

Flood Mapping for the Nation

A Cost Analysis for the Nation's Flood Map Inventory

**The Association of State Floodplain Managers
(ASFPM)**

March 1, 2013



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Executive Summary

The Association of State Floodplain Managers has developed an estimate, based on a careful analysis, of the total cost to provide floodplain mapping for all communities in the nation based on the parameters specified in the Biggert-Waters Flood Insurance Reform Act of 2012. The Nation has invested \$4.3 billion in flood mapping to date, and has enjoyed multiple benefits from that investment, including providing the basis for guiding development that saves over \$1 billion/year in flood damages. ASFPM has identified criteria of what constitutes adequate flood mapping for the country, and has produced an estimate showing the initial cost to provide flood mapping for the nation ranging from \$4.5 billion to \$7.5 billion. The steady-state cost to then maintain accurate and up-to-date flood maps ranges from \$116 million to \$275 million annually.¹ This national investment in a comprehensive, updated flood map inventory for every community in the nation will drive down costs and suffering of flooding on our nation and its citizens, as well as providing the best tool for managing flood risk and building sustainable communities.

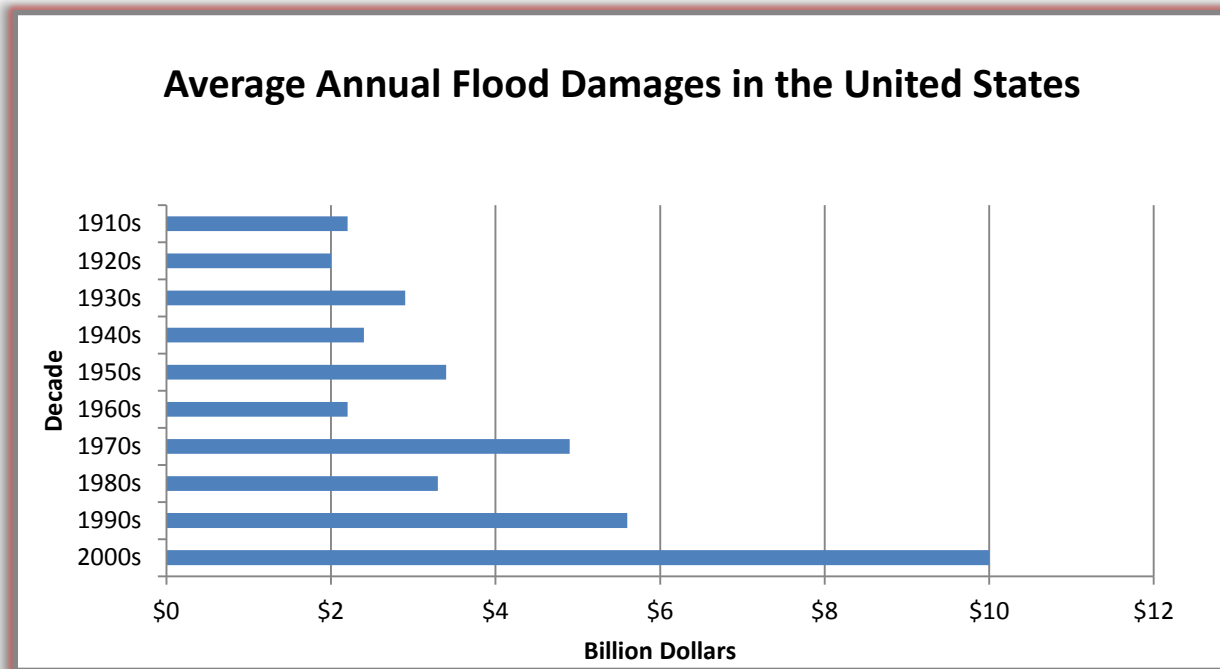
Objective of study

The Association of State Floodplain Managers (ASFPM) conducted a study to develop an overall estimate of the cost to adequately complete the mapping of flood hazards and communicate flood risk for all communities in the United States. The study has multiple objectives including:

- 1) Identifying the cost to complete the flood mapping effort in the nation consistent with the new congressionally established National Flood Mapping Program;
- 2) Identifying the annual, steady-state maintenance cost of the mapping program after the flood mapping has been completed for all parts of the nation;
- 3) Comparing these estimated costs with the Congressional authorization, of \$400 million annually for the National Flood Mapping Program, to help decision makers determine if we are on track in moving toward getting the 22,000 flood prone communities in the nation mapped, and to keep the maps updated,
- 4) Identifying issues, cost savings and other considerations that the Federal Emergency Management Agency (FEMA) and the Technical Mapping Advisory Council (TMAC) should consider as they work to lay out the plan for mapping the flood risk areas of the nation.

¹ These estimates do not include revenue from the Federal policy fee which is primarily used to support administrative cost including the issuance of letter of map change, program management, and data dissemination.

Costs and Impacts of Flooding



At the time of writing of this report, the nation is recovering from Hurricane Sandy – which appears as if it is going to be the second most costly flood disaster in the modern history of the United States. Sadly, Sandy and the costliest flood on record, Hurricane Katrina, have both occurred in the last 7 years. The cost to the Federal taxpayers of these two storms alone will exceed \$200 billion.

Floods are the leading cause of natural disaster losses in the United States, having cost approximately \$50 billion in property damage in the 1990s and accounting for more than two-thirds of federally declared natural disasters (National Research Council, 2009). Direct average annual flood damages have jumped from approximately \$5.6 billion per year in the 1990s to nearly \$10 billion per year in the 2000s, with some years much more than that. But the costs of flooding go far beyond these direct losses.

Individuals and businesses. The effects of a flooding event on individuals have been well documented and include lost wages, agricultural products, expenses for evacuating, and significant health and mental health issues for years following the event. For businesses, the effect is pronounced. Almost forty percent of small businesses do not reopen after a disaster (FEMA) and another 25 percent fail within one year according to FEMA. Similar statistics from the United States Small Business Administration indicate that over 90 percent of businesses fail within two years after being struck by a disaster. Businesses also experience lost revenues from being closed, which, in turn, means lost taxes, jobs and wages throughout the community. Businesses can be affected by employees being unable to get to work due to transportation system failures or their own homes being devastated. Supply lines can be disrupted.

Communities. Communities suffer as well. Loss of income taxes from closed businesses, and diversion of local funds earmarked for other uses, must instead go to flood repair and recovery, physical and mental health, and the use of community resources (staff, equipment, and infrastructure) for response and rescue. Community infrastructure can be severely impacted, including the most costly elements

Mega floods are not new to the California Central Valley. In fact, 7 such events have occurred based on the geologic record since the year 200 AD. ARKStorm is a product of the U.S. Geological Survey, Multi Hazards Demonstration Project (MHDP) and is a model based on the most recent of these storms to occur in 1861-1862 using 2008 development and population data. ARKStorm showed that if such an event happened today, over \$725 billion in direct property and indirect business losses would result. This is nearly 3 times the loss deemed to be realistic by the ShakeOut earthquake scenario for a severe southern California earthquake (United States Geological Survey, 2011).

such as water and wastewater treatment facilities. Debris collection and environmental cleanup can be significant. Local taxes (income, property, etc.) are reduced, both in the short and long term.

States. Roads, bridges, and other State infrastructure such as emergency facilities can be damaged or destroyed. State impacts of flooding include a diversion of state resources from necessary programs to response and recovery programs. State taxes (income, property, etc.) are reduced.

Federal Government. All taxpayers pay for the consequences of flooding. If property owners do not have flood insurance, taxpayers provide assistance through disaster relief. The casualty loss deduction allowance and lost wages due to business closure result in forgone tax revenue. Insurance subsidies, through either crop or flood insurance, result in cost to the U.S. Treasury.

Future costs

Given the brief period of history in which flood losses have been tracked in the United States, it is fair to say we have not seen the probable maximum flood for most areas. While Hurricanes Katrina and Sandy have caused over \$200 billion in losses, either event could have been worse, and some future events likely will be.

Trends indicate that the Federal taxpayer is paying a greater share of disaster costs than any time in history. A recent analysis shows that from 1989 to 2004, Federal aid as a percentage of all economic costs from major hurricane events averaged 26%. Since 2005, the Federal aid proportion jumped dramatically to 69% (J. David Cummings, 2010).

The United States currently has a population of about 320 million, which is expected to be about 380 million by 2030 and 460 million by 2050. This population explosion combined with our desire to live near water will lead to significantly increased pressure to develop in flood risk areas. Climate change is resulting in sea level rise on the coasts, and more intense storms everywhere. Recent reports from the Government Accountability Office (GAO), and the National Climate Assessment and Development

Advisory Committee indicate that there will be significant risk exposure to families, communities, infrastructure, and federal assets due to climate change and sea level rise.

Benefits of Flood Mapping

Flooding is a natural phenomenon. Maps will not prevent floods from occurring, but they are an essential tool in avoiding or minimizing the damage to property and loss of life caused by floods, and for communicating flood risk. Without accurate flood maps, local officials face serious difficulties in guiding development away from the most hazardous areas or in ensuring that development in or near the hazard area is properly built and protected.

Flood maps are used for many purposes. FEMA's Flood Insurance Rate Maps—the primary type of flood maps in the United States—are used to determine flood insurance rates, development regulations, and flood preparation for those at risk. Government officials use them to establish zoning, land-use, and building standards; to support land use, infrastructure, transportation, flood warning, evacuation, and emergency management planning; and to prepare for and respond to floods. Insurance companies, lenders, realtors, and property owners depend on these maps to determine flood insurance needs. For citizens, businesses and communities, the FEMA flood maps are the essential tool for reducing flood losses and are the nation's default source of flood hazard information.

In the creation of quality flood hazard data, high quality topographic information is essential. This elevation dataset has multiple uses, and associated costs are avoided since these data can be used by multiple programs and agencies. Communities can use these data to determine safe evacuation routes for citizens, support first responders in emergencies, account for changes in tax base, and update a variety of local plans (e.g. hazard mitigation, comprehensive land use, and capital improvement plans). Such data can reduce the need to conduct field surveys by agencies such as departments of transportation, and to plan for resilient community growth. The Congressional Budget Office found that lack of up-to-date topographic information causes a downward bias on the actuarial soundness of the NFIP (Congressional Budget Office, 2009).

Maps depicting flood hazard areas are not only the foundation of the NFIP, but also the basis of sound floodplain management policies at the local, state, and federal levels. Adequate, accurate, and current maps are essential for the program to function. If a potential flood prone area is not mapped, the community has no tool to adequately guide development to be safer and to mitigate future flood losses. Local governments, with state assistance and authority are the level of government with the tools to reduce future flood losses. Those tools are land use and building codes, which they use to guide development to lower flood risk areas, and to build in a resistant way in flood risk areas so future damages and risk are reduced. Currently many communities assist in cost sharing or in providing modern topographic mapping. Without mapping of the flood prone area, there is no real tool to communicate flood risk to community officials, citizens, or businesses. The sale of flood insurance is not mandated in areas outside floodplains mapped on FIRMs. Without adequate, accurate, and current maps, neither construction nor the insurance regulatory elements of the program can be effective (Technical Mapping Advisory Council, 2000).

The State of North Carolina has the most comprehensive statewide flood mapping program in the country. All streams with a drainage area greater than 1 square mile are mapped, and the state has partnered with FEMA to provide over half of the funding investment needed to generate comprehensive statewide flood maps and data. High quality elevation data was obtained statewide and all flood zones have base flood elevations associated with them. A key feature of the North Carolina approach is education and outreach.

Floodplain mapping is a cost-effective taxpayer investment. In 1997, FEMA conducted a benefit-cost analysis of its proposed flood mapping program (Map Modernization). Based on that analysis, floodplain mapping showed a benefit to the taxpayer of over \$2 for every \$1 invested in flood mapping. Later, the State of North Carolina used the same methodology as FEMA and calculated a benefit-cost ratio of 2.3 to 1. The North Carolina report further determined the following range of values of avoided losses per stream mile studied:

Flood Study Type	Range of losses avoided / stream mile
Detailed Study	\$5,482-\$6,166
Limited Detailed Study	\$1,713-\$2,539
Approximate Study	\$721

The North Carolina report indicates that for the 29,733 stream miles studied throughout the state, the average benefit provided is \$3,400 per year per mile and clearly shows significantly higher benefits of having more detailed flood studies (State of North Carolina, 2008).

Flood mapping reduces disaster costs. Development that complies with the floodplain management requirements is better protected against major flood-related damage. Since flood mapping is the basis for community floodplain management regulations, then it stands to reason that new construction in mapped floodplains would have to comply with such codes and be constructed to be more resilient in future disasters. In fact, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance (Federal Emergency Management Agency, 2012). Lower damage amounts can be a proxy for lower impacts and demands on disaster assistance. In its final report the TMAC indicated that a small investment in mapping can result in huge savings in flood-related disaster assistance in the future (Technical Mapping Advisory Council, 2000).

History and Current Status of Flood Hazard Mapping

To meet the objective that studies be conducted to accurately assess the flood risk within each flood-prone community and develop appropriate flood insurance rates, the 1968 Act called for: 1) the identification and publication of information within five years for all floodplain areas that have special flood hazards; and 2) the establishment of flood-risk zones in all such areas to be completed over a 15-year period following passage of the Act (these initial objectives of the Act were never fully achieved). After an initial funding of flood mapping from 1974-1980, funds were relatively stagnant until 2003. Compounding matters, there was an incorrect assumption that once the initial flood maps were published there would not be a need for updating or republishing.

As a result, mapping that had not been completed still remained to be done and the existing flood map inventory started to become outdated – whether from changes in the watershed or the flood hazard that resulted in different flood heights, or from the need to develop detailed flood data in areas that had only approximate or no flood information.

Also during that time, significant advances in cartographic mapping, flood hazard analysis, and modeling occurred. The 1994 Flood Insurance Reform Act called for the establishment of the Technical Mapping Advisory Committee. Their annual TMAC reports from 1995-2000 provided momentum and a road map for the FEMA Map Modernization Program. Additionally, the TMAC developed recommendations that should still be considered today.

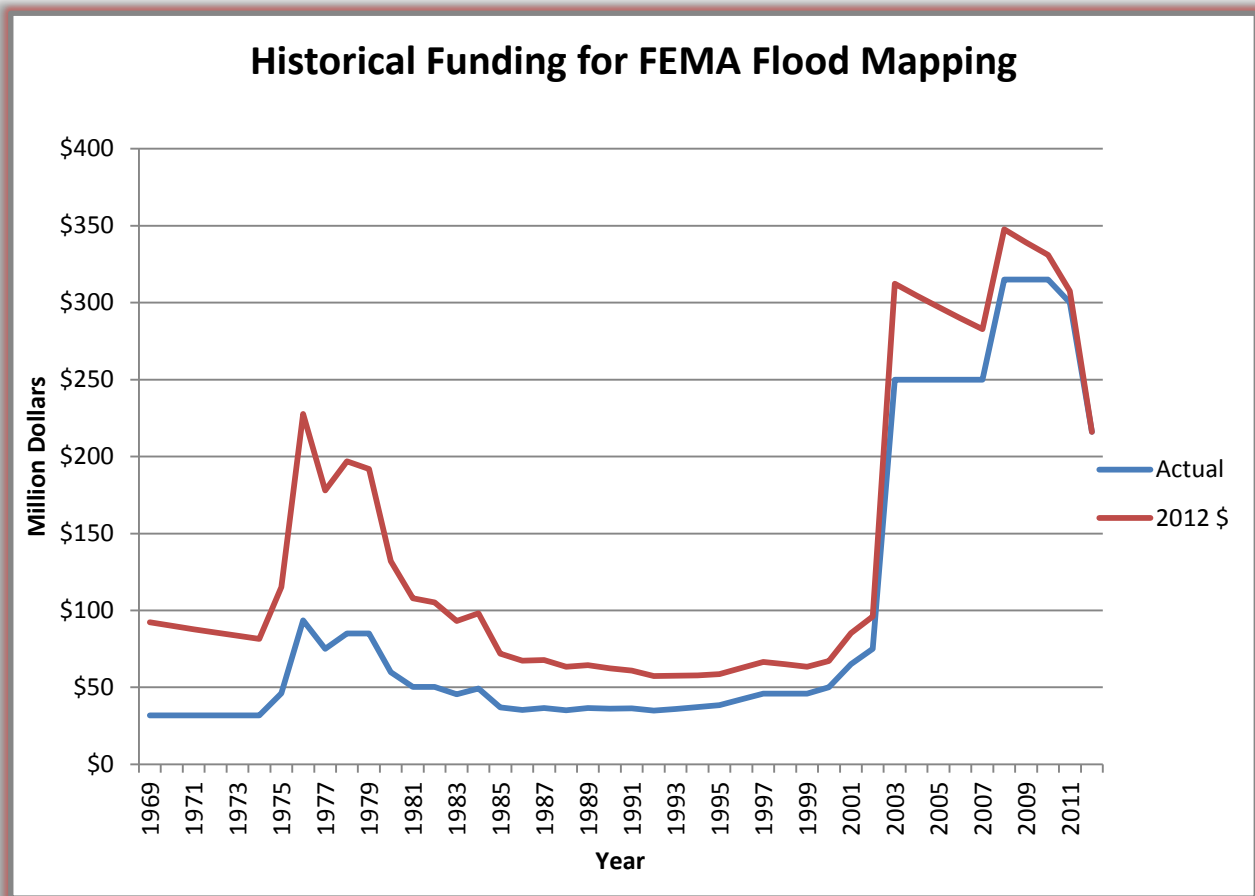
Map Modernization had a major goal to convert the nation's paper maps to a digital format—that was achieved for about 92% of population and 62% of the land area. While it was key that digital maps be provided for those areas, the limit on resources meant that few communities were provided new engineering models for updated flood levels and that large geographic areas of the United States still remained unmapped. Mapping efforts were focused on where the greatest population is located, equating population with risk. Unfortunately, this left a missed opportunity to provide maps for communities with emerging development which is being built in areas with limited or non-existent flood risk information.

FEMA's Risk MAP program became the successor to the Map Modernization program. An important aspect of Risk MAP is that it took lessons learned from Map Modernization and applied them. Such lessons included:

Flood hazard is not the same as flood risk. Most flood maps express only flood hazard—that is, the places where flooding is possible. Many do not currently reflect the elements that are included in flood risk—the probability that a flood will actually occur in a given area, the chance any existing flood prevention systems will perform as designed, and the total consequences (costs) of flooding.

FEMA's Risk MAP program is moving from simply portraying flood hazard and flood insurance rate zones to communicating and assessing risk, which will improve the utility of FEMA's flood maps for governments, business, and the public (National Research Council, 2009).

- Just providing a flood map outlining the flood hazard area perpetuates the concept that flood risk is an “in” or “out” proposition and doesn’t convey flood risk. As a result, the Risk MAP program has developed non-regulatory products such as the Flood Risk Map and Flood Risk Report that provide communities the additional risk data needed to better communicate the potential flood risk to its citizens and to take mitigation actions to reduce risk.
- There is great importance in effective communications with communities during the mapping process. While Map Modernization only resulted in limited communication with communities (and this communication included significant lag time between contacts), Risk MAP includes a much more robust communication role – with multiple communications opportunities throughout the mapping life cycle and with multiple audiences to encourage a more complete dialog of flood risk.



Since the inception of the NFIP, \$4.3 billion has been invested in the nation’s flood mapping program (\$6.2 billion adjusted to 2012 dollars). This amount includes both appropriated and fee generated funds.

Return on Existing Investment in the Nation's Flood Maps

What have been the results of investing in the nation's flood maps to date?

- There are \$1.5 billion in avoided damages every year for buildings constructed in compliance with NFIP standards. The Federal taxpayer would have largely have paid for these losses through disaster relief and other programs. These losses avoided would have not been possible without the flood maps. So the investment in flood mapping since the inception of the program until now can be offset by losses avoided in just over 4 years.
- Over 22,000 communities participate in the NFIP. Many of them have reasonably good flood data and, as a result, have been able to reduce flood damages to new development. Additionally, over 5.5 million flood insurance policy holders have their financial investment in homes and businesses protected by flood insurance. These are all potential damages that are paid through an insurance mechanism rather than disaster assistance. Those who live at risk pay for part of the cost of those decisions. NONE of this would be possible without flood maps.
- This investment has resulted in the creation of a digital platform for flood maps. This was a huge undertaking given that previous flood maps were developed using multiple, older cartographic methods. Now, the digital platform is compatible with modern Geographic Information Systems which means the maps can be integrated into federal, state, and local systems; and it positions the nation to move quickly and more cost effectively to develop new and updated maps for every community in the nation.

What remains to be done?

We need to (1) complete mapping for those communities that do not have a map, (2) update maps for those who have a map but have no data in some areas of the community that are developing, and (3) update maps for those who have detailed data but need to reflect changed conditions. Further, professionals in floodplain management know that there are different types of flood hazards – many of these are not identified or if they are, they are not on the flood maps. The framework for flood mapping as prescribed by the National Flood Mapping Program in the Biggert-Waters 2012 Reform Act, recognizes many of these existing needs and sets a robust course for moving forward.

Cost of Flood Mapping for the Nation

What Does Flood Mapping for the Nation Mean?

Section 100216 of the Biggert-Waters Flood Insurance Reform Act of 2012, Pub. L. No: 112-141, establishes The National Flood Mapping Program and describes the responsibility of FEMA to develop and maintain flood maps that are adequate to: 1) Make flood risk determinations and 2) be used by state and local governments in managing development and reduce the risks associated with flooding. To accomplish this, the 2012 Act requires that FEMA shall review, update, and maintain NFIP maps with respect to:

1. All populated areas and areas of possible population growth located within the 100-year and 500-year floodplains;
2. Areas of residual risk, including areas that are protected by levees, dams, and other flood control structures and the level of protection provided by those structures;
3. Ensuring that current, accurate ground elevation data is used;
4. Inclusion of future conditions risk assessment and modeling incorporating the best available climate science; and
5. Including any other relevant data from NOAA, USACE, USGS and other agencies on coastal inundation, storm surge, land subsidence, coastal erosion hazards, changing lake levels and other related flood hazards.

“All flood hazard areas need to be mapped in order for the NFIP to fulfill its potential for reducing the rate of flood-related disaster costs.” (Technical Mapping Advisory Council, 2000)

Key Assumptions

To complete flood maps and flood risk data for the nation, it is necessary to make certain key assumptions about the mapping program. Below is the list of the key assumptions made in this report as it relates to what constitutes mapping the nation.

Assumption #1: The framework for mapping the nation going forward has been established in the 2012 Reform Act and dovetails well with FEMA’s Risk MAP program and previous recommendations to improve floodplain mapping. In the past, and in the absence of clear Congressional direction, the mapping program was almost solely focused on supporting flood insurance rating as well as serving as a tool for the adoption and enforcement of local floodplain management regulations. However, the purpose of the National Flood Mapping Program is clearly meant to fulfill a broader mandate – to create the nation’s flood risk data set so communities, states, and individuals can take action to reduce losses.

FEMA’s Risk MAP program moved the discussion of flood hazard identification away from just the 1% chance flood and Flood Insurance Rate Maps to identifying multiple types of flood hazards and frequencies of flood risk. Further, the discussion has been shifted more to one on risk and what the property owner/community can do about it, rather than whether a person is in out of the Special Flood Hazard Area for purposes of flood insurance.

The Act makes a clear and unequivocal statement that flood maps produced by FEMA will be forward looking and inclusive of several types of flood risk data. The Congress has, in effect, acknowledged what most state and local officials already know – that the FEMA Flood map data is and should be the default national dataset for flood risk.

Assumption #2: Flood data and maps are developed for the entire nation. Based on the National Hydrographic Dataset, there are 3.5 million miles of streams in the nation. Currently, only 1.2 million miles have flood maps. FEMA’s floodplain mapping programs to this point have chosen to prioritize

limited resources to those areas of greatest population and flood insurance policies on the assumption these are the highest risk areas. While this approach has produced accurate and detailed maps in counties and communities with higher population levels (even in these communities there are flood prone areas that have not yet been mapped), there are many counties and communities throughout the nation that *continue* to have paper maps over 30 years old that are based on using obsolete mapping methods or that *do not have flood maps at all*. The current approach ignores lesser populated areas – that have considerable flood risk especially in relation to the local economy, and may have rapidly developing areas with no flood data to guide development. These communities are found all over the nation and continue to find themselves less able to be resilient because the foundational flood data does not exist. Unmapped flood hazard areas present a serious threat to people who may choose to buy or build within them (Technical Mapping Advisory Council, 2000).

Over 1 million miles of streams exist on Federal lands. While some development and infrastructure exists on these lands, the low future development potential coupled with other Federal agencies primacy over such areas, this cost model only shows the cost to map these areas in the high cost range scenario. ASFPM believes that mapping these areas could have benefits; however, flood mapping could, and probably should be developed by the owner agency as required by the federal Executive Order 11988.

Assumption #3: The minimal flood mapping level for the nation should be model based and include the ability to readily obtain flood elevation information. With advances over the past decade in automated technologies to map flood hazards and risk, and with high quality topographic data, the ability exists to map large geographic areas using such methods. This mapping would be done at a cheaper cost and the quality would be much improved over maps produced 30+ years ago. While FEMA has correctly identified the flood hazard area, communities and citizens need flood elevation data for important things like insurance rating, assessing actual flood risk and making development decisions and to plan for resilient community growth in order to truly manage the flood risk at the local level.

Assumption #4: Up to date detailed elevation data (LIDAR or other topographic maps) are needed anywhere flood mapping and data are to be generated. The accuracy of elevation data has an enormous impact on the accuracy of flood maps. Having accurate topographic data for floodplain mapping is especially critical in regions with low relief, such as coastal areas – these are the very areas that are seeing the most significant population growth and development.

Assumption #5: Residual Risk is being defined in this cost model as risk associated with levees and inundation/failure areas below dams; however other residual risk areas should be identified. There is a new mandate in the law that residual risk areas be identified. It is important that re-established TMAC work to help further define the term and criteria.

Assumption #6: The flood map inventory must be continuously updated. Flood map data is not static, it changes over time. Drivers of this change include: 1) Change in hydrology, i.e. updated rainfall records and changing storm patterns, 2) Changes in land use such as population growth or hardening of watersheds causing changes in runoff, 3) Need for detailed flood studies as new areas develop, 4)

Update of data based on new models, and 5) Technological advancements that allow for more dynamic analyses and presentation of flood risk. While the initial mapping effort for the nation must be completed, there too is an annual maintenance cost for the entire flood map and data inventory. The federal government's investment in the development of flood hazard data is considerable and must not be allowed to decay as happened in the mid-1980s and 1990s (see chart on Historical Funding for FEMA Flood Mapping).

The Cost

Program Element	Lower Range	Upper Range
Topographic Data Development with QA/QC	\$ 877,500,000	\$ 1,171,200,000
Mapping (Risk Identification and Assessment)		
Discovery, Scoping, Risk Communication & Outreach	\$51,609,830	\$ 73,034,759
Riverine Flood Study	\$ 2,941,056,518	\$ 4,949,637,440
Coastal Flood Study	\$ 7,733,725	\$ 48,647,625
Levee Mapping	\$ 53,746,875	\$ 358,312,500
Dam Failure Inundation	\$ 289,464,800	\$ 289,464,800
DFIRM Production with QA/QC	\$ 170,888,850	\$ 392,162,595
Non-Regulatory Flood Risk Products	\$ 67,846,631	\$ 188,741,513
Total	\$ 4,459,847,229	\$ 7,471,201,232

The national mapping program shown above has been broken down into major elements and there is also a low and high cost associated with each. The basis for these costs are the assumptions explained in the preceding section and actual cost information obtained from FEMA and states completing mapping projects under the Cooperating Technical Partners Program. Due to its complexity, the data behind these estimates is not included in this report, but is available from ASFPM upon request.

The most significant source of variability between the high and low range is due to assumptions made related to level of riverine flood studies for a given geographic area. While good cost data is available currently, it is important to note that changing technology as well as an assumption of nation-wide LIDAR could result in reduced costs. There is a high degree of uncertainty, though, of the extent of such cost savings. The upper range also includes mapping flood hazard areas on all Federal lands. As an area becomes more developed (and thus more at-risk) there is an increased need for higher levels of detail in flood studies. There is also significant variability for levee studies reflecting the relative uncertainty as to the number of levee miles and the needed level of analysis.

Program Element	Lower Range	Upper Range
Steady-State Map Maintenance (Annual)	\$ 116,180,416	\$ 275,204,714
Total	\$ 116,180,416	\$ 275,204,714

In terms of map maintenance, the largest variable has to do with assumptions of map decay – or the accuracy of the map over time. Flood maps and risk will change over time due to several factors including changes in topography in the watershed, changes in development and growth, and also changes in precipitation, additional stream gage data, and changes in water levels in lakes and oceans. In areas where all of these are changing rapidly, maps need to be updated much more frequently than in some rural areas that have little growth and development. Also, accelerated sea level rise and climate change could result in higher decay rates than are presented in this cost estimate. All flood maps need updated periodically, but some more frequently than others.

Standard Operations and Fee Income

The resources needed to annually operate the nation's flood mapping program varies from year to year, but in recent years is generally estimated to vary from \$85 - \$105 million. Standard operations include staffing, program management, intaking / processing / issuing Letters of Map Change, and data management and dissemination. *These critical functions are not identified in above costs to map the nation, nor are they included in the steady-state maintenance costs.*

FEMA collects a Federal Policy Fee on all policies and a portion of it is dedicated for flood mapping purposes. In 2011 the Federal Policy Fee generated approximately \$170 million; however, this revenue is used to support not only flood mapping activities, but floodplain management activities and other FEMA costs to run the NFIP. The amount used for floodplain mapping has recently been in the \$100-\$115 million range. From these data, based on current fee allocation and amount, standard operations costs largely offset the fee income. In order for fee income to support additional flood mapping, there would need to be a fee increase.

Cost Savings

The cost model developed by ASFPM includes estimates based on available information from states and FEMA, and is also based on today's technology and methods of providing flood map data, as well as the assumptions stated earlier. ASFPM believes that there are ways to achieve cost savings by leveraging funding, advances in technology and other approaches. A few of these are presented below.

1. *Efficiencies in mapping using better technology.* Throughout the FEMA Map Modernization program and in Risk MAP, FEMA has been successful in driving program efficiencies. This is also a result of changing and improving technologies.
2. *Leveraging state and locally collected elevation data.* Some states do routinely collect and maintain statewide, high quality LIDAR data that can be used for flood mapping. This may reduce the initial cost to collect and maintain the necessary topographic information needed for flood mapping. ASFPM has also identified potential cost savings related to conducting flood studies by having a nationwide LIDAR dataset due to economies of scale.
3. *Incenting better cost sharing overall.* Currently there is no required cost share for flood mapping. Whether through incentives or requirements, cost-sharing can drive down the Federal outlays for flood mapping and may be especially appropriate in rapidly developing areas.
4. *Streamlining the geospatial processes and management of data for flood mapping.* To be clear, there are still some communities in the country that continue to rely on paper flood maps. This

issue can be addressed by developing means to provide paper maps, when a community indicates a need--at a much lower cost than the added processing steps that are now necessary in order to always produce a paper map for every community.

5. *Increasing the flood insurance policy fee to provide additional funds for flood mapping.* In addition to direct appropriations, FEMA is authorized to use some of the fees collected from policyholders for mapping activities. Congress could direct FEMA to increase these offsetting fees. For example, a \$15 increase in the fee (on average, this would only increase the cost of a policy by 1-2%) would eventually generate about \$75 million per year. An alternative to the whole dollar amount charged would be to convert the fee to a percentage of the premium such that additional funding would be generated.

Conclusion

Flooding is a predictable risk in the sense that we can identify where in the nation flooding will occur. It is a manageable risk – there are established actions that individuals, businesses and communities can take to reduce potential damage – provided the flood risk areas are identified. Flooding continues to be the nation’s costliest hazard, with average annual losses now averaging over \$10 billion. Yet losses continue to climb – our nation has a flooding problem.

Investments in the nation’s flood mapping program over the past 40 years have been impressive. Over one million miles of streams, rivers, and shorelines have been mapped at a total cost of over \$4 billion. Yet we still have areas that have no flood maps, areas that have outdated flood maps that haven’t been updated, and areas with older engineering studies that need to be updated. And there are other flood hazards that need to be identified. Based on the data presented in this report, over half of the needed investment has been made. Why continue?

A recent report on the NFIP identified that the lack of understanding of the national flood risk, the inadequate communication of that risk, and diminished capabilities in flood risk management due to inaccurate or out-of-date flood hazard maps is a current major weakness in the program. However, it also concluded that reliable flood risk data, including updated flood maps, and educating residents about flood risk, contribute to mitigating future flood losses (Congressional Research Service, 2011). A comprehensive, updated national flood map inventory can drive down the costs – and impacts – of flooding on our nation and its citizens.

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