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# CALCULATION OF FLOOD LOSSES IN THE UNITED STATES

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**ABSTRACT:** In the United States, no one Federal agency has the responsibility for managing flood risk. One important implication of this is that no one agency collects data on damages and losses caused by flood events. Rather, many agencies collect different types of data and make use of such data in different ways in order to meet their individual missions and purposes. This does not necessarily result in a complete understanding of flood damages and losses experienced due to flood events within the Federal government. Further, it is not necessarily an efficient process, and may result in both duplication of effort and gaps in the data that is collected. The Federal Interagency Floodplain Management Task Force (FIFM-TF), an interagency group representing ten Federal agencies with missions and authorities related to flood risk and floodplain management, recognized the limitations caused by this piecemeal approach, in terms of both lack of efficiency within the Federal government and lack of complete understanding of the flood problem within the country. To better understand this problem, the FIFM-TF convened an interagency meeting of experts involved in their agencies' efforts to collect flood damage and loss data. The purpose of this meeting was to discuss what types of data were collected by each agency and how each agency used their data. Through this discussion, potential efficiencies in data collection efforts between agencies were identified, as were gaps in the types of data that were collected and used within the Federal government. The discussions, challenges and solutions identified, and improvements resulting from this interagency meeting will be discussed in detail. Further, longer term discussion on how the Federal government might lead efforts to develop a more accurate and comprehensive estimate of flood damages and losses to the Nation will be provided, including recommendations under consideration by the FIFM-TF for moving forward with such an activity.

Key Words: Flood Risk Management, Flood Damages, Federal Government

## 1. OVERVIEW OF THE CURRENT STATE OF FLOOD LOSS DATA COLLECTION

In the United States, the responsibility for flood risk and floodplain management is split between multiple levels of government and between multiple agencies within a given level of government. While the Federal government does play a significant role in flood risk management in the country, key responsibilities, including responsibility for things like building code requirements, land use zoning, and ordinances, fall to the state or local level of government. Further, within the Federal government, there is no one agency with responsibility for flood risk or floodplain management. Rather, there are multiple Federal agencies with missions, authorities, and responsibilities relating to water resources and related land resource management that in some way relate to flood risk management. Given the numerous Federal, state, and local agencies involved in flood risk and floodplain management, these activities are considered to be a shared responsibility among many partners.

As there is no one agency with complete responsibility for flood risk management, there is also no one agency in the United States with specific responsibility for collecting and evaluating detailed flood loss information. Within the Federal government, numerous agencies collect certain data on flood losses and damages, but all agencies collect different types of data for different purposes. For example, the National Weather Service (NWS), through its many field offices, provides loss estimates for significant flooding events. However, this task is ancillary to the primary focus of the NWS, providing forecasts and warnings

for events that lead to death and damage. Therefore, the estimates NWS provides should only be considered approximations (Pielke *et al.*, 2002). Each year the NWS produces a summary report of direct freshwater flood damages and fatalities. This report and flood loss information can be found at <http://www.nws.noaa.gov/hic/summaries/>.

However, NWS is one among many collecting data related to flood loss. The remainder of this paper will evaluate the types of data collected and uses of that data by numerous Federal agencies, and will outline the interest taken in this topic by the Federal Interagency Floodplain Management Task Force (FIFM-TF), an interagency body consisting of ten Federal agencies with missions, authorities, and responsibilities related to flood risk management. In taking an interest in flood loss and damage data in the United States, the FIFM-TF gathered preliminary information from the member agencies about collection and use of flood loss data.

## **1.1 Agency Definitions of Flood Loss**

The first topic of interest to the FIFM-TF in developing a better understanding of flood loss and damage data in the United States was the definition of flood loss. Each participating agency provided their definition, if they had one, of flood loss in preparation for an interagency discussion. It became quickly evident that a common definition of flood loss does not exist among the Federal agencies participating in the discussion, though there are some commonalities in the varying definitions.

The NWS, the agency that most closely tracks flood loss data, definition of freshwater flood loss includes fatalities and damages that are directly attributable to the flood event. Direct flood damages include damage to (a) private property, including structural damage and lost agriculture; and (b) public infrastructure and facilities. A more detailed look at the NWS definition of freshwater flood loss data, its origins, and user guidance can be found at <http://www.nws.noaa.gov/hic/>. This freshwater flood loss data is used by NWS to quantify the socio-economic impacts of flooding over time.

The U.S. Army Corps of Engineers (USACE) appears to be the only other agency among those that participated in the FIFM-TF discussions that defines flood loss. For USACE, flood loss is defined as those economic, social, and environmental losses that are caused by riverine and/or coastal flooding due to extreme storm events. Though USACE does have a definition of flood loss, the data collected is usually data on flood losses or damages prevented, rather than on the losses directly. Information about losses avoided are of more use to USACE in that such information can be used to demonstrate the benefits of flood risk management structures (e.g., levees or floodwalls) designed and built by USACE.

The Federal Emergency Management Agency (FEMA) does not define flood loss, but does define the term "direct physical loss by or from a flood event." This is defined as a loss or damage to insured property, directly caused by a flood. In order for damage to a property to meet this definition, there must be evidence of some physical change to the property due to the flood event. FEMA is the Federal agency responsible for managing the National Flood Insurance Program, which provides Federally backed flood insurance to residents of participating flood-prone communities. This agency mission is evident in the definition of a physical loss by or from a flood loss, in that FEMA is primarily concerned about damages to insured property rather than damage to all property. FEMA also has some similarity to NWS, in that they focus specifically on direct flood damages or losses.

Several other participating agencies reported that they did not have a definition of flood loss or flood damage. Specifically, the Department of Interior (DOI), the Department of Housing and Urban Development (HUD), and the Natural Resources Conservation Service (NRCS), a part of the Department of Agriculture (USDA), do not have a definition of flood loss or flood damage. While the Tennessee Valley Authority (TVA) reported that they did not have a definition for flood loss or flood damage, they did report an agency focus on flood losses or damages averted. Similar to the USACE definition, TVA focuses on collecting data that can be used to demonstrate the effectiveness of flood risk management structures and reservoir operation to avoid flood damages.

The evaluation of agency definitions of flood loss data revealed distinctions in how agencies think about flood loss data. One important distinction identified was how the agencies considered direct versus

indirect flood losses. Several of the agencies, including NWS and FEMA, identified an agency interest in direct flood loss data. Direct flood damages reported in the NWS annual freshwater flood loss summary report of accounts for damage to (a) private property, including structural damage and lost agriculture; and (b) public infrastructure and facilities. Whereas flood loss estimates reported by other entities, such as media, insurance, or other governmental agencies often include additional indirect flood-related costs such as (a) mitigation costs (e.g., sandbagging, temporary levees, and temporary shelters); and (b) projected estimates of economic loss (e.g., disruption to planting and harvesting, lost wages, disruption to transportation, interruption to commerce due to closed facilities, and reduction in tourism). Typically, flood loss estimates inclusive of indirect costs are much larger than the direct flood damage estimates reported by the NWS.

In Bond (2013), a fairly comprehensive listing of costs, including both direct and indirect, to be included in an assessment of flood losses, were recommended. Categories of flood losses to be considered included emergency response/recovery costs, direct costs of flood damage, costs of mitigation actions taken after a flood event, economic costs, and other effects on the nation. Within the category of direct costs Bond (2013) included damage to both buildings and contents, damage to public and private infrastructure, and damage to crops and agricultural facilities. Note that there may be some redundancy within these subcategories. Under economic costs, loss of production, loss of jobs, business interruptions, and inflation due to the loss of production or due to temporary shortages of building materials were recommended for consideration. These are all very important costs to a flood event or other type of disaster event, but they are difficult to quantify, and it does not appear that there is a Federal agency responsible for tracking these more indirect costs.

Finally, the non-monetary costs and losses due to flood events were recognized in Bond's outline of direct and indirect flood losses. To some extent, NWS attempts to quantify these non-monetary flood losses, at least in regards to fatalities due to flood events, however, other Federal agencies do not seem to try to account for these indirect, non-monetary losses. The sub-categories recommended by Bond (2013) of these losses included impacts on human health and impacts on the environment, including impacts on endangered species. Based on preliminary research between multiple Federal agencies, it does not appear that there is any comprehensive effort, or even the ability at the Federal level, to collect all of these important costs of flood events to produce a more complete understanding of the losses experienced by the United States due to flooding. This additional research further confirmed the importance of understanding both direct and indirect flood losses in order to fully comprehend the definition of flood loss and what the losses due to flooding experienced in the United States truly are.

## **1.2 Individual Agency Data Collection Efforts**

Individual agencies' data collection practices are varied and typically align with the agency's designated missions and purposes. No one agency is in charge of flood risk management or flood loss data information, which creates great variation in data collected by each individual agency. USACE, for instance, collects and reports data relating to flood damages prevented, relevant to the way it defines flood losses. Such data is associated with USACE infrastructure and flood risk management projects. Data collected on damages prevented associated with a specific USACE project is reported on an annual basis. In some cases, this data includes damages prevented during emergency operations and flood flight activities. Additionally, USACE collects data on project repair costs under the PL 84-99, Flood Control and Coastal Emergencies, program, under which USACE rehabilitates projects damaged during flooding events and responds during national disasters in many cases. However, since data is collected on a project-by-project basis, it is not typically aggregated so to report a single monetary figure.

TVA, a Federal corporation and the nation's largest public power company, collects data in ways comparable to USACE practices. TVA was established by the U.S. Congress in 1933 to reduce flood damages, among other purposes (TVA, n.d.). Given that this is TVA's mission, the agency focuses on collecting project-specific data related to flood damages prevented. TVA also has data that informs flood damage curves for several cities and locations. Data used to create these curves includes physical information on all structures within the 500-year floodplain as well as those structures' potential value. Data is also collected on flood elevations that would have occurred if TVA reservoir systems did not exist.

The widest array of data collected is a result of efforts by the FEMA, the Federal agency responsible for coordinating the Federal government's role in preparing for, preventing, mitigating the effects of, responding to, and recovering from domestic disasters, as well as for administering the NFIP. FEMA collects data over time, typically starting immediately following a flood until several years after the event. This data includes insurance claim information and actual repair cost information. FEMA also collects data to assess Individual Assistance and Public Assistance, two of the agencies' recovery focused programs. During Federally declared disasters, FEMA administers a Damage Survey Report based on requests for public assistance for repairs that includes some information on flood losses. However, the actual costs associated with projects and repairs following an event are not calculated until projects are completed, which can take four to five years.

FEMA also collects information to support Initial Damage Assessments, which are estimates of physical damages following an event provided by local officials, and Preliminary Damage Assessments, which are broad estimates developed based on site visits conducted by FEMA personnel. Individual Assistance Data collected by FEMA is typically utilized by the HUD as well as information from the American Housing Survey that similarly tracks insurance coverage and repair costs. In this respect, HUD does not seem to directly conduct flood loss data collection efforts.

Some agencies within DOI collect data for specific storm event(s) following one-time data requests. This differs from agencies such as FEMA, USACE and TVA. The National Park Service (NPS), FWS and the FWS National Wildlife Refuge System collect data for particular events upon request; data collected includes information on cost to repair or replace structures or infrastructure; to ameliorate impacts, such as demolition or debris removal; or, less often, to rehabilitate or enhance habitat to replace lost functions. This data does not reflect value of losses in the same way other agencies' data does. DOI also does not collect data on staff resources for response and recovery or the value of lost habitats.

Freshwater flood loss data collected by the NWS are compiled by the 122 Weather Forecast Offices across the United States and its Territories. Flood loss data includes flood fatalities and flood damages to a) private property, including structural damage and lost agriculture; and (b) public infrastructure and facilities. Each Weather Forecast Office can obtain flood loss data from emergency managers, the U.S. Geological Survey, the U.S. Army Corps of Engineers, power utility companies and newspaper articles. In the event that a direct number cannot be obtained from these sources, the Weather Forecast Office uses a guideline of storm damage estimates to produce their own estimate. These estimates are compiled nationally and quality controlled to produce a national summary. Meanwhile, NRCS, within USDA, collects flood loss data based on dollars used to assist with repairs to mitigate flood damage. Much agency practice to collect flood loss data varies as does the use of this collected data. Differences in data collection efforts are clear and demonstrate the subsequent differences this data collected is used for among agencies.

### **1.3 Use of Collected Data**

As mentioned, agencies efforts to collect and use of data in reference to flood losses has a great deal of variation. Similarly to the differences in data collected, differences also exist in how that information is applied agency to agency. For instance, both TVA and USACE collect data on damages prevented by their projects during floods. However, their uses of this data are slightly different. TVA uses such data to evaluate the effectiveness of the flood damage reduction operations of their reservoir system and to help communities evaluate potential flood damage reduction projects and to plan for evacuations. USACE performs analysis to determine flood damages prevented by its projects by comparing actual operations of USACE infrastructure to the without-project conditions. USACE produces a report to Congress every

year on riverine flooding. Using data in this way is intended to develop an annual report to the U.S. Congress on system performance in order to inform future budgets and decisions.

Data collected by FEMA is used to calculate assistance provided to communities that have suffered losses. Data also informs and improves accuracy of the agency's Flood Insurance Rate Maps (FIRMS), community training needs and mitigation opportunities, and decisions made as to where personnel are most needed.

HUD does not seem to collect its own data as much as it uses data collected by FEMA for its Individual Assistance Program in order to inform funding for HUD's Community Development Block Grant Disaster Recovery (CDBG-DR) allocations. Allocations are also based on data from the Small Business Administration's disaster loan programs, which HUD uses to identify the areas of greatest need and regions impacted by an event, such as with Hurricane Sandy.

DOI collects data in limited circumstances that is then used to inform budget requests to fund rebuilding or restoration efforts. These storm damage repair estimates are collected by the NPS and FWS for major storm events such as hurricanes where it may be more likely that a near-term supplemental budget would be appropriated. Data on storm damages is primarily utilized by DOI to inform budget requests and some local level resilience planning. DOI also employs data on sea level rise for its five-year conservation plans to avoid future flood losses developed for the National Wildlife Refuge System.

The U.S. Federal agency with the most direct charge to conduct flood loss data collection is the NWS, which gathers data related to flood losses using its many field offices to provide estimates of total freshwater flood losses on an annual basis. Within the NWS Hydrology Program, this data is used to track the socio-economic impact of flooding. The annual figures are also delivered to the USACE who uses this data to prepare their annual report to the U.S. Congress. The agency's primary mission is to provide forecast and warning for events that may lead to fatalities and damage. It is worth noting that the estimates provided by the agency on flood losses should be considered estimates of direct flooding and that challenges exist in both the collection of flooding impacts as well as the in the process used to estimate fiscal damages of these impacts. The differences evident in agency collection and uses discovered as a result of FIFM-TF efforts are discussed in more detail in the following sections.

## **2. OVERVIEW OF FEDERAL INTERAGENCY MEETING**

The FIFM-TF took an interest in understanding the current status of flood loss and damage data. Specifically, the FIFM-TF recognized the challenges and shortcomings associated with the current approach to collecting, tracking, and using data and the potential benefits that could be provided with improved data. The FIFM-TF acknowledged that trying to understand the current status of flood loss data collection and identify approaches to improve the available flood loss data in the United States would be a significant undertaking since many agencies do not collect the same types of data as a result of variation in agency defined missions. However, the group believed that it was important to take this activity on, and as soon as possible, given the fact that current trends suggest the United States is experiencing increasing losses due to flood events (Bond, 2013; Smith and Katz, 2013). Further, it was believed that this activity could identify specific opportunities to improve flood loss data and advance our understanding of the true extent of flood losses in order to inform future decision making and investments.

Thus, the FIFM-TF incorporated an activity on this topic into their work plan. The purpose of this activity is to "assess flood loss data collected by various agencies and to identify areas for improving the collection, dissemination, and understanding of these data by interested parties" (FIFM-TF, 2013). As a first step to this activity, the FIFM-TF Working Group hosted a one-day interagency working meeting for representatives of the FIFM-TF agencies to gather to discuss their agency's collection and use of data. Several representatives of USACE, FEMA, NWS, NRCS, and FWS participated in this meeting. Topics of discussion during this meeting included the definition of flood loss, the benefits that could come from improved data, a review of the experience of collecting data on the losses and damages due to Hurricane Sandy, reports from each agency on their collection and use of data, gaps and overlaps in the current approach, and opportunities for improvement.

## 2.1 Categories of Flood Costs

Categories of flood costs can include both direct and indirect costs associated with flood losses. The categories identified by FIFM-TF include many discussed by Bond (2013). Direct costs of flood losses can include private property including buildings and contents; crops and agricultural damages; public infrastructure and facilities; and loss of life.

A second category of flood costs are based on indirect flood losses. These can include efforts for prevention and protection such as flood preventative infrastructure, and development and testing of evacuation plans. Mitigation efforts are other activities categorized as indirect costs related to flood losses, as well as response and recovery activities. Response activities include emergency response equipment and personnel; flood fighting tools and equipment; and dewatering efforts. Loss of production, loss of jobs, and business interruptions are categorized as indirect costs associated with recovery efforts. Two additional areas considered as indirect costs associated with floods are any environmental damages and loss of ecosystem services, and social impacts such as long-term mental and physical human health and diseases.

Certain areas in the categories as defined align with U.S. Federal agencies' missions. For example, indirect costs associated with personnel to conduct flooding fighting or emergency response activities aligns with FEMA's mission areas. Direct costs align with USACE and TVA missions and data collection activities in that they focus on losses associated with infrastructure and facilities. However, while these categories align with certain agencies' missions, they do not necessarily correlate with data collection practice in all cases, nor is there any assurance that data collected relating to these categories is accurate or aggregated to consider an actual estimate of flood losses for the nation. These challenges will be discussed in greater detail in the following sections.

## 2.2 Challenges and Limitations Associated with Collected Data

The interagency working meeting revealed a number of challenges and limitations associated with the current approach to collecting data and with the data itself. The discussion revealed early on the lack of a uniform or consistent definition of flood loss. Each agency defined flood loss slightly differently, depending on their missions and authorities. This increases the challenge of understanding the true flood loss when the Federal government agencies do not necessarily mean the same thing when they refer to flood loss. It can also be inferred from this discussion that state and local governments may also have varying definitions of flood loss, further complicating efforts to develop a more comprehensive understanding of flood losses in the country. Differences in definitions of flood loss may also hinder the ability to share collected data across agencies.

In addition to the fact that all agencies may be collecting and tracking slightly different data on flood losses, for instance direct losses by NOAA, direct loss to insured buildings by FEMA, and losses avoided by USACE, there is no central standard for data collection, each agency has their own method used in collection efforts. Nor is there a central repository for data collected, meaning a comprehensive compilation of all the data that is collected related to flood losses by the Federal government does not exist (Gall *et al.*, 2009). In some cases, there is not even a standard process in place to collect, use, and report data within different offices of a single Federal agency. Additionally, the process to finalize calculations of flood loss or damage from an event is typically extensive. It can take between 15 months and several years to determine the losses and damages that can be attributed to a specific event. This long time lag means that estimates are often released early in the recovery process, before a full understanding of the flood losses has been developed, and those estimates become the accepted truth regarding flood damages and losses, though in fact those initial estimates may be inaccurate and in need of further refinement over time.

NOAA's NWS has the most comprehensive source of data on loss events, but reporting this data after an event has occurred is not the primary mission or focus of the NWS. The primary mission of NWS is to provide forecasts and warnings, rather than flood loss data collection, tracking, or reporting. As the NWS works in collaboration with partners to affect a *Weather Ready Nation*, the continued collection and

documentation of losses will support future impact based decision support services. However, challenges still remain in ensuring consistency and completeness in collecting fatality and impact data as well as assigning monetary value to determine loss. The NWS field offices are well positioned to work with partners in the local community to document the impacts of a flood in terms of height or water, inundated structures, damaged or destroyed vehicles, and damaged or destroyed municipal infrastructure. However, significant challenges remain in assigning a monetary value to these flood impacts. While other agencies collect data for their specific purposes, they do not always share or report on the data they collect. For instance, the Department of Defense does collect data on flood impacts to military facilities; however, this information is rarely released to the public, and usually not included in government-wide flood loss estimates. Additionally, given the size of the organization, the data is disaggregated through the military services and difficult to access without significant efforts.

There are also significant challenges associated with the type of data collected by individual agencies and the circumstances under which each agency collects data. For instance, not every Federal agency collects data for every flood event. Many Federal agencies have certain thresholds which an event must exceed before the agency will collect data. As an example, FEMA collects data for many flood events, but the most detailed level of data is collected only for presidentially-declared disaster events. It was also determined that not all of the data initially collected after a flood event is retained for further use. For instance, immediately after a flood event, FEMA may collect data on losses and damages from many people, and then, upon further analysis and investigation, discover that some of those people are not eligible for assistance from FEMA. In these circumstances, data collected from people not eligible for assistance is typically discarded, as it is not relevant to FEMA's mission and needs at the time.

There are multiple physical aspects of flooding that influence how Federal agencies collect and track data. For instance, many agencies view freshwater and coastal flooding very differently. Many agencies collect freshwater flooding data only. Though NWS does collect data for both freshwater and coastal flood events, these events are categorized separately, so the data is considered and reported separately. This may hinder the ability of other Federal agencies, policy and decision-makers, and the general public to fully grasp the magnitude of flood losses and damages experienced across the United States. Additionally, during flood events, there are frequently other factors, such as wind, that accompany the flood and could be responsible for some damage. It is typically very difficult to distinguish between damage or loss due to the flood waters versus due to the accompanying wind.

Flood losses and damages can occur in many categories, and some of these categories are much easier to quantify than others. Direct, physical damages to structures or property, for instance, are typically fairly easy to quantify; however, job loss or lost revenue due to the effects of a flood event are more difficult to quantify, especially at the level of the Federal government. It was very clear from this discussion that the Federal government currently tracks only a fraction of the true costs associated with flood events. The discussion suggested that most Federal agencies have the highest degree of participation in collecting and assessing what was characterized as direct flood loss data. Figure 1 illustrates the distinction between direct flood losses and the total cost of flooding developed by the interagency working meeting participants.

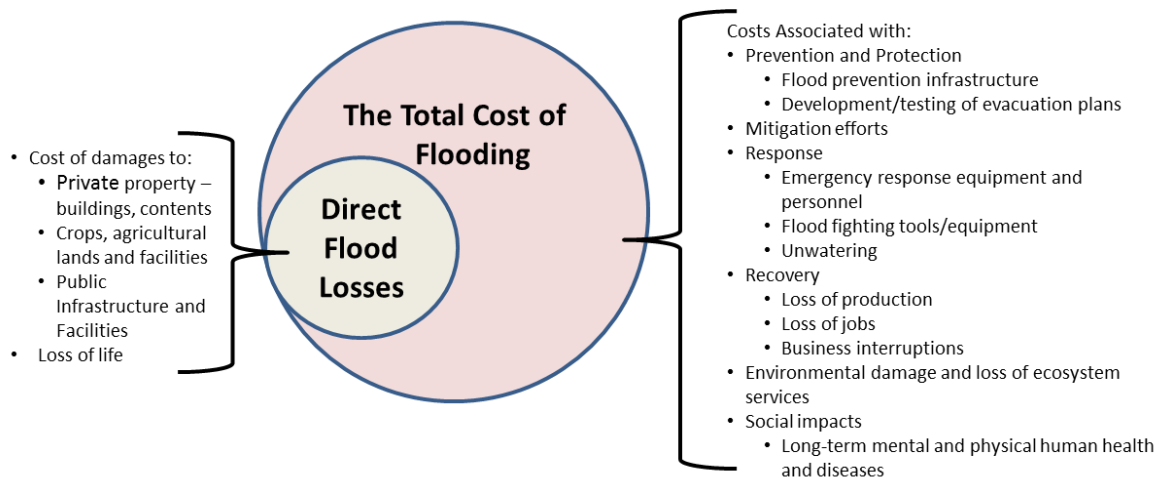


Figure 1. Classification of Direct and Total Flood Loss Data

### 2.3 Opportunities for Improvement

The discussion during this interagency working meeting revealed several opportunities for improvement in the current system of collecting and tracking flood loss data. Participants did believe that there was value in continuing efforts to improve the collection, tracking, and understanding of data on flood losses. One such opportunity related to the definition of flood loss. It was generally not believed that it was necessary to develop a uniform or consistent definition of flood loss to be used by all the agencies because of the different needs of each agency; however, it was suggested that there could be value in at least understanding what different agencies do and do not consider in their definitions of flood losses. This would allow Federal agencies to communicate more transparently and effectively on this topic, and would likely aid in making comparisons and drawing conclusions based on data collected by different agencies.

Another opportunity for improvement was identified in how the Federal government communicates about the data that is collected. Specifically, the need to be more clear about which components of flood loss the Federal government is and is not able to collect and track was noted. As illustrated in Figure 1, there are numerous components of total flood loss estimation which are very difficult to quantify at all, and certainly would be difficult for the Federal government to collect data on. The interagency working meeting participants felt that it was important that the Federal government communicate very clearly the significant amount of the total cost of flooding that is not being quantified currently.

During the discussion, it was identified that several agencies, including FEMA and NWS, interact with state and local government officials frequently in obtaining initial damage assessments. However, it was noted that there typically is not any guidance, template, or standard process used in this initial outreach. Further, in many cases the Federal agency representatives do not have adequate training on economic impact data. This leaves room for variability in the data that is collected from one event to another and it also may lead to repeated requests to the same state or local government officials for initial damage assessments from different Federal agencies. This can be an inefficient use of resources at both the Federal and state or local government levels.

### 2.4 Benefits of Improved Data Collection and Tracking

Participants at the interagency working group meeting identified a number of potential benefits that would come from improved collection and tracking of flood loss and damage data. These benefits will be used to assist in supporting proposed next steps. Several of the benefits identified relate to use of resources more efficiently. In particular, it is believed that improved processes for data collection, developed in a coordinated manner across relevant agencies, could save resources on data collection efforts by consolidating data collection efforts by each agency, reducing duplication of collected data, and



leveraging existing efforts. It is also thought that having improved information about actual flood damages could help drive improved scientific study, as well as identify areas where scientific and modeling capabilities most need improvement by providing additional information to use in verifying model performance.

Also identified were a number of ways that improved flood loss data collection and use could improve prioritization of investments and development of policies to improve flood risk management in the U.S. First, improved data about the true costs of and losses due to flooding would assist the Federal government in making a stronger business case to prioritize where flood risk management resources could most effectively be utilized. It has also been suggested that an improved understanding of flood losses could provide a baseline condition against which to assess and evaluate various flood risk management and mitigation policies (Gall *et al.*, 2009). Further, improved data could possibly provide more information about the geographical locations where losses occurred most frequently, helping to identify the regions and types of resources that were most vulnerable to flood events. Finally, it was identified that more information about the true costs of flood events in the U.S. could allow for and inform the development of more appropriate policies that could assist in reducing or avoiding future flood costs.

On a similar note, it was believed that more accurate information about flood losses and damages could help change the national perspective on flood events. First, because it is believed that current methods underestimate the cost of flooding by at least an order of magnitude, having more accurate flood loss data may prompt additional interest and attention to the nation's flood risk. In particular, key policy and decision makers at all levels of government may begin to think differently about how the nation manages flood risk in order to better reduce future losses and damages. This may also lead to more interest and attention from both the general public. Specifically, having more accurate and timely information available about fatalities and other serious quality of life impacts due to flood events may lead to a more comprehensive understanding of the severity of flood events. This information would be important for the general public and all decision makers to understand, and could lead to changed behavior in areas at risk of flooding. Based on these identified benefits, the participants of the interagency working meeting did feel that there was a need to continue to work together to improve our efforts to collect, understand, and use flood loss and damage data.

### **3. PROPOSED NEXT STEPS**

Though improving our understanding of flood loss data is a significant undertaking, there are several smaller next steps that have been proposed to begin the improvement process. The first step to be taken includes an assessment of Federal agency expenditures related to flood events over a period of ten years. This first step will provide a better understanding of the magnitude of Federal spending due to floods, which may be used as an initial surrogate for flood losses or damages, as many Federal agencies and programs provide compensation in some way for flood losses or damages to businesses, individuals, and/or communities. This will certainly not approximate the true cost of flooding to the U.S. as there are many types of costs, damages, and losses that are borne by the individual or by local or state governments rather than the Federal government, and there are many categories of losses that cannot easily be quantified at this time. Further, as an initial step, this effort will not fully capture the Federal expenditures related to flood events because, at least initially, only the Federal agencies participating in the FIFM-TF will be canvassed. This will result in an understanding of many, but not all, sources of Federal expenditures due to flood events. Most of the Federal agencies with missions related to flood risk or floodplain management participate with the FIFM-TF; however, there are several key agencies that provide funds and assistance after flood events that do not participate in FIFM-TF.

The next potential step suggested was to seek additional sources of data that might provide valuable information on the nation's flood losses. For instance, after Hurricane Sandy, and frequently after other significant flood events, a great deal of information was collected and publicized about damages, losses, and impacts to the Atlantic Coast. Some of the sources identified in this review, especially those outside the usual purview of the Federal government, might well provide very useful information, especially on aspects of flood losses and damages that the Federal government is not easily able to track. Thus, the

sources identified in the review after Hurricane Sandy, and possibly similar sources identified after other recent significant flood events, should be reviewed and incorporated into the process of collecting and using flood loss data.

The review of the processes used to collect data by each Federal agency on flood losses revealed several possible areas of overlap as well as several gaps in the type of information collected. A possible next step would involve development of improvements to refine and enhance the data collection process, ideally to limit the overlap between Federal agency efforts as well as to fill the gaps identified. For instance, one shortcoming of the current process identified was the limited training available for both Federal agency employees and the state and local officials that provide much of the information on flood losses and damages. If additional training on topics related to the collection and use of this data were developed and provided, it may significantly improve the quality and consistency of data provided. This evaluation should also attempt to identify opportunities for leveraging of resources and efforts between the various Federal agencies.

#### **4. CONCLUSIONS**

In the United States, there is no single Federal agency that is responsible for flood risk management. Further, there is no single Federal agency that is responsible for collection or tracking of data on flood losses or damages. Instead, each Federal agency collects data after flood events occur in response to their own missions and needs. These data collection efforts are typically not coordinated across the Federal government, which can lead to inefficiencies. Additionally, because flood risk management is a shared responsibility across multiple levels of government, some responsibility for collecting and tracking flood loss or damage data falls to state and local government agencies. The number of different parties involved in flood risk management and collection of flood loss data can make it difficult to develop a comprehensive understanding of the flood losses and damages in the United States.

The FIFM-TF has identified this as a topic of interest that could result in improved flood risk management processes and policies for the nation. To obtain a better understanding of flood losses in the US, the FIFM-TF has brought together an interagency group to discuss the collection and use of flood loss data across the Federal government. This group has identified a number of benefits that could come from improved understanding of flood loss in the US, and proposed several steps that could be taken in the short and long term to improve our efforts to collect, track, and use this type of data. The group will continue to refine these proposed next steps to further improve our understanding.

#### **5. REFERENCES**

Bond, L.A., 2013: *Federal Flood Policy: The Cause of Flood Disasters in the U.S.* LA Bond Associates, High Rolls, NM, U.S.

Frequently Asked Questions About TVA. (n.d.). *TVA: Frequently Asked Questions About TVA*. Retrieved April 30, 2014, from <http://www.tva.com/abouttva/keyfacts.htm>

Federal Interagency Floodplain Management Task Force (FIFM-TF), 2013: *Federal Interagency Floodplain Management Task Force Work Plan*. Retrieved on April 26, 2014 from <http://www.fema.gov/floodplain-management/federal-interagency-floodplain-management-task-force>

Gall, M., Borden, K.A., and Cutter, S.L., 2009: "When Do Losses Count? Six Fallacies of Natural Hazards Loss Data" *Bulletin of the American Meteorological Society* 90:6, 799-809.

Pielke, Jr., R.A., M.W. Downton, and J.Z. Barnard Miller, 2002: *Flood Damage in the United States, 1926-200: A Reanalysis of National Weather Service Estimates*. UCAR, Boulder, CO, U.S.

Smith, A.B. and Katz, R.W., 2013: "US billion-dollar weather and climate disasters: data sources, trends, accuracy, and biases" *Natural Hazards* 67:2, 387-410.