

White Paper

Study Recommendations for Agricultural Structures in the Floodplain

Performed Under:

Hazard Mitigation Technical Assistance Program (HMTAP)

Contract No. HSFE60-15-D-0014

Task Order 16-J-0203

Prepared for:



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June 21, 2016

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1.0 EXECUTIVE SUMMARY

In June 2014 at Congressional request, the U.S. Government Accountability Office (GAO) published a study to evaluate the possible effects of the National Flood Insurance Program (NFIP), including its building requirements, on farmers in riverine areas in high-risk flood zones. The report tasked the Federal Emergency Management Agency (FEMA) with updating existing guidance on mitigating the risk of flood damage to agricultural structures, to include additional information that reflects recent farming developments and structural needs in vast and deep floodplains. FEMA agreed with the recommendation. In addressing the recommendation, FEMA determined a white paper should first be developed to better define the parameters of a more comprehensive study.

This white paper provides an overview of: how agricultural buildings and contents can sustain damages as a result of flooding; the types of mitigation measures required under the NFIP; and what flood insurance and crop/hail insurance coverage is currently available to farmers. It then discusses the structural, insurance, and lending considerations for farmers when building or expanding agricultural structures in the floodplain. Finally, this white paper outlines a suggested approach to undertaking a more comprehensive study that will ultimately review and update existing guidance related to agricultural structures in the floodplain. Some of the recommendations for further exploration during this study include:

1. Analyze new and substantially improved/substantially damaged agricultural structures based on building type, function, and contents against the type of floodplain/floodway in which they are located to determine the feasibility of elevating, dry floodproofing, and/or wet floodproofing. Evaluate and make recommendations for planning considerations in Technical Bulletin 7 pertaining to agriculture structures.
2. Recommend strategies for minimizing damages to pre-Flood Insurance Rate Maps (FIRMs) agricultural structures.
3. Identify legislative, regulatory, and program changes affecting management of agricultural structures in the floodplain.
4. Identify other requirements for commodity handling and storage, such as Food and Drug Administration (FDA), U.S. Department of Agriculture (USDA), distributor, and other requirements.
5. Determine the number and type of agricultural structures currently insured under the NFIP. Understand the contents contained in these structures and how they are insured.
6. Understand what changes have occurred in the agriculture industry in the last 25 years with respect to ownership and operations and include information that reflects recent farming developments and structural needs such as confinement operations and the effect that flood damages can have on farm operations. Advancements in building design may already minimize flood damages and should be explored.

7. Determine if corporate and individual farm owners insure their property differently for flood.
8. Identify other options for farmers to insure their agricultural structures.
9. Identify what crop/hail insurance covers, including contents inside structures. Identify new programs to protect livestock, dairy operations, hay, and forage.
10. Understand mandatory purchase requirements and implications of the Biggert-Waters Act of 2012 (BW-12) and the Homeowners Flood Insurance Affordability Act of 2014 on lender requirements for agricultural structures.
11. Explore how special rating guidelines are applied to agricultural structures and types of mitigation techniques that would result in reduced risk.
12. Identify the sources of information used to do the larger study in addition to the ones used in this White Paper.

2.0 INTRODUCTION AND PROJECT TEAM

In June 2014 at Congressional request, the GAO published a study to evaluate the possible effects of the NFIP, including its building requirements, on farmers in riverine high-risk flood zones. Specifically,

GAO was asked to evaluate the possible effects of NFIP, including its building requirements, on farmers in riverine areas that have a high risk of flooding. This report examines, among other things, the effects of building requirements on farmers in high-risk areas and options that could help address any challenges farmers face. To do this work, GAO analyzed laws, regulations, and FEMA policy and claims data; interviewed 12 state and local floodplain managers, 24 farmers, and six lenders in eight selected communities in California, Louisiana, North Carolina, and North Dakota (selection based on geographic diversity, presence of high-risk flood areas, and type of farming that required on-site structures); and interviewed flood management and planning experts and FEMA officials. (GAO, June, 2014)

The GAO report tasked FEMA with updating existing guidance on mitigating the risk of flood damage to agricultural structures to include additional information that reflects recent farming developments and structural needs in vast and deep floodplains. FEMA responded to the GAO report's recommendations by initiating a white paper that serves as a roadmap to a larger, more comprehensive study. The white paper identifies areas where additional exploration and guidance are needed. A technical approach to carrying out the study is also outlined in this white paper, which includes suggestions for study geographies, a matrix of key stakeholders to engage, and methods for data collection and analysis.

This white paper discusses the extent of damages sustained by agricultural structures during floods. It highlights the NFIP minimum requirements for minimizing flood damages to new, substantially improved, or substantially damaged agricultural structures in high risk flood zones. Lastly, this white paper identifies how flood insurance is currently structured and the lending requirements for small and large-scale farms.

Some of the topics this white paper recommends for further exploration in the larger study include: better defining the universe of agricultural structures requiring flood insurance; identifying strategies to more easily bring agricultural structures in compliance with NFIP building regulations; and outlining comprehensive mitigation options to reduce flood risk to buildings and contents, potentially reducing the cost of flood insurance. Of particular interest to FEMA is understanding the extent of flood damages experienced by agricultural structures in wide, deep floodplains. Farmers in these types of floodplains have concerns with the feasibility of elevating, dry floodproofing, and wet floodproofing structures to protect these structures to the base flood elevation. These wide, deep floodplain geographies will require further exploration in the larger study to fully understand the current methods employed to mitigate and insure agricultural structures in order to ultimately present guidance and solutions.

The members of the project team for this white paper are engineers, planners, insurance specialists, and researchers with specialized experience in building science, insurance, agriculture, and floodplain management, and include staff from Dewberry Consultants LLC (Dewberry), Bender Consulting Services, Inc. (Bender Consulting), Crawford & Company, and FEMA.

Table 1. Agricultural White Paper Project Team Members.

PROJECT TEAM MEMBER	ORGANIZATION	ROLE(S)
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3.0 BACKGROUND

3.1. Historic Floods and Impacts on Agricultural Operations

Agricultural operations in the United States located in close vicinity to riverine and coastal water bodies have historically experienced costly flood damage to crops, livestock, infrastructure, and buildings. Depending on the geography of the landscape, a flood can manifest as:

- Wide, expansive, deep flooding in riverine areas without levees
- Wide, expansive, deep flooding when levees are breached or no longer meet the requirements of 44 CFR 65.10.
- High velocity flows in narrow, deep floodplains
- Vast, shallow flooding

For example, on the landward side of levees in the wide, deep floodplain, flood depths can reach 17 to 22 feet in Missouri and Illinois, and can reach 30 feet or more at the confluence of the Ohio and Mississippi Rivers (personal communication with Paul Osman, May 23, 2016). The Great Flood of 1993 was one of the most significant flood events to impact the United States, causing unprecedented destruction to agricultural areas in the Mississippi, Missouri, Illinois, and Iowa River watersheds. Hundreds of levees failed along these rivers and inundated at least 15 million acres of farmland, as shown in Figure 1 (Larson, 1996). Damages from this flood, which lasted from May through September, 1993, were widespread and totaled nearly \$15 billion. Additional information about the 1993 flood and its implications for floodplain management practices is available in *Sharing the Challenge: Floodplain Management Into the 21st Century* (Galloway, 1994; <http://fas.org/irp/agency/dhs/fema/sharing.pdf>).



Figure 1. The Great Flood of 1993 devastated more than 15 million acres of farmland [Source: NOAA, <http://www.floodsafety.noaa.gov/states/mo-flood.shtml>]

California's Central Valley experienced its most devastating flood event in January, 1997, when major storms caused significant rainfall, followed by melting snowpack in the Sierra Nevada mountain range. The Sacramento and San Joaquin rivers were overwhelmed, and levees ruptured in more than 30 locations, damaging urban and agricultural land (Figure 2); \$524 million was needed to fund actions to replace, restore, and rehabilitate the land (United States Army Corps of Engineers).



Figure 2. Floods in California's Central Valley in 1997 damaged many agricultural operations such as this dairy farm [Source: California Department of Water Resources. <http://www.water.ca.gov/floodsafe/ca-flood-preparedness/fpw-day3.cfm>]

Flooding in eastern Iowa during the summer of 2008 resulted in \$10 billion in damages and the flooding of 2.5 to 3 million acres of corn and soybeans (Buchmiller & Eash, 2010). More recently, during 2015, two major floods occurred in Illinois and South Carolina. The Illinois flooding followed after a wetter-than-average winter and then prolonged June rain, which resulted in a record breaking statewide average rainfall of 9.37 inches. South Carolina's historic rainfall event occurred during October, 2015, when a storm complex stalled over the region, bringing nearly 16 inches of rain to some areas. The state's agricultural industry suffered more than \$500 million in losses, primarily due to flooded, unharvested soybean, cotton, and peanut crops. In the spring of 2016, approximately 35 trillion gallons of rain fell across southeastern Texas, which is the amount it would take to cover the entire state with eight inches of water (CNBC, May 29, 2016). This significant amount of rainfall over a relatively short period of time has adversely impacted farming and ranching operations, as shown in Figure 3. The extent of the damages are yet unknown;

however, spring crops have been deteriorating in the field, while summer crops have not yet been planted and it may be too late to plant those crops.



Figure 3. Flooding in Texas in Spring 2016 is adversely impacting farming and ranching operations, forcing some cattle producers to move their herds elsewhere. [Source: Agweb, <http://www.agweb.com/article/texas-sized-flooding-and-cattle-round-up-naa-wyatt-bechtel/>]

Historic floods across the United States have caused wide-spread damage not only to crops in the field, but also to farm structures. In the research done for this white paper, it was found that these structures serve a variety of purposes for example, livestock housing, storing and processing of harvested goods, and holding expensive, specialized equipment that is needed for farming operations. A brief discussion of the types of damages to buildings, contents, and land caused by these floods is included in the following sections.

3.1.1. Agricultural Building Damage

There are many different types of buildings found on a farm; the size, type, and use will depend on the types of commodities produced and size and level of production on the farm. Examples of some common farm buildings include: pole-frame buildings, grain bins, sheds, food storage facilities, dairy facilities, barns, greenhouses, hoop structures, and animal confinement facilities (Figure 4). Additional information about agricultural building types is included in Appendix A. The value of these structures can range from a few thousand dollars to hundreds of thousands of dollars, depending on the size and type of construction. The structures most at-risk to flood damage are

those within or immediately proximate to the floodplain or coast and buildings not designed to withstand flood forces. There are some structures in which the contents are stored on a temporary basis, such as storing certain commodities (for example, corn, soybeans, rice and other commodities). These types of agricultural buildings are used only during parts of the year and stand empty during other times when commodities are sent to market.



Figure 4. Grain bins are one common type of agricultural structure and are often used to store small grains, barley, wheat, oats, and corn. [USDA, <http://www.ars.usda.gov/News/docs.htm?docid=4355&page=6>]

Flood damage to agricultural structures occurs in similar ways as other structures. The effects are summarized below, and more detailed information can be found in FEMA P-936, *Floodproofing Non-Residential Buildings*, and other publications. Different types of construction can help mitigate risk of some types of flooding to the structure and its contents, as shown in Figure 5.

- Inundation – Building materials that become saturated can become weakened. The buildings and their contents can expand as they absorb water, straining fasteners until they eventually break. Inundated building utilities can result in critical systems and equipment within the building ceasing to operate or become totally damaged.
- Hydrostatic forces – Hydrostatic forces can act laterally on a building, pushing against it or upward against the building (i.e., buoyancy), which could result in lifting a building off its foundations.
- Hydrodynamic forces – Floodwaters that flow around a building can have significant velocity. The force these flows can exert on a building can result in frontal impact on the upstream face, drag along the sides, and suction on the downstream side significantly damaging or destroying the building.
- Erosion/undermining – Erosion occurs when floodwaters wash away soil. Loss of soil supporting a building can cause instability and lead to building systems failure, particularly foundations.

- High velocity flows – In addition to the effects of hydrodynamic forces, high velocity flows can result in erosion and scour around structures and/or dislocation of structures. High velocity flows can also result in unequal hydrostatic pressures on a building.
- Impact forces – Moving floodwaters often carry debris. This debris can impact a structure, causing damage.
- Wave forces (coastal areas) – Wave runup occurs as waves break and run up beaches, slopes, and vertical surfaces. A breaking wave can exert forces at least 10 times the forces exerted by wind during a storm event. Wave uplift forces can lift both slabs-on-grade and the lowest floors of elevated structures if they are insufficiently elevated. There may be wave forces that may occur in riverine situations under certain conditions.
- Storm surge (coastal areas) – Storm surge occurs when water along the coast rises above the normal (astronomical) tidal level as a result of a storm.



Figure 5. Bolted silos like the one on the right were prone to seepage during the 2008 Midwest floods and consequently contents were lost. Welded silos like the one on the left did not experience seepage. [Source: FEMA P-765, Midwest Floods of Iowa and Wisconsin. http://www.fema.gov/media-library-data/20130726-1722-25045-0903/fema_p_765.pdf]

3.1.2. Building Content Damages

The contents stored inside agricultural structures are typically the most valuable assets on a farm and, depending on the building location, can be at great risk to damage or destruction during a flood. Vulnerable contents include agricultural equipment (e.g., tractor, seeder, tiller, combine), building mechanical systems (e.g., ventilation, electrical, automated feeding and watering systems), harvested crops (e.g., grains, fruits, vegetables), livestock, feed and silage, agrochemicals and

supplies and tools. Significant losses can occur when buildings used to store harvested crops are inundated by flood water, as shown in Figure 6. Flooding can also expose stored crops to contaminants, which often renders them unsuitable for sale. Farm offices can contain valuable office equipment and records that require protection during a flooding event.

Other “structures” such as aquaculture ponds and tanks, as well as rice and cranberry paddies, and the structures containing these products once they are harvested are also extremely vulnerable to damage if located in the floodplain. For example, during growing season cranberry beds are not flooded but are irrigated to maintain desirable soil moisture content. While the beds may be flooded to facilitate harvesting, flooding during the growing season can be detrimental to production. After they have been picked, cranberries are sensitive to moisture and temperature; most are either taken immediately to market or frozen for use as juice and sauce. Cranberries that are stored are placed in slatted crates in barns that have humidity and temperature controls.



Figure 6. When hay inside this flooded silo became wet and hot, it spontaneously combusted. [FEMA, <http://www.fema.gov/media-library/assets/images/62255>]

3.1.3. Agricultural Land Damages

In addition to damage sustained by buildings, their contents, and supporting infrastructure, farmers can experience other losses in the field due to a flood event. Some of the most costly losses occur when a field of crops is flooded before harvest, resulting in rotting crops and plants. Similar vulnerability exists for fruit and nut orchards, nursery stock and other perennial shrubs, plants and trees which bear annual agricultural crops. One of the most environmentally devastating damages due to flooding occurs when on-site improvements such as animal waste lagoons breach and the toxic waste water seeps into nearby fields, streams, and wells, creating a public health and environmental emergency for nearby residents. The study of crop losses in the field and impacts of flooded holding facilities from confinement operations such as lagoons should be addressed. It is important to mention them in the context of the variety of concerns farmers and others have with respect to the effects of flooding on agricultural property and production, riverine systems, wells, and other structures.

3.2. Flood Hazard Mapping

FEMA considers agriculture, along with other open land uses, to be a good use of floodplain. These areas provide fertile soils for agricultural production while allowing flood waters to spread over a large area of open flat land. Agricultural floodplains also act as a recharge area for groundwater, and the vegetation in this area can act as a filter for runoff and overbank flows. Through FEMA’s flood hazard mapping program, Risk Mapping, Assessment and Planning (Risk MAP), FEMA identifies these flood hazards, assesses flood risks and partners with states and communities to

provide accurate flood hazard and risk data to guide them on mitigation actions.

Communities that participate in the NFIP must officially adopt the effective maps from the date of their release and reference them as part of their floodplain management ordinance. Flood hazards are presented in the Flood Insurance Study (FIS) and on Flood Insurance Rate Maps (FIRMs), which are an important part of the NFIP as they set the basis for NFIP regulations and flood insurance requirements. The FIS is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. When a flood study is completed for the NFIP, the information and maps are assembled into an FIS. The FIS report also contains detailed flood elevation data in flood profiles and tables. The FIRMs are the official map

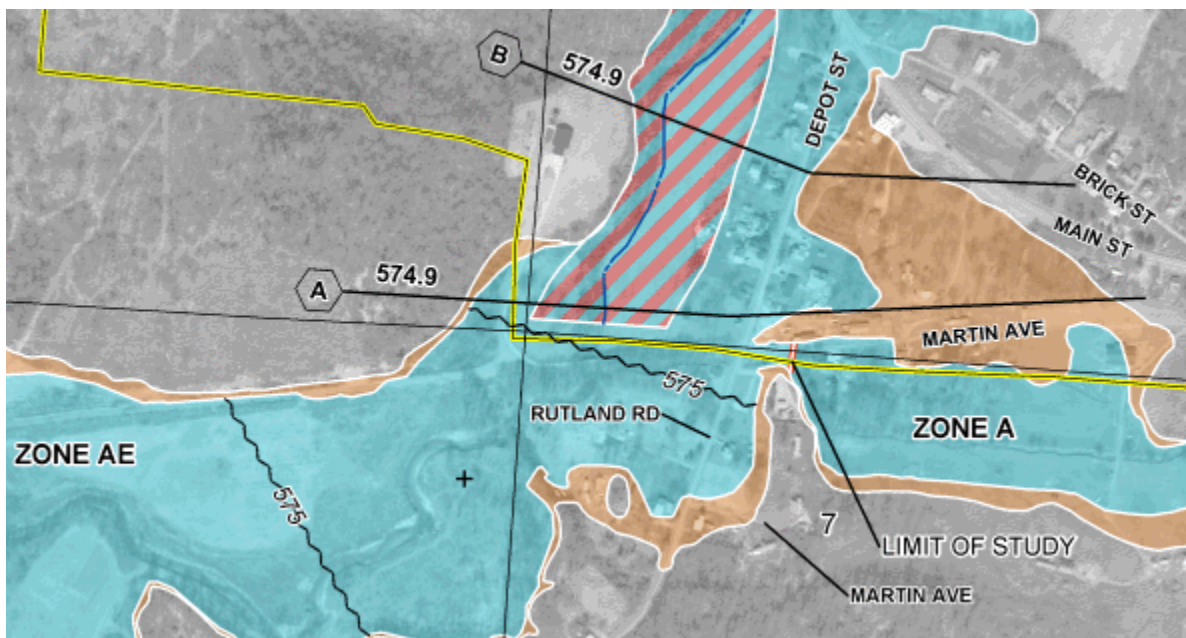


Figure 7. FEMA FIRMs display different levels of flood risk and denote BFEs [FEMA, <https://msc.fema.gov/portal/resources/faq>]. On this map, the floodway is in the red and blue hatched area, Zone AE is blue, and Zone X is orange.

of a community on which FEMA has delineated both the special flood hazard areas and the risk premium zones. FIRMs include statistical information such as data on river flow, storm tides, hydrologic/hydraulic analyses and rainfall and topographic surveys. FEMA uses the best available data to create these flood hazard maps in order to display a community's flood risk. There are different levels of risk displayed on a FIRM, as shown in Figure 7. The highest risk flood Zones are labeled A, AE, V, and VE. These zones are Special Flood Hazard Areas (SFHAs) where the 1-percent annual chance flood can occur, also known as the 100-year flood zone. The expected water surface level of this 1-percent annual chance flood is the Base Flood Elevation (BFE) and is labeled on FIRMs and shown in the FIS on the flood profiles. The BFE varies based on the geography and hydrology of an area. Low to moderate risk flood zones are labeled as Zones B, C, X-shaded, and X-unshaded.

Table 2 summarizes the different FEMA flood map zone designations based on the apparent risk level.

Table 2. FIRM Zone Risk Designations

ZONE	RISK LEVEL
B, C, X (unshaded X and shaded X)	Low to moderate risk
A (without BFE's or floodways determined) and AE, A1-A30, AH, AO, A-99, AR)	High risk
V and VE (Includes V1-V30)	High coastal risk
D	Undetermined

3.3. NFIP Floodplain Management Requirements

The NFIP makes flood insurance available to homeowners, renters, and business owners if their community participates in the NFIP. If a community chooses to participate in the NFIP, they must agree to adopt and enforce floodplain management ordinances, building codes, zoning ordinances, subdivision ordinances, and other regulations that contain the NFIP floodplain management requirements that meet or exceed the minimum NFIP requirements to reduce the risk of flooding. FIRMs and FISs are used to display the community's risk of flooding used to enforce building requirements and set rates for flood insurance.

Communities must enforce minimum building requirements for new construction and substantial improvement and substantial damage of residential and non-residential structures in Zone A in their community, as set forth in 44 CFR 60.3. The lowest floor, including basements, of both residential and non-residential structures must be elevated to or above the BFE. Communities can be granted an exception by the Federal Insurance Administrator to allow basements in residential structures under 44 CFR 60.6. In addition, non-residential structures can be floodproofed whereby together with attendant utility and sanitary facilities, must be designed so the part of the structure below the BFE is water-tight. Walls must be substantially impermeable to the passage of water, with structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy.

Furthermore, 44 CFR 60.3(a)(3) states all new construction and substantial improvements located in floodprone areas:

- Must be designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
- Be constructed with materials resistant to flood damage;
- Be constructed by methods and practices that minimize flood damages; and
- Be constructed with electrical, heating, ventilation, plumbing, and air conditioning

equipment and other service facilities designed and/or located to prevent water from entering or accumulating within the components during flooding conditions.

***New construction** includes structures for which the start of construction commenced on or after the effective date of a floodplain management regulation adopted by a community and includes any subsequent improvements to such structures.*

***Substantial improvement** includes any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before “start of construction” of the improvement.¹*

*A related term, **substantial damage**, refers to damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.*

Requirements similar to 44 CFR 60.3 are included in Section G1001 of the International Building Code (IBC). The IBC classifies agricultural buildings under Group U, which includes buildings that are accessory in character and miscellaneous structures not classified in any specific occupancy of the IBC. Group U buildings include but are not limited to: agricultural buildings, aircraft hangars, barns, carports, fences more than six feet high, grain silos, greenhouses, livestock shelters, private garages, retaining walls, sheds, stables, and towers.

Newly constructed, substantially improved, and substantially damaged buildings are also required to comply with floodway development requirements. A floodway is the channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. Section 60.3(d)(3) of 44 CFR limits development within the floodway by prohibiting “encroachments including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge.”

Community participation in the NFIP is voluntary and requires a community to adopt and enforce minimum floodplain management regulations aimed at reducing flood losses, though higher standards are encouraged. Communities can be placed on probation, which results in a \$50.00 surcharge to the premium for all existing and new flood insurance policies. Communities can also be suspended from the NFIP if they fail to enforce the regulations and as a result, property owners are unable to purchase or renew flood insurance policies and may be subject to limitations for other

¹ Substantial improvement does not include work to correct existing violations of local or state health, safety, or sanitary codes or alterations to an historic structure as long as the alterations do not preclude the structure’s continued designation as historic.

federal assistance (such as federal grants or loans, federal mortgage insurance, and federal disaster relief). Presently, there are more than 22,100 participating communities where the NFIP's flood insurance is available to residents and business owners.

The NFIP has established the following requirements for complying with floodplain management requirements for newly constructed, substantially improved, and substantially damaged buildings in a SFHA:

- Elevation – Elevation involves raising a structure's lowest floor (including basement) to or above the BFE.
- Dry floodproofing – Dry floodproofing may involve a combination of methods that, when applied, result in a structure and its utilities and equipment being watertight. All elements of the building are substantially impermeable to the entrance of floodwater, and structural components have the capacity to resist flood loads.
- Wet floodproofing – Wet floodproofing involves the use of flood damage-resistant materials and construction techniques to minimize flood damage to areas below the flood protection level of a structure, which is intentionally allowed to flood.

Farmers need to understand vulnerabilities associated with being located in a floodplain and take measures to protect themselves. Wet floodproofing could be one such measure. FEMA Technical Bulletin 7-93 (TB-7), *Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program*, allows wet floodproofing of four types of structures in A Zones following the issuance of a variance:

- Structures functionally dependent on close proximity to water
- Historic buildings
- Accessory structures used solely for parking or limited storage
- Certain agricultural structures, including farm storage structures used exclusively for storing farm machinery and equipment, grain bins, corn cribs, and general purpose barns used for temporarily feeding livestock if they remain open on one side (as shown in Figure 8).

While elevation or dry floodproofing is required by the NFIP for substantially improved and new

non-residential structures in Zone A, dry floodproofing is not allowed in V Zones under the NFIP and ASCE 24 *Flood Resistant Design and Construction*, or in Coastal A Zones under ASCE 24. In addition, dry floodproofing is not recommended for wood-frame structures or for areas where flood levels are expected to be greater than three feet. Additional information about mitigating substantially improved, substantially damaged, and new agricultural structures in the floodplain is discussed in Section 6.5.3 of FEMA P-758, *Substantial Improvement/Substantial Damage Desk Reference*.



Figure 8. TB-7 allows general purpose barns to be wet floodproofed. [Photo by Fred Gasper/NRCS
<https://photogallery.sc.egov.usda.gov/netpub/server.np?find&catalog=catalog&template=detail.np&field=itemid&op=matches&value=4713&site=PhotoGallery>]

Newly constructed and substantially improved agricultural structures designed and constructed in accordance with floodplain management requirements as described above are eligible to be insured through the NFIP. Structures that are dry floodproofed must be floodproofed to the BFE plus one foot to be eligible for a premium reduction under the NFIP.

3.4. Insurance

3.4.1. NFIP Coverage

The NFIP provides property owners in participating communities the ability to purchase flood insurance. Flood insurance can only be purchased through a licensed property and casualty insurance agent who writes coverage through one or more of about 75 companies that write FEMA's insurance program on their paper (a Write Your Own company, or WYO) or through the NFIP's Direct Servicing Agent (NFIP-Direct).

Coverage

Coverage is provided through three different policy forms: Dwelling, General Property, and Residential Condominium Building Association Policy (RCBAP); this white paper will not include discussions related to condominiums. The Dwelling form is used to insure one-to-four family residential buildings (e.g., farmer's residence), and the General Property form is used to insure five-or-more-family residential buildings, non-residential businesses, and other non-residential buildings. These include agricultural processing facilities, grain bins, silos, sheds, and other farm buildings not used as a residence. Limits of coverage are provided in Table 3.

To be an insurable building, a structure must have two or more outside rigid walls with a fully secured roof and be affixed to a permanent site (permanently affixed mobile homes and travel trailers without wheels can also be insured). Included as part of the building coverage are fixtures, machinery and equipment such as awnings and canopies, elevator equipment, fire extinguishing apparatus, pumps and machinery to operate the pumps, and ventilating equipment. Examples of ineligible risks include greenhouses, pole barns, and pumping stations (unless they have at least two rigid walls and a roof).

Table 3. Limits of Coverage Under the NFIP

OCCUPANCY/PROPERTY COVERED	LIMITS
Residential (1-4 Family)	
Building	\$250,000
Contents	\$100,000
Other Residential	
Building	\$500,000
Contents	\$100,000
Non-Residential/Other Residential	
Building	\$500,000
Contents	\$500,000

Contents coverage can be purchased, covering items like furniture and fixtures, machinery and equipment, and stock. Contents located in silos, grain storage buildings, and cisterns are insurable as are equipment like tractors if they service the farm and are stored in an insurable building. There is limited building and contents coverage for property in basements located in any flood zone and in building enclosures below the lowest elevated floor of an elevated post-FIRM² building in most SFHAs.

Except for principal residences insured for at least 80 percent of their replacement cost, all building and contents claims will be adjusted at the time of loss based on their Actual Cash Value (ACV), or depreciated cost, versus Replacement Cost. A common complaint is: the cost of flood insurance becomes much greater than the ACV of some buildings, so it is not worth buying flood insurance for them.

Rating

While there are many factors that go into calculating the premium to be paid to insure a building or its contents, three major ones are:

- **Flood Risk (as identified by flood map)** – As shown in Table 2 high-risk zones are labeled with letters beginning with “A” or “V” and moderate- or low-risk areas identified with the letters B, C, or X. Areas of possible but undetermined hazards are shown as Zone D. Generally, higher risk areas have higher rates. Many rural areas still have not received updated FIRMs for more than 25 years, so the existing map’s detail makes it challenging to identify the exact location of each farm building, which can be problematic if the BFE or flood zone is changing on the property in the buildings’ vicinity.
- **Building Characteristics** – Some of the building characteristics considered include elevation, foundation type, occupancy, and use. In high-risk areas, the higher the lowest

² A post-FIRM structure is one that is constructed in a community after its first Flood Insurance Rate Map became effective.

floor (Lowest Floor Elevation or LFE) is above the BFE³, the lower the risk and hence the lower the premium (up to a 4-5 foot difference), as shown in Table 4.

- **Pre- or Post-FIRM** – Buildings in a community constructed before its first Flood Insurance Rate Map became effective are known as pre-FIRM buildings. Because they were built before NFIP regulations were in place to help guide construction, their flood insurance premiums in SFHAs have been based on lower or “subsidized” rates that do not reflect their true risk. Rates for post-FIRM buildings in SFHAs represent the full risk and typically require an Elevation Certificate to help determine the rate to use. Pre-FIRM buildings in SFHAs may be rated using post-FIRM rates if the resulting premium is less; however, an Elevation Certificate is typically needed to use these rates.

Table 4. Effects of Elevation on NFIP Premiums

EFFECTS OF ELEVATION ON PREMIUM	
Difference Between Lowest Floor & BFEs	Premium
+4	\$570
+3	\$591
+2	\$710
+1	\$1,073
At BFE	\$2,136
-1	\$4,786
Residence on slab; \$200,000 Building/\$80,000 limits; Zone AE; April 2016 rates; no HFIAA surcharge	

Except for the following scenario, rating agricultural buildings is performed the same as any other non-residential building, whether it is classified as non-residential business or as other non-residential (e.g., a private barn that is not on a commercial farm). The exception is that ***the NFIP does provide a lower non-residential business and other non-residential rate for agricultural buildings*** in Zone A1-A30 or Zone AE where the lowest floor elevation difference is between two and 10 feet below the BFE. Rate differences can be up to 35-percent lower and are specific for all non-elevated agricultural buildings that do not have a basement and for elevated pre-FIRM buildings with an enclosure other than a crawlspace. Agricultural contents, though, are rated the same as other non-residential contents.

3.4.2. Impacts of Recent Legislation on NFIP Coverage

In 2012, Congress passed BW-12 to reauthorize the NFIP for another five years and help make the NFIP more financially stable. Changes were made to all major parts of the program, including ensuring insurance rates reflected actual flood hazard risk. That meant subsidized pre-FIRM rates would be phased out and a cost-saving rating option related to map changes known as grandfathering would be significantly impacted.

In 2014, Congress repealed and modified certain provisions of BW-12, while making additional changes by passing the Homeowner Flood Insurance Affordability Act (HFIAA). Changes included lowering certain rate increase caps, restoring grandfathering, and essentially creating a new rating option for properties newly mapped into an SFHA. HFIAA created a new surcharge (\$25 for

³ The elevation of surface water resulting from a flood that has a 1-percent chance of equaling or exceeding that level in any given year.

primary residence policies and \$250 for all other policies) and a new lapse rule for newly mapped properties and subsidize-rated policies. Except for certain pre-FIRM buildings, annual rate increases for other buildings are capped at 15-percent for a class (i.e., rate table) and 18-percent for a specific property (i.e., rate).

As a net result of these changes, certain pre-FIRM subsidize-rated buildings experience rate increases of 25-percent a year until they reach their full-risk rate. These include non-primary residences and businesses, which does include buildings used on commercial farms (e.g., silos, barns, sheds). Other non-residential buildings (e.g., private barns, sheds) will see increases of the 15- to 18-percent described above. Added to these costs is the previously-mentioned additional \$250 annual HFIAA surcharge.

3.4.3. Impacts of Map Changes on Risk Reduction Through Flood Insurance and the Insurance Policy Rating

When FEMA and participating communities issue a new FIRM, some property owners will find the identified flood risk for their property has changed – it may have increased (e.g., areas of the farm were newly mapped into Zone AE, or the BFE increased) or it decreased (e.g., some or all of the farm or its buildings or infrastructure are no longer in the floodplain but in Zone X).

If the risk has increased, the NFIP provides rating options to help reduce the financial impact. As explained previously, the NFIP provides the Newly Mapped Procedure to help reduce the financial impact as a result of properties being mapped from Zone B, C, D or X to Zone As (or Vs). This rating option allows property owners to purchase coverage at the lower-cost Preferred Risk Policy⁴ (PRP) rate for the first 12 months after new maps go into effect. After the first year, the rate begins to transition with annual rate increases of no more than 18-percent each year until it reaches a Standard Zone X rate or full-risk rate based on the current FIRM, whichever is less.

If the Base Flood Elevation is increasing, the NFIP provides the grandfather rating option to lock in the current BFE for future rating - again, helping reduce the financial impact a map change can create. Note for pre-FIRM properties, a policy must be purchased before the maps change to lock in any zone or BFE for future rating. If this does not occur, rating will be based on the new FIRMs. Post-FIRM properties can still be grandfather-rated based on built-in compliance grandfathering.

As mentioned in the previous section, if a subsidize-rated pre-FIRM building's policy lapses and is under the mandatory purchase requirement when it lapses or is cancelled, it will have to be rated using full-risk rates and the current FIRM. The NFIP does allow for a policy to transfer to a new owner at the time of a building's sale to help ensure continuous coverage.

3.4.4. Crop Insurance Coverage

Crop insurance (Crop/hail) is an important tool when assessing risk management for the farmer or

⁴ There is an eligibility requirement based on filed claims. If they do not qualify for a PRP rate, then they can still be grandfather-rated; however, pre-FIRM properties must have a policy in place before the new map becomes effective or they will lose their grandfathering opportunity. Post-FIRM properties can still be grandfather-rated.

rancher throughout the United States. Generally, Crop/hail protects crops from weather related events, including flood and hail and is designed to protect crop yield and/or revenue losses, such as those shown in Figure 9. “Yield” based policies provide protection against a loss in yield due to an unavoidable event. These events include: adverse weather (e.g., excessive moisture, floods, drought, hail, wind, frost/freeze, tornado, lightning, excessive temperature during pollination), insects, plant disease, wildlife and earthquake (Iowa State University Extension and Outreach, February, 2011).

Crop/hail coverage is sold by private insurance companies, regulated by state insurance departments, and can be purchased at any time during the growing season. A Crop/hail policy provides a “designated level of coverage” for approximately 130 separate crops that includes: corn, soybeans, wheat, rice, peas, pumpkins, fruits and peanuts. Crop/hail is not limited to crops; new and pilot programs protect livestock and dairy producers and ranchers can purchase coverage for hay and forage losses. Many lenders now require crop insurance coverage to make operating loans to crop and livestock producers, and many producers use crop insurance as collateral for the loans (Corp Insurance America, July 2011).



Figure 9. Farmers can obtain crop insurance policies to cover flood damages such as this corn field in the southern Illinois floodplain [Photo by Robert Kaufmann/FEMA; <https://www.fema.gov/media-library/assets/images/53019>]

4.0 RECOMMENDED STUDY TOPICS

4.1. Agricultural Buildings

➤ In this section, recommendations for further study are denoted by arrow bullets.

Flood forces impact agricultural structures similarly to any other non-residential structure; new and substantially improved agricultural structures in the SFHA must comply with NFIP requirements. TB-7 allows wet flooding of certain agricultural buildings. In wide, expansive floodplains, there will be various depths of flooding that could impact agricultural structures.

- Identify flood-related legislative, regulatory, and program changes affecting agricultural structures.
- For post-FIRM structures, analyze agricultural building types, functions, and contents by commodity and the type of floodplain/floodway in which they are located for feasibility of elevating, dry floodproofing, and/or wet floodproofing.
- Provide recommendations for minimizing damages to pre-FIRM agricultural structures.
- Consider aggregating the value of agricultural buildings under one assessment rather than assessing each building individually. The buildings are often attached and function together to support the operation.

Because many agricultural structures house commodities for human consumption as well as expensive, specialized equipment, they are subject to meeting requirements of other federal agencies, such as FDA and USDA. In May 2016, the FDA issued new guidance on equipment, tools, buildings, and sanitation for agricultural facilities as part of the Food Safety Modernization Act.

- Identify requirements for commodity handling and storage such as FDA, USDA, distributor, and other requirements.

Changes to farming industry practices are resulting in different building construction practices and specifications. Some areas of the country are seeing independent owner-operator farms converted to corporate ownership due to economic conditions or retirement of the independent farm family. The 2012 USDA Census of Agriculture indicates that 40-percent of U.S. farmland is rented or leased, and land owners indicated they intend to transfer ownership of 91.5 million acres in the next five years. This change in ownership may or may not create a change in the commodity produced or result in investment in new or upgraded farm buildings or infrastructure. In other parts of the country, the farm-to-table movement during the past decade has fueled a resurgence of small

vegetable, egg, dairy, livestock, orchard and nursery operations, many of which are organic. These smaller, organic farms typically have a larger variety of crops and animals, and therefore require a larger variety of structures on the farm to accommodate the different operational needs. These structures are likely smaller and less expensive than those found on large, corporate farms, but could cost farmers more in fixed fees and surcharges due to the number of flood insurance policies required.

- Understand what changes have occurred in the agricultural industry over the last 25 years with respect to ownership and operations.
- Identify the predominant agricultural structures used and constructed for different commodities to establish a clear understanding of the types of structures at risk of flooding within the floodplain.

4.2. Insurance

Agricultural producers have made suggestions about FEMA creating lower rates, more limited coverages, and even creating an agricultural flood zone designation⁵ (e.g., Zone AG, or use Zone D). Before FEMA looks at creating a new class of coverage, a different rating structure or new flood zone for agricultural buildings, information needs to be provided on what the implications are for these types of approaches. In the past, FEMA has not separated out agricultural buildings from other non-residential. Of the existing 1.1-percent of the NFIP policies that are non-residential business located in an SFHA⁶, FEMA does not know how many are agricultural buildings. Starting November 2015, FEMA began collecting an identifier on new and renewed flood insurance applications to indicate whether or not a building is an agricultural building; however, FEMA still does not capture the type of agricultural structure.

- Determine the number and types of agricultural structures currently insured under the NFIP. Understand contents contained in these structures and how they are insured.

Some insurers have indicated that large agribusinesses seek to minimize their risk and therefore might insure differently than smaller family farms. For example, some large commercial farms might use risk managers to determine coverages needed and use insurance companies that can give better rates and coverages on their commercial or farm policy⁷, and some commercial policy packages include flood insurance. For commercial insurance packages that include flood insurance, it will be important to understand if the policy has a \$500,000 deductible to match the NFIP

⁵ As suggested in California's Central Valley Flood Protection Plan (CVFPP) and supported by California Department of Water Resources

⁶ NFIP BureauNet, March 31, 2016

⁷ With the increase in companies writing private flood insurance, these companies and the policies they write should be included in the research.

maximum limit, or if it starts at a lower amount and if it is per building or for the farm's total flood exposure (the NFIP's policies cannot schedule buildings but rather issue a separate policy for each building, even a shed).

- Determine if corporate and individual owners insure their property differently for flood and if so, how the coverage differs.

A possible way to make the value of flood insurance more appealing to farmers is through the application of premium discounts. Other than listed previously, the NFIP does not provide premium discounts for other mitigation activities such as wet floodproofing, dry floodproofing machinery and equipment, and floodwalls around multiple farm buildings. TB-7 provides wet floodproofing activities that a community will allow for an agricultural building in the floodplain, but there is no discount applied to the insurance premium. In certain cases (in both V and A zones), elevating machinery and equipment can reduce premiums.

- Identify other options for farmers to mitigate and insure their agricultural structures. Consider potential impacts on insurance rates and the way flood insurance policies are structured. Explore how special rating guidelines are applied to agricultural structures and types of mitigation techniques that would result in reduced risk. (See the Specific Rating Guidelines related to agricultural structures - <http://www.nfipiservice.com/Stakeholder/pdf/bulletin/w-15064.pdf>).
- Identify what Crop/hail insurance covers, including contents inside of structures. Identify new programs to protect livestock, dairy operations, hay, and forage.

Some grassroots groups have expressed interest in FEMA creating a new zone designation for agricultural areas in a floodplain (e.g., AG); this will require an act of Congress. Others have suggested using a Zone D designation; while this approach removes any building or lender requirement for the farmer, it does not reflect the true risk. Furthermore, if that land stops being used as a farm and becomes residential, having a Zone D designation for what really may be a SFHA could result in a large exposure for the residents, community, and lenders.

When agriculture buildings in the SFHA are included as collateral for a farm loan, the cost of insurance can be quite high, especially for smaller agribusinesses with older pre-FIRM buildings. For those buildings, rate increases of 25-percent per year mean premiums are more than doubling in four years, and at some point, the cost of insurance paid could become higher than the worth (ACV) of the building. Besides providing some rate relief for negatively-rated agriculture buildings, the NFIP currently has limited options to alleviate or reduce the rate:

- **Increase in CRS class** – If a community has not joined FEMA's Community Rating System (CRS), it could complete the paperwork to join and then work to get to at least the first level

(CRS Class 9), which will provide a 5-percent discount for these properties. If it is a CRS community, it could work to improve its rating, since discounts up to 45-percent can be earned by the community for its policyholders in high-risk areas.

- **Choose a higher deductible** – The NFIP offers a deductible as high as \$50,000 which can provide a substantial premium discount for a non-residential building (up to 56.5%). If the building is collateral for a loan, the lender may have maximum deductible requirements.
- **Elevate** –Elevating the lowest floor to or above the BFE for agricultural buildings can result in lower insurance premiums. Elevation in shallow flood areas may be possible but unlikely in deeper floodplains.
- **Add Flood Openings** – If an agricultural building is elevated on an enclosure, adding flood openings in accordance with 44 CFR 60.3(c)(5) could possibly result in lower premiums:

Require, for all new construction and substantial improvements, that fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exist of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect to meet or exceed the following minimum criteria: A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

- **Dry Floodproofing** –Credit is available for non-residential buildings (and limited residential buildings) that are dry floodproofed to the BFE plus one foot.

4.3. Lending Requirements

While the flood insurance program originated with the National Flood Insurance Act of 1968 as amended, the federal mandatory purchase requirement for flood insurance was introduced in the Disaster Protection Act of 1973. This was further strengthened by the National Reform Act of 1994, which provided penalties on lenders for non-compliance. Even stricter penalties and enforcement were introduced in the recent round of reform legislation (i.e., BW-12 and HFIAA) and included the requirement for all flood insurance premiums to be escrowed on new loans and the option to escrow for existing loans.

Requirements for agricultural loans for the farmer/rancher are very similar to the requirements as part of the commercial/industrial and homeowner market. Flood insurance is required through the

NFIP or a private carrier for the term of the loan when all three factors below are present:

1. The loan is secured by improved real estate or a mobile home that is affixed to a permanent foundation.
2. The property securing the loan is located or will be located in a SFHA as identified by FEMA.
3. The community in which the property is located participates in the NFIP.

In general, if a property owner is making, increasing, renewing, or extending a loan through a federally regulated (including farm credit banks and credit unions) or insured lender or with a Government-Sponsored Enterprise (GSE, like Fannie Mae) on a property in the SFHA, they will be required to carry flood insurance for the life of the loan.

- Understand mandatory purchase requirements and implications of BW12 and HFIAA on lender requirements for agricultural structures.

5.0 STUDY APPROACHES

5.1. Potential Stakeholders and Stakeholder Engagement

It will be important to include a variety of stakeholder groups in the study to ensure different views are represented. Due to the large number of potential stakeholders, the level of participation for various groups in the actual study will vary based on the input and informational needs of each part of the study. The responsibility assignment matrix shown in Table 9 in Appendix B identifies groups of stakeholders and their recommended level of involvement in each part of the study.

- Responsible (R) parties – These stakeholders will design and conduct the study and will be responsible for maintaining communication with the other stakeholders.
- Accountable (A) parties – These stakeholders will direct the Task Order Manager and the study’s progress and will review and approve the messaging content to other stakeholders.
- Consulted (C) parties – These stakeholders will provide expertise to ensure the study objectives are met.
- Informed (I) parties – These stakeholders have a vested interest in the progress and outcome of the study but will not have direct input into the process.

Stakeholders will be engaged during each study task in accordance with the level of accountability they are assigned in the matrix. Suggested methods and frequencies of stakeholder engagement are summarized in Table 10 in Appendix B.

The complexities surrounding flood insurance requirements for agricultural structures will require engaging subject matter experts with a variety of backgrounds at various points throughout the study. Including the expertise of these individuals is critical to the study’s success. Table 5 summarizes the type and number of subject matter experts who should be engaged in the study.

Recommendations for specific geographies and commodities follow in Section 5.2.

Table 5. Recommendations for Subject Matter Expert Inclusion in the Study

SUBJECT MATTER EXPERT PARTICIPATION		
Agricultural Industry Subject Matter Experts	Number	Information to be Provided
FEMA Actuary & Underwriter	2-3	Impacts of mitigation measures on insurance rates and coverages
Farm Community Lender & Regulator (e.g., FDIC, FSA, etc.)	4-6	Requirements to secure and maintain loans for agricultural facilities
Insurance Adjuster for NFIP and Property & Casualty (P&C)	2-4	Post-flood loss calculation methods
P&C Insurance Underwriter	3-4	Underwriting for independent and commercial farming operations
Farm Community Insurance Agent	4-5	Existing options and possible approaches for farmers to insure existing and new/substantially improved structures in the SFHA, both P&C and NFIP
Farm Structure / Infrastructure Engineer / Architect / Designer	2-4	Design considerations and mitigation retrofit options for structures/infrastructure in the SFHA
NFIP Floodplain Management and Building Science Specialists	2-4	Feasible building science and floodplain management approaches to comply with NFIP requirements
NFIP Insurance Specialist (Consultant WYO)	3-4	Identify underwriting requirements and differences in underwriting farm and non-farm buildings
Farmers	8-15	Insights on planning to minimize damages to contents and structures
FEMA Regional staff and State NFIP Coordinators	10	Insights into issues facing farmers in their state

5.2. Recommended Study Geographies

As previously stated, flooding can affect agricultural operations in different types of watersheds; farmers with land located in floodplains, but also land outside the floodplain, may have the ability to relocate out of the floodplain. Farmers with land in wide, deep floodplains and behind levees that no longer provide protection in riverine areas, however, may not have this option. In addition, some farms are located behind recently de-accredited levees and therefore have been mapped into mapped floodplains, some of which are 10 to 20 feet deep, as shown in Figure 10. These farms now need to comply with NFIP requirements for new, substantially improved, or substantially damaged non-residential structures. Therefore, it is necessary that the study evaluate the flood risk of farmland located behind levees in mapped SFHAs.

Some areas with wide, deep floodplains like those shown in Figure 11 should also be included in the study. The geographies recommended for inclusion in the study are summarized in Table 6. These areas represent a cross-section of the major types of agricultural commodities produced in the U.S., as well as the watershed types of particular concern.

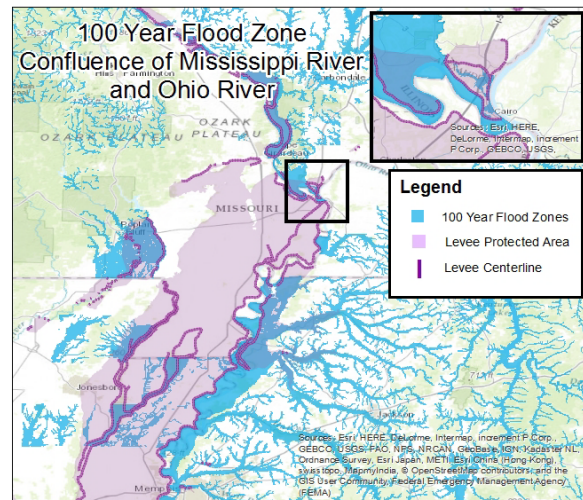


Figure 10. Wide, expansive floodplains in the Midwest frequently experience flooding that results in extensive damage to farms.

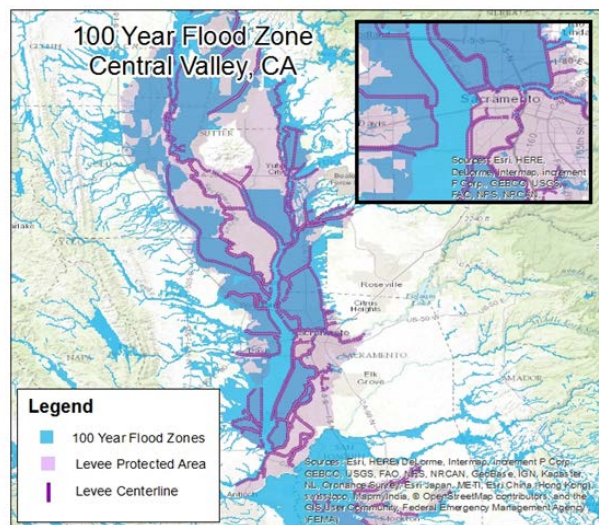


Figure 11. California's Central Valley has recently been mapped into a floodplain.

Table 6. Proposed Study Geographies

PROPOSED STUDY AREAS BY FEMA REGION	Floodplain Descriptor				Livestock					Grains			Fruits, Vegetables, Nuts					Other				
	Behind levees	Wide deep floodplains	Narrow deep valleys	Coastal floodplains	Poultry/eggs	Cattle & Calves	Swine	Sheep & Lambs	Horses	Grains/oil seeds/dry beans/dry peas	Cereal grains	Forage	Potatoes/onions/sugar beets	Vegetables	Fruit/tree nuts/berries	Cranberries	Peanuts	Cotton	Rice/sugar cane	Aquaculture	Greenhouse/floriculture/nursery	Honey
FEMA Region 3																						
PA - Chester, Lancaster, Berks, Lebanon Counties	X	X	X		X	X	X	X	X	X	X	X		X	X						X	X
FEMA Region 4																						
NC - Sampson, Duplin, and Wayne Counties		X	X		X	X	X		X	X	X				X	X	X		X			
FEMA Region 5																						
IL - confluence of Mississippi and Ohio Rivers	X	X				X	X	X		X	X	X										
WI - central part of the state		X	X			X	X	X	X	X	X	X	X	X	X	X						X
FEMA Region 6																						
LA - southwestern part of the state	X	X		X		X						X						X	X	X		X
TX - central and northeast parts of the state		X		X	X	X		X	X	X	X	X		X				X	X			X
FEMA Region 7																						
IA	X	X			X	X	X	X		X	X	X		X	X							
FEMA Region 8																						
SD	X	X			X	X	X	X		X	X	X	X								X	X
FEMA Region 9																						
CA - Central Valley	X		X			X		X		X				X	X			X	X	X	X	X

5.3. Recommendations for Approaches

Multiple study strategies should be used to ensure all relevant topics are covered and stakeholders are engaged when updating existing guidance. Additional desktop research should be conducted to gather more in-depth data regarding: agricultural operations in the floodplain; the regulations that govern compliance of structures within the floodplain; and the lending requirements that may drive farmers to purchase flood insurance policies. Desktop research will likely be conducted primarily using online resources and may be supplemented by reviewing government files and data. Some good sources of online data and information include the USDA website, particularly the Agricultural Census and Agricultural Statistics; the Agricultural Research Service, Grants and Loans, and Insurance Programs; the American Farm Bureau Federation; state agricultural cooperative extensions; FEMA floodplain management and building science documents; FEMA FIRMs and Flood Insurance Studies; the Farm Services Administration; the Small Business Administration; the Farm Credit Administration; the Association of State Floodplain Managers; and the National Association of Flood and Stormwater Management Agencies. Additional resources are included in Appendix C.

Desktop research should be supplemented by field research. Field research for the study will generally be qualitative rather than quantitative; i.e., will use observational methods rather than laboratory-type experiments. A preliminary strategy in conducting field research could be using a survey that is made available online to interested parties. This strategy for gathering data is low-cost and can reach a wide audience, yielding information on stakeholders' viewpoints while also providing an opportunity for them to raise concerns that may not yet be identified as significant. However, this method is subject to Office of Management and Budget (OMB) approval under the Paperwork Reduction Act (PRA), which could delay its implementation because the approval process can take six to nine months. PRA approval is not required for general invitation of public comments and suggestions where specific questions are not asked; creating a public input forum online is another approach that would foster public participation while allowing the study schedule to proceed more quickly. Other options may need to be explored.

Another field research strategy is the interview process, which allows the research team to gain a first-hand understanding of agricultural operations. Interviews can be conducted in-person or remotely (e.g., via conference call) with individuals or focus groups, and can be unstructured, semi-structured, or structured. Focus group interviews, if used, can be structured so the same open-ended questions are asked, allowing for comparison of answers between groups to identify commonalities and differences. Focus groups, if they involve 10 or more respondents, would also be subject to PRA approval; Federal Advisory Committee Act (FACA) requirements could also apply. Individual interviews could be structured or semi-structured, depending on the purpose of the interview and the experience of the interviewer; semi-structured interviews allow the interviewer to delve deeper into a topic that may be of particular interest to or area of expertise of the person being interviewed. Semi-structured interviews are unlikely to be subject to PRA requirements. Some

individuals/groups to be interviewed could include farmers, lenders, property and casualty insurers, write-your-own insurers, agricultural insurance agents, and floodplain managers.

Some interviews should be conducted concurrently with site visits to farms in the floodplain within the geographies recommended (or a subset thereof). Site visits will enable researchers to see first-hand and photograph the agricultural operations and structures vital to their continued success and understand the physical constraints farmers face with respect to NFIP compliance for agricultural structures in the regulated floodplain.

Public meetings could be held in the recommended study geographies to provide an opportunity for public education and comment, and to gather additional viewpoints from local stakeholders and residents. These meetings could be conducted in conjunction with an online comment forum to allow for public feedback.

After information is gathered using desktop and field research strategies, the data needs to be analyzed to identify common themes and trends. If a formal online survey is conducted, analyzing survey results is relatively easy, as many tools include some basic analytical results. Input into an online forum is more difficult to analyze as there is no consistent format, but key words could be searched to identify common themes. Feedback from interviews should be compiled and sorted. Structured interviews are generally easier to analyze than semi-structured interviews because the same questions are asked; responses from semi-structured interviews can be used to supplement the structured interview responses to provide more in-depth information regarding a topic or concern. Based on data gathered through the survey, interviews, and site visits, the research team can develop case studies to illustrate success stories for achieving compliance.

When the analysis is complete, final recommendations can be developed to address the concerns expressed by study participants and researchers' findings. The research strategies, findings, and recommendations should be summarized in a report. Table 7 summarizes the recommended study strategies, but the study approach is not limited to these strategies.

Table 7. Recommended Strategy for Conducting the Study

STUDY STEP	ACTION AND DELIVERABLE
Desktop Research	
Internet Searches	<ul style="list-style-type: none"> • Research agricultural operations in SFHA's, commodities produced, productivity of these operations, historic data on flood losses • Identify regulations governing compliance of structures in SFHAs • Identify lending requirements driving the purchase of flood insurance policies
Field Research	
Survey	<ul style="list-style-type: none"> • Survey (either formally or via open online forum) primary stakeholders to identify all concerns with compliance with current NFIP regulations for new and substantially improved agricultural structures
Interviews	<ul style="list-style-type: none"> • Use primary stakeholder feedback to perform targeted outreach, through phone calls and face- to-face interviews, in order to identify geographically unique topics • Targeted stakeholders could include farmers, floodplain managers, insurance agents, lenders, etc. • Focus groups, if used, should be limited to fewer than 10 like-typed people per group
Site Visits	<ul style="list-style-type: none"> • Perform site visits to a variety of farms in each of the identified study areas (based on results from targeted outreach) in order to observe damage to agricultural structures and operations
Data Analysis	
Compile Data	<ul style="list-style-type: none"> • Compile desktop study data • Compile survey results • Review and compile interview feedback
Conduct Analysis	<ul style="list-style-type: none"> • Identify common needs of farmers across different geographies and types of farming operations • Analyze mitigation options for cost, feasibility of flood protection, and compliance with federal, state, and local regulations • Analyze impacts of mitigation implementation on insurance coverage, premium costs • Draw conclusions and develop recommended solutions
Develop Case Studies	<ul style="list-style-type: none"> • Synthesize information obtained during desktop and field research to develop case studies that success stories in complying with NFIP requirements
Final Recommendations	
Report	<ul style="list-style-type: none"> • Deliver a report summarizing the study's findings and recommended solutions

6.0 CONCLUSION

In response to the GAO report, FEMA concurs that an in-depth study of agricultural structures in the floodplain is needed to update existing relevant guidance for complying with NFIP requirements for substantially damaged/improved and newly constructed structures. As the nature of farming evolves, with both the advent of more sophisticated equipment and changes in farm ownership, farmers have a growing need to construct new and/or larger facilities. The federal, state, and local investment in modernizing flood hazard identification has produced updated Flood Insurance Studies and Flood Insurance Rate Maps that have, in many cases, increased the SHFAs in riverine areas. In addition, the floodplains behind many levees have been recently remapped. Agricultural structures in areas newly mapped into the floodplain will need to comply with NFIP building requirements for new construction, substantial improvement, or substantial damage requirements.

FEMA desires to update existing guidance on mitigation risk of flood damage to agricultural structures so it reflects recent farming developments and structural needs in wide, deep floodplains and areas recently mapped into the floodplain. A study that explores these topics in depth should result in feasible recommendations including recommendations for updated guidance on agricultural structures.

The recommended topics to be included in the larger study are summarized below:

1. Analyze new and substantially improved/substantially damaged agricultural structures based on building type, function, and contents against the type of floodplain/floodway in which they are located to determine the feasibility of elevating, dry floodproofing, and/or wet floodproofing. Evaluate and make recommendations for planning considerations in Technical Bulletin 7 pertaining to agriculture structures.
2. Recommend strategies for minimizing damages to pre-Flood Insurance Rate Maps (FIRMs) agricultural structures.
3. Identify legislative, regulatory, and program changes affecting the management of agricultural structures in the floodplain.
4. Identify other requirements for commodity handling and storage, such as Food and Drug Administration (FDA), U.S. Department of Agriculture (USDA), distributor, and other requirements.
5. Determine the number and type of agricultural structures currently insured under the NFIP. Understand the contents contained in these structures and how they are insured.
6. Understand what changes have occurred in the agriculture industry in the last 25 years with respect to ownership and operations and include information that reflects recent farming developments and structural needs such as confinement operations and the effect that flood

damages can effect farm operations. Advancements in building design may already minimize flood damages and should be explored.

7. Determine if corporate and individual farm owners insure their property differently for flood.
8. Identify other options for farmers to insure their agricultural structures.
9. Identify what crop/hail insurance covers, including contents inside of structures. Identify new programs to protect livestock, dairy operations, hay, and forage.
10. Understand mandatory purchase requirements and implications of the Biggert-Waters Act of 2012 and the Homeowners Flood Insurance Affordability Act of 2014 on lender requirements for agricultural structures.
11. Explore how special rating guidelines are applied to agricultural structures and types of mitigation techniques that would result in reduced risk.
12. Identify the sources of information used to do the larger study in addition to the ones used in this White Paper.

7.0 REFERENCES

- Baker, Rex et. Al. 1994. Rodent-Proof Construction and Exclusion Methods. U.S. Department of Agriculture Animal and Plant Health Inspection Service Animal Damage Control. <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1025&context=icwdmhandbook>
- Buchmiller, Robert and Eash, David. 2010. Floods of May and June 2008 in Iowa. U.S. Geological Survey, Open Source Report No. 2010-1096. <https://pubs.usgs.gov/of/2010/1096/pdf/OFR2010-1096.pdf>
- California Department of Food and Agriculture. 2010. Commodity Specific Food Safety Guidelines for the Production, Harvest, Post-Harvest, and Valued-Added Unit Operations of Green Onions.
- Crop Insurance America. “USDA to Congres: ‘Crop insurance is a vital part of the farm safety net.’” <http://www.cropinsuranceinamerica.org/usda-to-congress-crop-insurance-is-a-vital-part-of-the-farm-safety-net/#.V2lJt2ffOe9>
- Delta Farm Press. 2005. “USDA: Katrina crop damage at \$900 million.” <http://deltafarmpress.com/usda-katrina-crop-damage-900-million>
- Eastern Carolina University. 2009. “Hurricane Floyd.” <https://www.ecu.edu/renci/StormsToLife/Floyd/>
- eXtension. 2013. Managing Flooded Grain Bins. October 2, 2013. <http://articles.extension.org/pages/69712/managing-flooded-grain-bins>
- eXtension. 2013. Salvaging Flood-Damaged Agricultural Buildings. October 1, 2013. <http://articles.extension.org/pages/26795/salvaging-flood-damaged-agricultural-buildings>
- FEMA Region VII. 1998. National Flood Insurance Program Applicable Floodplain Management Requirements for Certain Agricultural Structures Regional Guidance.
- FEMA. 1993. Technical Bulletin 7-93 Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program. <https://www.fema.gov/media-library/assets/documents/3503>
- FEMA. 2013. Floodproofing Non-Residential Buildings. <http://www.fema.gov/media-library/assets/documents/34270>
- FEMA. 2013. Technical Documentation of NFIP Actuarial Assumptions and Methods Supporting Rates Effective October 1, 2013. http://www.fema.gov/media-library-data/c6ffd503e17685376705c64588e84973/Actuarial+Methods+and+Assumptions+2013-09-04_508.pdf

FEMA. 2015. National Flood Insurance Program Specific Rating Guidelines. https://www.fema.gov/media-library-data/1422560633315-f7fddc063a3551d9cb39409af97d1053/SRG_Apr2015_29Jan2015.pdf

FEMA. 2015. Substantial Improvement/Substantial Damage Desk Reference. <http://www.fema.gov/media-library/assets/documents/18562>

FEMA. 2016. Flood Insurance Manual Effective April 1, 2016. <http://www.fema.gov/media-library/assets/documents/115549>

Ferris, Robert. 2016. “Texas floods and commodities: Farms face ‘total loss for year’.” CNBC, may 29, 2016. <http://www.cnbc.com/2015/05/29/texas-floods-and-commodities-farms-face-total-loss-for-year.html>

Garcia-Diaz, Daniel. 2014. National Flood Insurance Program Additional Guidance on Building Requirements to Mitigate Agricultural Structures’ Damage in High-Risk Areas is Needed. Government Accountability Office, Report No. GAO-14-583, June 2014. <http://gao.gov/assets/670/664518.pdf>

Jones, Terry. 2015. “Farmers beg for assistance as Mississippi River overtops levee near the Morganza Spillway.” The Advocate, July 15, 2015. <http://theadvocate.com/news/12922139-123/farmers-beg-for-assistance-as>

Knapp, Frank. 2016. “Help SC farmers recovery from costly flood damage.” The Post and Courier, March 13, 2016. <http://www.postandcourier.com/article/20160313/PC1002/160319747/1023/rescue-farmers-from-flood-losses>

Larson, Lee. 1996. The Great USA Flood of 1993: in the Proceedings of the IAHS Conference, June 24-28, 1996, Anaheim, California. http://www.nwrhc.noaa.gov/floods/papers/oh_2/great.htm

National Grain and Feed Association. 2008. “FDA Guidance Pertains to Reconditioning Moisture-Damaged Grain.” NGFA Newsletter, Vol. 60 No. 13, June 19, 2008. <http://www.extension.iastate.edu/grain/files/Migrated/Reconditioning20MoisireDamaged20Grain1.pdf>

National Research Council. 2000. Risk Analysis and Uncertainty in Flood Damage Reduction Studies. National Academies Press, October 20, 2000.

North Dakota State Water Commission. 2016. Quick Guide Floodplain Management in North Dakota. http://www.swc.nd.gov/pdfs/floodplain_quick_guide.pdf

SBA Secretary of Agriculture. 2012. Disaster Declarations with Open Filing Periods.

Schnepf, Randy. 2008. CRS Report for Congress Midwest Floods of 2008: Potential Impact on Agriculture. Congressional Research Service.

South Carolina Department of Agriculture. 2016. 2015 Impact on South Carolina Agriculture. <http://www.scstatehouse.gov/CommitteeInfo/SenateSpecialCommitteeRegardingFloodReliefEffortsInSC/December72015Meeting/SCDA-flood-presentation.pdf>

Texas Engineering Extension Service. 2011. Hurricane Ike Impact Report. The Storm Resource. http://www.thestormresource.com/Resources/Documents/Full_Hurricane_Ike_Impact_Report.pdf

U.S. Environmental Protection Agency. 2016. “Agriculture.” <https://www.epa.gov/agriculture>

U.S. Geological Survey. 1999. USGS Fact Sheet FS-073-99 Floods in Northern California, January 1997. <https://pubs.usgs.gov/fs/1999/0073/report.pdf>

UMass Agricultural Extension. 2016. “Storage.” <https://ag.umass.edu/vegetables/resources/winter-production-storage/storage>

University of Missouri Extension. 2016. “Farm structures.” <http://extension.missouri.edu/main/DisplayCategory.aspx?C=33>

USDA. 2012. Census of Agriculture. <https://www.agcensus.usda.gov/Publications/2012/>

USDA. 2016. Food Safety Modernization Act Requirements (Applies to Fruits and Vegetables) Equipment, Tools, Buildings, and Sanitation: Subpart L. <http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm334552.htm#L>

Utah Division of State History. 2008. “Agricultural Building Types.” <https://heritage.utah.gov/history/agricultural-building-types>

Wilcke, Bill. 2013. Managing flooded grain bins. University of Minnesota Extension. <http://www.extension.umn.edu/agriculture/small-grains/managing-flooded-grain-bins/>

Wright, James M. 2000. The Nation’s Responses to Flood Disasters: A Historical Account. Association of State Floodplain Managers. http://www.floods.org/PDF/hist_fpm.pdf

Zaleski, Gene. 2016. “Ag Commissioner: Flood relief funds ‘critical’ for 2016 crop.” The T&D. March 30, 2016. http://thetandd.com/news/local/ag-commissioner-flood-relief-funds-critical-for-crop/article_66001d7f-602a-5623-a00c-19f50dea35ad.html

8.0 ACRONYMS

ACV	Actual Cash Value
BFE	Base Flood Elevation
BW-12	Biggert Waters Flood Insurance Reform Act of 2012
FACA	Federal Advisory Committee Act
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GAO	Government Accountability Office
HFIAA	Homeowner Flood Insurance Affordability Act
IBC	International Building Code
LFE	Lowest Floor Elevation
NFIP	National Flood Insurance Program
OMB	Office of Management and Budget
PRA	Paperwork Reduction Act
RCBAP	Residential Condominium Building Association Policy
Risk MAP	Risk Mapping, Assessment, and Planning
SFHA	Special Flood Hazard Area
TB-7	Technical Bulletin 7-93
USDA	United States Department of Agriculture
WYO	Write Your Own

APPENDIX A

Agricultural Building Types

Table 8. Common Types of Agricultural Structures

Type of Structure	Usage	Construction and Building Characteristics
Grain Bin	Grain drying and storage	Low profile bins (12 - 13 ft depth), deep bins (17-18 ft depth), and hopper-bottom bins Bins consist of fans, dryers/heat recyclers, aerators and ventilators
Corn Crib (rarely used anymore)	Corn drying and storage	Constructed of wood, masonry, or metal. Foundation, floor, walls, bracing, roofing, and rat proofing are essential aspects of the building
General Purpose Barn	Temporary feeding of livestock	Constructed of masonry bearing walls, wood or steel framed exterior walls, pole frame, or metal frame and walls.
Farm Storage Structure	Storage of farm machinery and equipment	Pole and pre-fabricated metal frame structures with open or closed sides
Silo	Grain and corn storage	(1) Horizontal silo (either trench silo cut into ground or bunker silo built aboveground) typically open to the elements or (2) tower silo (above ground) cylinder shape. Constructed of concrete or metal construction. Watertight, sometimes airtight.
Poultry Operations	Includes laying chickens or broilers	Long, single story building with closed walls on all 4 sides, constructed of concrete, wood, and/or metal. mechanical equipment and windows for ventilation. Vents may be at the top on the roof.
Milking Parlor	Milking dairy cows	Concrete, metal, masonry, and/or wood construction. Building closed on all 4 sides. Mechanical equipment for automated milking and refrigeration for storage of milk.
Hog Barn	Hog breeding, farrowing, nursing and finishing	Long, single story building with closed walls on all 4 sides, constructed of concrete, wood, and/or metal. Mechanical equipment and windows for ventilation.
Beef Barn	Raising beef cows	Monoslope barn with open sides, concrete piers, wood framing, and steel roofing
Greenhouse	Growing plants	Masonry or metal foundation, metal or wood framing with plastic or glass roofing and siding. Ventillation, heat, and humidity monitoring systems

APPENDIX B

Engagement Strategy

Table 9. Suggested Stakeholder Engagement Strategy

	Study Approaches								Study Topics														Administrative Tasks			
	Conduct Desktop Research	Conduct Survey	Participate in Interviews	Participate in Focus Groups	Participate in Site Visits	Conduct Analysis	Develop Recommendations	Complete Report	Identify flood-related legislative, regulatory, and program changes	Conduct analysis to determine feasibility of complying with NFIP requirements for agricultural structures	Provide recommendations for minimizing damages to pre-FIRM structures	Evaluate feasibility of aggregating building assessments	Identify requirements for commodity storage and handling	Understand how the agricultural industry has changed over the past 25 years	Identify the predominant agricultural structures used and their risk for flooding	Determine the number and types of agricultural structures insured under the NFIP	Determine if corporate and individual farm owners insure their property differently for flood	Identify other options for farmers to mitigate their structures	Identify what crop/hail insurance covers and new programs	Explore how special rating guidelines are applied to agricultural structures	Understand mandatory purchase requirements and lender requirements	Participate in Kickoff Meeting	Develop Work Plan	Coordinate Stakeholder Outreach	Complete monthly reports	Monthly Progress Newsletter
FEMA Mitigation Associate Administrator	I	I	I	I	I	I	A	A	I	I	I	A	I	I	I	I	I	I	I	I	I	C	I	I	I	I
FEMA Floodplain Management Division	A	A	A	A	A	A	R	R	A	A	A	R	A	A	A	A	A	A	A	A	A	A	R	A	R	R
FEMA Federal Insurance Underwriting Branch	C	R	R	R	R	R	R	R	R	C	C	R	I	C	I	R	C	R	C	R	C	R	C	C	I	C
FEMA Building Science Branch	C	R	R	R	R	R	R	R	R	R	R	C	C	C	C	C	C	R	I	R	C	R	C	C	I	C
FEMA Regional Offices	C	C	C	C	R	C	C	C	C	C	C	C	C	C	C	C	C	C	I	I	I	I	I	C	I	C
FEMA Risk Management Directorate	C	C	C	C	I	C	C	C	C	C	C	C	I	I	C	I	I	I	I	I	I	C	C	C	I	I
FEMA External Affairs	I	C	C	C	C	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	C	I	R
Study Contractor	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	A	R	A	A
Other Federal Agencies (USDA, USACE, FDA, etc.)	C	C	C	C	I	C	C	C	C	I	I	I	C	C	C	I	I	C	I	I	I	I	I	C	I	I
State Agricultural, Conservation, Environmental Agencies	C	C	C	C	C	C	C	C	C	C	C	I	C	C	C	C	C	C	C	I	I	I	I	C	I	I
State and Local Floodplain Managers/NFIP Coordinators	C	C	C	C	C	C	C	C	C	C	C	C	I	C	C	C	C	C	I	C	I	I	I	C	I	I
Insurers	C	C	C	C	C	C	I	I	C	C	I	C	I	C	I	C	C	C	C	C	C	C	I	I	C	I
Lenders	C	C	C	C	C	C	I	I	C	C	I	C	I	C	I	C	C	C	C	C	C	C	I	I	C	I
Farmers	C	C	C	C	C	C	I	I	I	C	C	C	C	C	C	C	C	C	C	C	C	C	I	I	C	I
Agricultural Structure Architects, Engineers	C	C	C	C	C	C	I	I	C	C	C	I	C	C	C	I	I	C	I	C	I	I	I	C	I	I
Farming Supply Companies	C	C	C	C	I	C	I	I	I	I	I	I	I	C	C	I	I	I	I	I	I	I	I	C	I	I
Universities and Cooperative Extensions	C	C	C	C	C	C	I	I	I	I	I	I	C	C	C	I	I	I	I	C	I	I	I	C	I	I
American Farm Bureau	C	C	C	C	C	C	I	I	I	I	I	I	C	C	C	C	I	I	I	C	I	I	I	C	I	I
Associations	C	C	C	C	I	C	I	I	I	I	I	I	C	C	C	I	I	I	I	C	I	I	I	C	I	I
Grassroots groups	I	I	C	C	C	I	I	I	I	I	I	I	C	C	C	I	I	I	I	I	I	I	I	C	I	I

R = Responsible
A = Accountable
C = Consulted
I = Informed

Table 10. Suggested Stakeholder Engagement Strategy

STAKEHOLDER TYPE	ENGAGEMENT STRATEGY								FREQUENCY OF ENGAGEMENT
	In-Person Meetings	Conference Calls	Email	Interviews	Focus Groups	Social Media	Survey	Electronic Newsletter	
Responsible	✓	✓	✓						Weekly
Accountable	✓	✓	✓						Weekly or Bi-weekly
Consulted		✓	✓	✓	✓				Varies
Informed			✓			✓	✓	✓	Monthly

Appendix C

Partial List of Resources

Table 10. Partial List of Resources

DOCUMENT TITLE	DATE	WEBSITE
USDA Agricultural Research Service website		http://www.ars.usda.gov/main/main.htm
USDA-NASS, Census of Agriculture website		https://www.agcensus.usda.gov/
Small Business Association Agriculture website		https://www.sba.gov/managing-business/business-guides-industry/agriculture
USDA Farm Services Agency website		http://www.fsa.usda.gov/
FDIC Final Rule on Loans in Areas Having Special Flood Hazards		https://www.fdic.gov/news/news/financial/2015/fil15032.pdf
USDA Programs and Services website		http://www.usda.gov/wps/portal/usda/usdahome?navid=PROGRAM_AND_SERVICE&navtype=MA&deployment_action=changenav
FDA Food Safety Modernization Act		http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm334114.htm
FDA Guide to Minimize Microbial Food Safety Hazards		http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ProducePlantProducts/ucm187676.htm
USDA Cooperative Research and Extension Services website		http://www.usda.gov/wps/portal/usda/usdahome?contentid=cooperative_research_extension_services.xml
USDA Economic Research Service website		http://www.ers.usda.gov/
USDA. First Aid for Flooded Homes and Farms. Agriculture Handbook No. 38.	1974	N/A
Lorenzen, R.T. et al. "Design aspects of buildings for floodplain locations." Paper No. 75-4037. American Society of Agricultural Engineers Annual Meeting.	1975	N/A
USACE. Physical and Economic Feasibility of Nonstructural floodplain management measures - Ch.1. RD-11.	1978	http://www.hec.usace.army.mil/publications/ResearchDocuments/RD-11.pdf
Determining the Feasibility of Wet Floodproofing for Nonresidential Structures	1979	N/A
Purdue University - Managing Dry Grain in Storage	1980	https://www.extension.purdue.edu/extmedia/AED/AED-20.html
Low Temperature and Solar Grain Drying Handbook. MWPS-22.	1983	N/A

Table 10. Partial List of Resources

DOCUMENT TITLE	DATE	WEBSITE
Pole and Post Buildings. NRAES-1.	1984	N/A
Farm shop plans book. MWPS-26.	1985	N/A
Livestock Waste Facilities Handbook. MWPS-18.	1985	N/A
Grain Drying, Handling, and Storage Handbook. MWPS-13.	1987	N/A
USACE. National Economic Development Manual - Agricultural Flood Damage.	1987	http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/87-R-10.pdf
Beef Housing and Equipment Handbook. MWPS-6.	1987	N/A
Bodman, G.R. et al. "Electrical Systems for Agricultural Buildings." G87-845-A. Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska – Lincoln.	1987	http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1594&context=extensionhist
Irish, W. and Graves, R. Planning Dairy Stall Barns. NRAES/NDPC-37.	1988	N/A
Heating, Cooling, and Tempering Air for Livestock Housing. MWPS-34.	1990	N/A
Mechanical Ventilating Systems. MWPS-32.	1990	N/A
Swine Housing and Equipment Handbook. MWPS-8.	1991	N/A
Swine Farrowing Handbook. MWPS-40.	1992	N/A
Farm Building Wiring Handbook. MWPS-28.	1992 (2013 edition available)	N/A
Illinois - Updates for the Illinois Real Property Appraisal Manual	1993	N/A
Reynolds, S. J. et al. Farm Flood Response Workshop. University of Iowa.	1993	N/A

Table 10. Partial List of Resources

DOCUMENT TITLE	DATE	WEBSITE
Sharing the Challenge: Floodplain Management into the 21 st Century	1994	http://www.floods.org/PDF/Sharing_the_Challenge.pdf
Collins, E. R. et al. "Electrical Wiring for Swine Buildings." Fact Sheet PIH-10. Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska – Lincoln.	1994	http://www.animalgenome.org/edu/PIH/110.html
Designing Facilities for Pesticide and Fertilizer Containment. MWPS-37.	1995	N/A
Background on Regulating Agricultural and Accessory Structures Under the NFIP	1995	N/A
USACE. Impacts of the Great Flood of 1993.	1996	N/A
An Assessment of the Technical and Economic Feasibility of Wet Floodproofing for Agricultural and Accessory Structures Under the NFIP	1997	N/A
Herendeen, J., et al. Disaster Handbook for Extension Agents. Cooperative Extension Service, The Pennsylvania State University.	2009	N/A
Flood Insurance for Farmers Act	2013	https://garamendi.house.gov/legislative-work/flood-insurance-farmers-act
GAO 14-583 National Flood Insurance Program: Additional Guidance on Building Requirements to Mitigate Agricultural Structures' Damage in High-Risk Areas is Needed	2014	http://gao.gov/assets/670/664518.pdf
NFIP Specific Rating Guidelines	2015	https://www.fema.gov/media-library-data/1422560633315-f7fddc063a3551d9cb39409af97d1053/SRG_Apr2015_29Jan2015.pdf