Climate Resilient Mitigation Activities
Flood Diversion and Storage

Purpose

The President's 2015 Opportunity, Growth, and Security Initiative (OGSI); Executive Order 13653 Preparing the United States for the Impacts of Climate Change; the President's 2013 Climate Action Plan; FEMA's Climate Change Adaptation Policy; and the 2014-2018 FEMA Strategic Plan, all identify the risks and impacts associated with climate change on community resilience to natural hazards, and direct Federal agencies to support climate resilient infrastructure.

FEMA is encouraging communities to incorporate methods to mitigate the impacts of climate change into eligible Hazard Mitigation Assistance (HMA) funded risk reduction activities by providing guidance on Climate Resilient Mitigation Activities. FEMA has developed initial guidance on Climate Resilient Mitigation Activities including green infrastructure methods, expanded ecosystem service benefits, and three flood reduction and drought mitigation activities: Aquifer Storage and Recovery (ASR), Floodplain and Stream Restoration (FSR), and Flood Diversion and Storage (FDS).

FEMA encourages communities to use this information in developing eligible HMA project applications that leverage risk reduction actions and increase resilience to the impacts of climate change.

Project Description

Flood Diversion and Storage projects involve diverting floodwaters from a stream, river, or other body of water into a wetland, floodplain, canal, pipe, or other conduit (e.g., tunnels, wells) and storing them in above-ground reservoirs, floodplains, wetlands, green infrastructure elements, or other storage facilities. Many FDS projects are currently eligible for HMA funding as flood risk reduction activities. This guidance focuses on FDS projects implemented using green infrastructure methods as much as possible to address drought mitigation and climate change resilience in addition to reducing flood risk. FDS projects can be used to retain water to allow infiltration to ground water supplies. This allows for a controlled baseflow release and tempers peak flows, stages, and velocities to mitigate flooding.

Actively managing floodwaters by diversion, storage, and infiltration can replenish water supply through groundwater recharge, increasing base flows, and enhancing usable water supply to mitigate the effects of drought. FDS projects can also help maintain healthy ecosystems. The concept of floodwater diversion and storage can be scaled for the project area and/or site. FDS projects can range from large scale municipal or regional projects to localized, small scale neighborhood flood control projects. FDS projects lend themselves readily to design and implementation using green infrastructure methods.

Project Design and Implementation Considerations

Depending on the scope, scale, and location of potential sites, floodwater diversion and storage projects can vary in complexity. Proper planning, siting, sizing, and construction are required to implement successful

floodwater diversion and storage systems. Online storage allows for water to be temporarily stored within the river channel and its floodplain and can include elements such as an impounding structure, flow control structure, or spillway. Offline storage diverts water from the river channel to be stored in a separate area (which may be part of the floodplain such as a marsh) and is then subsequently released back to the river or to another channel. In general, flood storage areas can be categorized into five different categories:

Type of Flood Storage Area/Reservoir	Description
Online	Both dry and wet weather flows pass through the flood storage area
Offline	Dry and first-flush wet weather flows pass through the flood storage area. Larger flows bypass the facility
Dry	The flood storage system is kept essentially dry due to infiltration and evapotranspiration
Wet	The flood storage area contains water under all flow conditions
Wet/Dry	Part of the flood storage area contains water and part is dry during various flow conditions

Green infrastructure methods can be used for larger scale FDS projects by diverting the water into appropriately sized bio-retention or bio-detention basins. Smaller projects can provide localized flood reduction by channeling the diverted water into a bio-swale, raingarden, storm water tree trench, or smaller bio-retention or bio-detention basin. The diverted water can then be allowed to infiltrate to re-charge ground water supply.

Project Benefits and Cost Effectiveness

An FDS project provides flood risk reduction benefits that can be calculated using the existing FEMA BCA Tool. In some cases, the flood risk reduction benefits may even be sufficient to demonstrate the project is cost effective before considering benefits for drought mitigation and ecosystem services. However, any additional benefits for ecosystem services provided by green infrastructure methods can be included when appropriate.

FDS projects can also provide drought mitigation by facilitating groundwater re-charge and increasing water supply. At a minimum, the project application would need to identify the increased water supply capacity the FDS project would provide in relation to the population that will be supported in a drought and during the project's useful life. A recurrence interval for drought periods will need to be identified to use the FEMA BCA Tool. Estimating the probability of a drought can be difficult due to historical data gaps and variance in annual weather patterns/precipitation. There is not currently a single methodology to establish a recurrence interval for drought. Rather, FEMA encourages communities to use the best available data to document a recurrence interval. In addition to regional or local sources of historical drought periods, federal agency resources that

provide drought related resources with information that could support a recurrence interval are listed in the Climate Change, Drought Information, and HMA Resources section.

An FDS project that results in new or restored wetlands, estuaries, riparian or green, open space, may consider the total annual benefits for these categories in the cost effectiveness evaluation. For these benefits, it would be necessary to quantify the total restored ecosystem area (in acres), define the land use type, and quantify the additional water supply provided by the project in relation to the population that will be supported in a drought, and identify the project's useful life.

Ecosystem services are beneficial goods and services provided by nature for people. Every landscape yields a variety of ecosystem services, presenting an opportunity for mitigation actions that provide multiple ecosystem services benefits. FEMA is building on the existing ecosystem services that can be used for acquisition/open space projects to allow more ecosystem service benefits for climate resilient activities. FDS projects can make extensive use of green infrastructure methods and are likely to provide several or more ecosystem services. FEMA will be providing more guidance on the ecosystem service benefits that can be used in evaluating the cost effectiveness of these mitigation projects in 2016.

Environmental and Historic Preservation Considerations

As part of eligibility review, FEMA is required to ensure that all HMA projects are compliant with environmental and historic preservation (EHP) requirements. This includes, but is not limited to, the processes and requirements established by the National Environmental Policy Act, Endangered Species Act, National Historic Preservation Act, Coastal Barrier Resources Act, and any other applicable laws, Executive Orders, Federal regulations or requirements. More detailed information on the EHP review process and requirements can be found in the HMA Guidance in the FEMA Library.

The size and scale of the FDS project and presence of potentially sensitive environmental and/or cultural resources may impact the level of complexity of the EHP review. Neighborhood scale projects in urban areas may not require as complex an EHP review as a larger scale project impacting a floodplain. Projects larger than a neighborhood scale are more likely to affect wetlands, coastal zones, cultural resources, or habitat for plants and wildlife. These issues will need to be carefully evaluated during design and planning of the project. In particular, the impacts on downstream flow patterns will need to be considered to evaluate the effects on land use, the special flood hazard areas, stream functions, stream habitat, and erosion or sedimentation rates.

Project applications must include the necessary data and information for FEMA to conduct the appropriate EHP review. FEMA, in consultation with appropriate Federal and State agencies, will use the information provided in the application to ensure compliance with EHP requirements. This may include demonstrating methods to incorporate public participation in the review process and/or mitigate any EHP impacts resulting from the mitigation action.

Climate Change, Drought Information, and HMA Resources

U.S. Drought Portal which includes the National Integrated Drought Information System (NIDIS)
http://www.drought.gov/drought

NASA Gravity Recovery and Climate Experiment (GRACE) provides satellite data on aquifer water levels
http://www.nasa.gov/mission_pages/Grace

U.S. Department of Agriculture Disaster and Drought Information
http://www.usda.gov/wps/portal/usda/usdahome?navid=DISASTER_ASSISTANCE

Hazard Mitigation Assistance Guidance and Addendum (February 27, 2015)
https://www.fema.gov/media-library/assets/documents/103279

U.S. Global Change Research Program conducts a National Climate Assessment every four year
http://www.globalchange.gov

NOAA Climate.gov provides science and information for a climate-smart nation and houses the National Drought Monitor
https://www.climate.gov

Information Requests and Questions

FEMA encourages communities to work with their State or Tribal Hazard Mitigation Office in identifying and developing Climate Resilient Mitigation Activity projects. States and federally-recognized tribes should contact their FEMA Region Office with questions. Questions can also be submitted by email to FEMA-HMA-Grants-Policy@fema.dhs.gov.