (such as economic development departments and municipal tax offices) that collect information on economic activity will likely have access to this data. Local media may collect information on business closures following an event. Comparing a comprehensive list of all businesses before and after a disaster may yield a close approximation to the number of business closed due to a disaster.
Average level of business insurance	Ideally, the coverage amount of active insurance policies would be collected for all businesses and then averaged. Alternatively, a survey could be used to poll a representative sample of businesses within the area for information on their insurance coverage. Data collectors may try contacting insurance providers directly for information on local coverage amounts.
Number of commercial bankruptcies	Bankruptcy declarations are processed by the U.S. court system and statistics on the state and county level are available to the public: http://www.uscourts.gov/Statistics/BankruptcyStatistics.aspx . For local declarations, organizations that collect economic development information may have access to bankruptcy data. Local court systems will keep records of bankruptcy proceedings.
Economic output	Filed tax records for businesses will be the most direct source of data on economic output. Local economic offices may publish yearly or quarterly reports on total income, revenue, or profit generated from businesses within the area.
Total businesses located in central business district	Comprehensive listings of businesses can be used with mapping software to summarize the number of businesses within a discrete area.
Number of small businesses	Tax records for businesses will contain information on the number of employees. Developing a listing of businesses by employment will allow the user to divide the list into larger and smaller businesses.
Number of large businesses	Tax records for businesses will contain information on the number of employees. Developing a listing of businesses by employment will allow the user to divide the list into larger and smaller businesses.
Restoration of business supply lines	A survey of local businesses may be needed to assess the status of supply chains.
Net business gain/loss	Local media or governmental institutions may publish disaster impact reports that attempt to quantify the total economic loss due to a disaster.

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METRIC	DATA SOURCES
Economic structure (sector-share) in community	A location quotient calculator is provided by the U.S. Bureau of Labor Statistics and can be found here: http://data.bls.gov/location_quotient/ControllerServlet . The location quotient can be calculated on yearly intervals from 2001 onward.
Return of client/customer base	A survey will likely be needed to assess the general experiences of local businesses; qualitative descriptions can be generated by summarizing the survey results.
Amount of FEMA funding distributed	FEMA provides information on money distributed for specific disaster declarations: http://www.fema.gov/openfema .
Amount of non-FEMA recovery funding distributed	Local government economic agency
Amount of donations received	Organizations that deal with private donations such as the Red Cross should be contacted to approximate the value of donations. Surveys may be used to standardize the questions across organizations.
Amount of insurance payments received	Local insurance providers should be contacted to quantify the amount of funds fully dispersed. This metric can be quantified using FEMA funds, or private insurance agencies, depending on the needs of your community.
Total funding used for permanent reconstruction projects	FEMA funds can be sorted by construction project type; contacting local construction and planning organizations may quantify additional projects not funded by FEMA.
Number of hazard mitigation, emergency preparedness and recovery public meetings held and number of public participants	Users should contact their local planning or emergency services department for information on public meetings related to preparedness or recovery.
Disaster management plans (emergency preparedness/hazard mitigation/recovery plan) developed or updated post-disaster	The planning or emergency services department (or agency responsible for plan development) should be contacted.
Disaster management plans (emergency preparedness/hazard mitigation/recovery plans) address vulnerable populations (seniors, low-income persons, non-English speakers)	Disaster management plans should be collected and analyzed to see if they have specific elements pertaining to vulnerable populations. Updates to plans that specifically address vulnerable populations can be summarized in this metric.

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METRIC	DATA SOURCES
Improved community resiliency	Any construction of resilient infrastructure or drafting of regulatory policy should be noted in this metric. The planning and building departments should be contacted for information on new policies or the creation of new infrastructure.
Outreach methods used to engage public in disaster planning (e.g., radio and television advertisements, brochures, web surveys)	Local planning department, emergency management department, or health and human services department may be contacted. Links to brochures, instructional videos, pamphlets, or any other outreach methods can be stored in the description space for this metric.
Number of organizations involved in recovery and disaster management planning processes	Planning department or agency responsible for the local preparedness/recovery planning processes. Following up with organizations identified by the planning department may be necessary to gauge the level of involvement.
Government monitoring of recovery plan goal progress	Engage the creator of any recovery plans to identify if monitoring systems are in place.
Recovery plan used to initiate recommendations for enactment or repeal of procedures, or extension of emergency resolutions, ordinances, and orders	Creator of recovery plan.
Regulations implemented for priority resettlement areas	Planning agencies that develop plans or codes that call for the creation of priority resettlement areas.
Building moratoria lifted	Building moratoria enacted have been lifted.
New resident housing tenure	U.S. Census
Owner-occupied vs. renter-occupied housing units	U.S. Census/Local housing records
Percent of population residing in temporary housing units	Organizations providing temporary housing units such as FEMA or the Red Cross should be contacted.
Average level of homeowner's insurance	Homeowner insurance providers can be contacted directly. Alternately, a survey can be conducted of local homeowners to determine the average monetary value of active homeowner insurance policies.
Median home value	U.S. Census/Local housing records
Median and mean household income	U.S. Census
Vacancy rates	U.S. Census
Number of abandoned housing units	U.S. Census

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METRIC	DATA SOURCES
Availability of social services	A survey may be dispersed to relevant governmental and non-governmental organizations to determine the availability of social service programs. Consideration should be given to organizations that have closed social services and, as of the time of data collection, have not reopened them.
Re-establishment of social networks and community facilities (e.g., re-establishment of schools, community facilities, houses of worship)	A survey may be conducted with key local leaders to access the status of social networks and community facilities. Informal interviews may be conducted with leaders that the community has determined are particularly knowledgeable on the topic of social networks.
Re-establishment of day care, after-school, and teen programs	Day care, after-school and teen programs should be identified and contacted to assess their ability to provide services that existed before the disaster. The space provided for this metric can be used to describe changes in their service, and track its progress through time.
Community health care facilities operational	The local health department should be contacted to first identify all existing health care facilities. The status of their personnel and supplies should be assessed during normal conditions, to establish a baseline. In the event of a disaster, the facilities should be contacted again periodically to assess their current capacity.
Workforce assistance programs available	Economic development departments or other relevant organizations should be contacted to identify any existing workforce programs to establish a baseline. Their capacity to provide services after a disaster should be explored and noted in this metric.
Number of physicians	The local health department or hospital should be contacted to determine the number of professionals with a medical license operating within your community.
Organizations available to offer disaster-related medical or mental health support for post-traumatic stress disorder, depression, etc.	Health and human services departments. Organizations that exist prior to the disaster should be inventoried. After a disaster this list should be referenced to ensure that services have continued. Any new organizations or services created after the disaster should be noted.
Number of domestic violence incidents	Local law enforcement agencies should be contacted to establish a pre-disaster baseline. After the disaster these numbers should be updated periodically.
Self-reported trust rating of local government	A survey should be used to assess how confident citizens are of the government's ability to operate efficiently and equitably. Ideally, surveys would be distributed to establish a baseline, and then compared in the weeks or months after a disaster.
Total population	U.S. Census

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METRIC	DATA SOURCES
Disaster-displaced individuals	U.S. Census
Unemployment rate	U.S. Census
Population Below Poverty Line	U.S. Census
Households without access to a car	U.S. Census
Population over age 65	U.S. Census
Population under age 16	U.S. Census
Population disabled	U.S. Census
Population without high school diploma	U.S. Census
Population non-white	U.S. Census
Population non-English speakers	U.S. Census
Households headed by single parents	U.S. Census
Reconstruction/repair of damaged cultural or heritage sites (e.g., landmarks, artifacts)	Organizations responsible for curating cultural or heritage sites should be identified. A comprehensive listing of cultural or heritage assets should be created and periodically updated.
Reconstruction/repair of damaged arts and religious facilities	Artistic and religious organizations should be identified and contacted. The status of repairs and reconstruction should be periodically updated in this metric.
Re-establishment of arts and sports organizations	The Parks and Recreation department may have access to a database of local sports organization. Cultural or heritage organizations can be contacted for information on arts organizations.
Religious service attendance	Interviews or surveys with religious leaders within the community.
Governing body fully functioning	This metric may require a survey or informal interview with representatives from each branch of the government. Dates should be noted where continuity of government plans and procedures were enacted and lifted.
Number of civic organizations	A comprehensive listing of civic organizations should be compiled before a disaster to establish a baseline. Once the disaster has occurred each organization on the list should be contacted to establish their operational capacity.
Tax revenue	Economic development agency; yearly budget reports.

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METRIC	DATA SOURCES
Public services available	Public works department, law enforcement agencies, and local libraries.
Children enrolled in community schools	Local schools should be contacted for enrollment numbers.
Number of voter registrations	Local board of elections
Re-establishment of transportation and transit system(s) (local and regional)	Local Department of Transportation and transit agencies should be contacted to assess the state of transportation and transit systems.
Public transit ridership	Local Department of Transportation and other transit agencies.
Miles of disaster-damaged roads and bridges repaired	DOT/Public works department
Damage to critical infrastructure (e.g., utilities, water treatment, gas pipelines) repaired	DOT/Public works department/Local utility companies
Railway and maritime shipping infrastructure repaired	Relevant organization such as the Department of Transportation and any private shipping organizations in the area should be contacted. This metric should attempt to describe the process of the recovery and reconstruction over time. A damage assessment after the disaster may be created, and each item in the assessment would be described through time.
Damage to public facilities repaired (e.g., municipal buildings)	A comprehensive listing of all public facilities should be gathered pre-disaster. This list should be referenced periodically after a disaster to assess the status of repairs.
Status of debris management	Areas of particularly high concentrations of debris should be identified. Periodically, their status should be updated.
Re-establishment of environmental governance/pollution monitoring	Local environmental department or relevant agency such as U.S. EPA. A comprehensive listing of environmental governance should be compiled pre-disaster. After a disaster, each element of the list should be assessed for compliance.
Restoration of protected natural areas	The local planning department should have access to data on the location of protected natural areas. These areas should be assessed for any damage incurred by the disaster. Damage should be identified and progress toward its restoration periodically updated.
Coastlines and wetlands assessed to determine if additional hazard mitigation measures should be implemented	Local planning department or emergency management department will have knowledge of relevant hazard mitigation plans. The assessment process should be completed by local environmental agencies. Any measures in the hazard mitigation plan or assessments that pertain to coastlines or wetlands should be noted in this metric.

METRIC	DATA SOURCES
Damage to coral reefs, shrimp hatcheries, or other coastal resources inventoried	Damage reports from environmental agencies should inventory damages relating to coastal resources. The local Department of Natural Resources or comparable organization will be responsible for this inventory.
Soil testing at debris management sites	Scientific data for areas identified in the “status of debris management” metric should be collected. Community needs and the nature of the disaster will dictate what measurements should be taken.
Rates of erosion	The Department of Natural Resources or USGS should have maps indicating areas at risk for erosion. An initial inventory of shoreline, riverbank, and coastlines should be developed to establish a baseline. Following a disaster, these water boundaries should be compared against baseline conditions.
Incidence of landslides	<p>The USGS maps instances of landslides across the nation: http://landslides.usgs.gov/hazards/nationalmap.</p> <p>Natural Resource Departments may collect information on landslides.</p>

APPENDIX 2. CASE STUDY SYNOPSES

Two jurisdictions, New Hanover County, North Carolina, and the City of Hoboken, New Jersey, were selected for the case studies on the basis of meeting or exceeding the following conditions:

A robust community fact base, available within existing planning documents, necessary to thoroughly assess the community's pre-disaster condition.

A federal disaster declaration within the last five years for the community under investigation, preferably more recent, allowing for greater availability of online media resources and avoiding large gaps between baseline conditions and current status data.

The existence of pre-disaster emergency operations plans or hazard mitigation plans for the communities under investigation, allowing a more thorough validation of the identified goals and activities within the Community Recovery Checklist.

Hoboken was also selected in order to meet a request from funders at the Department of Homeland Security's Science and Technology Directorate that one of the case studies include a community affected by Hurricane Sandy.

Retrospective "baseline" data for the Community Recovery Checklist goals was gathered by examining pre-existing planning documents including multi-jurisdictional hazard mitigation plans, pre-disaster recovery plans (when available), emergency operations plans, community comprehensive (or master) plans and U.S. Census data. When identified, a baseline condition for a recovery goal or activity was recorded within the checklist along with the source of the data.

Current status data was gathered using electronic media reports and internet databases, using a search method described by Chang et al. (2009), involving three basic steps: 1) using an online database or search engine to gather relevant media articles using Boolean search terms; 2) reading the gathered media reports and recording identified community recovery goals and their current status into the Community Recovery Checklist along with source data; and 3) performing a final media search in order to address any gaps in the collected recovery data following the first two steps.

Recovery Goals Identified in Case Study Communities

RSF/CORE CAPABILITY	NUMBER OF RECOVERY GOALS	NUMBER OF RECOVERY GOALS IDENTIFIED: HOBOKEN	NUMBER OF RECOVERY GOALS IDENTIFIED: NEW HANOVER
Community Planning and Capacity Building	8	2	2
Economic Recovery	18	11	12
Health and Social Services Recovery	13	3	8
Housing Recovery	17	9	12
Infrastructure Systems Recovery	9	7	5
Natural and Cultural Resources Recovery	12	5	4
Public Information and Warning	7	2	3
Operational Coordination	6	4	5

The two case studies indicate that a large number of recovery goals and activities are well-represented in community planning documents (baseline conditions) and electronic media reports following a disaster (current status data). The process of validating the Community Recovery Checklist has revealed that utilization of this tool can potentially serve as an effective means to track the recovery of a community or jurisdiction following a major disaster.

APPENDIX 3. INTERVIEW GUIDE: KEY INFORMANT INTERVIEWS AND FOCUS GROUPS

The following questions were used to guide discussion in key informant interviews and focus groups.

Background Questions

1. Please tell us in what agency/institution you work and your role?
 - a. How many years of experience do you have in this specific role?
2. How many years of experience do you have in disaster recovery?
3. *If applicable*, please describe your role during disaster recovery (employed by FEMA, local hire, etc.)
 - a. What have been your responsibilities in recovery?
4. Please describe any other disaster recovery roles (employing organization [state, federal, local]; years of experience; specific duties).

Proposed Aggregate Recovery Focus Areas

The research team identified 651 disaster recovery metrics in a literature review, aggregated to 90 using a recovery plan review and case studies, and then aggregated to the 15 recovery focus areas that we will be talking about today. Each of the 15 focus areas has been assigned primary, secondary and (if applicable) tertiary metrics. First, we'd like to know what you think about the 15 recovery focus areas.

1. Based on your experience, to what extent does this list of recovery focus areas capture/address community recovery from disasters?
2. Please describe examples as to how these focus areas might reflect the priorities of local communities affected by disasters during their recovery.
3. Please describe any examples that indicate that the focus areas need to be reconsidered.

Proposed Community Metrics

Now we'd like to ask you about the specific metrics for each recovery focus areas. We would like to concentrate on the focus areas and metrics where you have the most experience in disaster recovery. These metrics are intended to be used in a toolkit for practitioners that you work with in the field. They will be developed into a checklist to guide collection of disaster recovery data. "Primary" metrics refers to core indicators that provide a basic picture of a community's functioning. "Secondary" and "Tertiary" metrics are supporting indicators that help to provide a more complete picture of recovery, but are not essential.

1. First, for which recovery focus areas/metrics do you have the most experience?
2. What do you think of this approach?
 - a. In your opinion, would this be an effective tool for people you work with at the local (city or county) level?

3. How could you have used this approach with those you work with in your previous recovery responsibilities?
4. How feasible do you think this approach is for those you work with to implement as part of their recovery responsibilities?
 - a. How could you see using this approach with those you work with in future disaster recovery efforts?
5. For each recovery focus area list of metrics:
 - a. Are there any metrics that are unclear?
 - b. If yes, how could the metric(s) be made clearer?
 - c. Are there any metrics for which it would be difficult/not feasible to obtain data?
 - d. Please provide any suggestions regarding organization of primary, secondary, and tertiary metrics.
 - e. Do we have the right metrics on the primary, secondary, and tertiary lists?
 - f. Are there specific metrics that should be specifically related to short (24-72 hours post incident), medium (72 hours to weeks post incident), or long-term recovery (months to years post incident)?
 - g. Are any of the existing metrics particularly relevant to your previous work in disaster recovery?
 - h. Are there metrics which you or those you work with could use for other post- disaster grant reporting (e.g., HUD housing assistance grants—some may know these grants as Sandy Supplemental/CDBG grants, Hazard Mitigation Grant Program, Public Assistance, Individual Assistance, Small Business Administration housing grants, others)?
 - i. Are there metrics which you or those you work with could use for other post- disaster loan reporting (Small Business Administration, Lenders/Financial Institutions, others)?
 - j. Are there metrics which you or those you work with could use for other post- disaster insurance proceeds reporting (National Flood Insurance Program [homeowners, business], Homeowners Insurance, others)?
 - k. Are there any metrics that would not be at all relevant to your work with communities during disaster recovery?
 - l. Are any metrics missing?
 - m. If yes, please describe the metric and how it is useful in recovery.
6. Do you have any other comments, suggestions or questions about the recovery focus areas and metrics?

APPENDIX 4. FINDINGS: KEY INFORMANT INTERVIEWS AND FOCUS GROUPS

The research team identified 28 potential interview participants with direct experience and knowledge, through either research or practice, of the proposed focus areas and potential metrics (see Table below). Potential interviewees were sent an email invitation to participate in a brief interview for the project. Twenty-two of the 28 participants (79%) replied to state their interest in the project and 21 (95%) participated in the interview. Additionally, two focus groups were conducted with a total of 10 expert participants to obtain additional feedback on the tool and metrics.

Summary of Key Informant Interview and Focus Group Participants

	ACADEMICS	PRIVATE PRACTITIONERS	PUBLIC PRACTITIONERS	TOTAL PARTICIPANTS
Key informant interviews	4	2	15	21
Focus group 1	1	1	3	5
Focus group 2	3	1	1	5

Five major themes emerged from the key informant interviews and focus groups.

1. The Recovery Indicators Tool will potentially serve multiple purposes, both pre- and post-disaster.

The majority of participants noted that a tool like the one currently under development is useful as a means to “get people thinking” about specific community elements that need to be addressed to prepare for a potential disaster and foster a successful recovery following a disaster event. One participant described the tool as a “focusing mechanism” that would keep “momentum moving forward” during recovery. Another respondent suggested the tool might function as an “executive playbook” for community decision-making in the aftermath of a disaster, particularly if decision-makers have not received training in emergency management. Other participants envisioned the tool being used for evaluations of the community, above and beyond the assessment of community recovery. Some ideas for potential uses include a “pre-disaster self-assessment” generated from baseline data entered into the tool or a means of measuring the “adaptive capacity” of a community in order to evaluate the ability to quickly recover from a disaster. Additionally, it was suggested that the tool could be used post-disaster to roughly estimate the level of recovery assistance needed by the community.

2. The proposed recovery Focus Areas are comprehensive, but there is room for improvement in both their content and organization.

While it was noted that the proposed Focus Areas “align nicely” with the National Disaster Recovery Framework, many interviewees found redundancies between some of the Focus Areas (“Business Recovery” and “Economic Stabilization,” specifically) and suggested that combining similar areas might ease both organizational understanding and data collection and entry. There was some concern that the Focus Areas are not “intuitive” and “hard to digest” making it difficult to understand how the areas fit

together during the disaster recovery experience. Similarly, another participant noted “separating metrics into Focus Areas makes it difficult to capture the interconnections that exist between different metrics and characteristics.” A suggestion was made to improve the proposed Focus Areas by creating thematic “clusters” to organize the Focus Areas in order to highlight similarities and interconnections. Finally, it was noted that the importance and/or relevance of specific Focus Areas might be “highly dependent” on the characteristics of the impacted community as well as the type of disaster experienced.

3. Using metrics to measure or gauge recovery progress might lead to unfair comparisons between communities, or worse, the development of a “moral hazard” situation when disaster recovery is judged to be “complete” and the assistance-funding stream is terminated.

Participant feedback noted that it is critical to clearly communicate the purpose of the CRC to communities, in order to assure users that the tool is a self-assessment and is not designed for inter-community comparative purposes. Interviewees suggest clearly articulating the “end goal” of the tool—a means to measure a community’s recovery progress—and soliciting the assistance of a local “project champion” to increase trust and community buy-in. Other suggestions to help overcome doubts are to develop a means of incentivizing use of the tool as well as to demonstrate the usefulness of the tool to the community by focusing on the “story” that can be told through the metrics and data collected. In addition to concerns about comparisons being made, one key informant noted there is the potential for a “moral hazard” to develop. This was described as a situation where a tool intended to help the community recover actually ends up causing harm due to a subjective determination being made regarding the status of disaster recovery. This interviewee was troubled at the thought of recovery assistance streams being prematurely cut off as a result of using the CRC.

4. Potential data collection and reporting issues exist.

A number of participants noted potential issues that might exist relating to data collection and reporting. Local government units with less capacity may have difficulty dedicating time and/or staff to tracking the necessary baseline and post-disaster data required for the tool to serve its purpose. Respondents also mentioned the critical need for users to receive training in order to properly use the tool and interpret the results, including how to collect useable, “good” data and how to interpret changes and trends in the collected data. One concern that remains challenging is the availability of easily accessible, open source data for all metrics.

Key informants made two suggestions to overcome potential data collection issues: 1) provide communities with likely data sources for individual metrics; and 2) pre-populate data for the CRC where possible in order to ease the burden on users. Participants noted it might also be necessary for users to acquire data from “non-traditional” sources (such as a local Chamber of Commerce) to fill any gaps in publically available data. Additionally, if data is not directly available for a metric, proxies might be required. An illustrative example provided by one respondent is a case in Colorado where a disaster-impacted community, heavily dependent on the natural environment, is using tourism revenue as a proxy to gauge the recovered value of natural resources. A final issue relating to data collection and

interpretation raised during interviews is the importance of evaluating spatial data in addition to quantitative and qualitative data. Respondents expressed concern that the allocation of recovery funding is not always primarily driven by the degree of disaster impact. It was suggested that including spatial data, linking the damages and recovery assistance, in the CRC might improve assistance delivery and support greater accountability.

5. Potential issues with metrics and measurements exist.

A variety of suggestions and critiques of the metrics and measurements contained within the Focus Areas of the CRC were discussed. A frequent comment concerned the recovery timeframe being addressed through the metrics; interviewees had a difficult time interpreting whether the checklist was assessing short-term or long-term recovery outcomes. Some confusion also existed as to whether metrics were prioritized in some way; the primary, secondary, and tertiary categorization of metrics within Focus Areas appeared to unnecessarily complicate the tool, based on interview responses. A number of participants expressed concern over “assigning quantitative indicators to fundamentally qualitative measures” (i.e., how a community “feels” in the recovery period). Other respondents suggested that some metrics seemed vague and that others might simply be “un-measurable” (one example provided was the metric relating to ecosystem resilience). A general comment on using metrics to gauge recovery was that the “focus of measurements should be outcomes, not outputs; for example, it is better to measure the number of schools reopened rather than dollars spent on school recovery.” Supporting the case for the precedence of whole-system functionality over costs, another key informant discussing transportation systems expressed “cost doesn’t really capture what’s important... we need qualitative indicators of how well the system is working.” Two final metric-related issues raised are: 1) social equity must be addressed by identifying specific metrics relating to community equity; and 2) a community’s plan for post-disaster recovery and redevelopment will change the way metrics are interpreted and used. For instance, the data collected will be utilized quite differently if a “new normal is on the horizon” rather than if a community is “aiming to go back to what it was before the disaster.”

APPENDIX 5. GLOSSARY OF TERMS

TERM	DEFINITION AND USES
Baseline Data	The value/description of a metric immediately prior to a disaster occurring; a baseline may be predetermined for some metrics, such as those using decennial Census data
Community Capacity/Capability	The various resources (both material and immaterial) available to and effectively utilized by a municipality
Community Fact Base	The collective data that provides an accurate snapshot of a municipality's demographics, economy, environment, and more
Community Recovery Checklist (CRC)	A tool consisting of organized metrics to help communities prepare for, and successfully recovery from, disaster
Current Data	Any quantitative or qualitative information used to evaluate a metric following the occurrence of a disaster
Data Points	Sequential entries of information for metrics that can be used to evaluate the trajectory of a community's recovery
Disaster Recovery	Generally described in phases including response, restoration, reconstruction, and commemorative reconstruction (Haas, Kates & Bowden, 1977)
Equity (social)	The recognition that certain vulnerable populations may require greater attention, due to a diversity of needs and abilities, in order to put them on equal footing with the rest of the community
Geographic Designation	The primary location (neighborhood, town, county, etc.) for which data is collected for the metrics
Indicator	A "marker" used to designate a certain state or level; definition often varies between disciplines and practices
Metric	A means of measurement; metrics in the CRC have been organized as primary or secondary based on availability of data and influence on the recovery process
National Disaster Recovery Framework (NDRF)	"A guide that enables effective recovery support to disaster-impacted States, Tribes, Territorial and local jurisdictions. It provides a flexible structure that enables disaster recovery managers to operate in a unified and collaborative manner. It also focuses on how best to restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community and build a more resilient Nation." (www.fema.gov); the NDRF is used as an organizing framework for metrics contained within the CRC
National Preparedness Goal	"A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk." Contains 31 "Core Capabilities," two of which (Operational Capacity; Public Information & Warning) were used to categorize metrics contained within the CRC

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Qualitative Metrics	Metrics that can be measured numerically
Quantitative Metrics	Metrics that require descriptive data
Recovery Focus Areas	Groups in the CRC that organize related metrics, or metrics utilizing similar data
Recovery Outcomes	The goal(s) of an individual community following a disaster; may be formal (as found in a recovery plan or other guiding document) or informal (the collective desires of the community to return to “normal”); metrics in the CRC can be used to gauge progress toward these goals
Resilience	“Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events” (<i>The National Academies, 2012</i>)
Socially Vulnerable Populations	The “set of characteristics of a group or individual in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is at risk by a discrete and identifiable event in nature or society” (Blaikie et al., 1994)
Suggested Data Sources	Recommendations for finding the necessary information for evaluating recovery metrics, based on publically available information as well as research and case studies conducted as part of this project
Survey	A suggested method for obtaining information from the community for certain metrics by posing a set of pre-determined questions to a subject; a survey may attempt to include all affected individuals/organizations or just a sample
Themes	A method of organizing related Recovery Focus Areas within the CRC; the four themes include: 1) Financial; 2) Process; 3) Public Sector; and 4) Social
Validation of Metrics	The process by which proposed metrics were tested for applicability, usability, and value; three phases of validation were conducted for the CRC: a review of pre-disaster recovery plans, two retrospective case studies, and key informant interviews and focus groups with academics and practitioners
Vulnerability	“The inability of people, organizations, and societies to withstand adverse impacts from multiple stressors to which they are exposed” (Flores-Ballesteros, 2008)
“Whole Communities” Approach	“Recognizing that preparedness is a shared responsibility, it calls for the involvement of everyone—not just the government—in preparedness efforts. By working together, everyone can keep the nation safe from harm and resilient when struck by hazards, such as natural disasters, acts of terrorism, and pandemics.” (www.fema.gov)

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