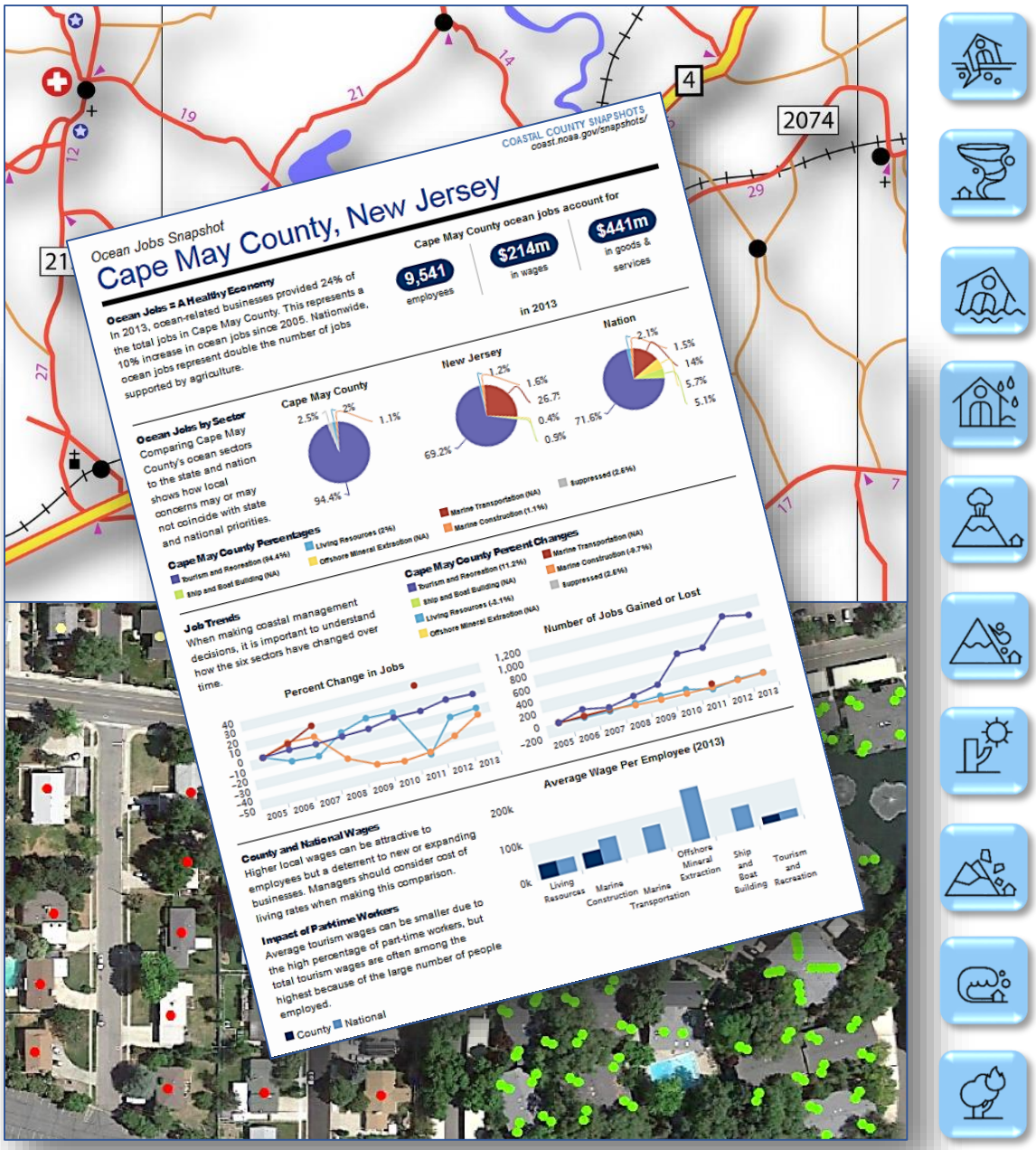
# The Role of Geospatial Data and Technologies

## In the Continuum of Natural Disasters





NSGIC
National States Geographic Information Council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# Endorsements

The following organizations have endorsed this publication and plan to distribute it to their respective memberships. As they are provided, additional endorsements will be added to this page.

Association of State Flood Plain Managers (ASFPM)

National Alliance for Public Safety GIS Foundation (NAPSG)

National Association of Counties (NACo)

**Cover Images:**

1) A road centerline file with other physical features is in the background at the top.
2) Google aerial imagery licensed by the State of Utah is at the bottom with the State's Address Point data displayed on the rooftop of each structure.
3) The Coastal County Snapshot shown in the middle of the page turns complex geospatial data into easy-to-understand stories, complete with charts and graphs. This County Snapshot is from Digital Coast.
4) On the right side of the page are typical icons used to denote various natural disasters.

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## Executive Summary

Dealing with natural disasters is not strictly a function of emergency management agencies and the first responder community. Preparing for disasters begins with the day-to-day operations of all government agencies. By properly documenting, inventorying, and sharing their geospatial data, agencies will contribute positively to comprehensive disaster management efforts that help save lives and protect property. Additional benefits include cost savings, cost avoidance and improved interagency coordination. This report provides practical examples of these benefits.

Most government staff are not geospatial experts, nor are they experts in dealing with natural disasters. Instead, they are skilled professionals in many other disciplines that happen to use geospatial tools to improve their workflow. Geospatial experts from the homeland security, emergency management, and public safety communities created this document to assist these other professionals. Their goal is to encourage all government agencies to participate in comprehensive geospatial solutions for dealing with natural disasters that start with the planning process and go through the entire spectrum of government services.

Over the past 35 years, there has been a significant increase in the number of large natural disasters (~350%). They have sometimes devastated huge areas with epic intensities. Over the same period, geospatial technologies have matured to a point where they routinely help government agencies make better decisions in the planning, zoning, permitting, mitigation, and enforcement processes to minimize future losses from these events.

Sophisticated geospatial data sources (e.g. real-time weather data) are coming online on a daily basis and government agencies constantly create their own geospatial data to meet their particular missions. This report discusses how to document, inventory, and find these data to maximize their value. It also provides a guide to the types of data that are most important for each type of natural disaster and how to access open sources for these data. The data layers are broken into two lists. The first list in Appendix 3 identifies the types of data routinely used by all government agencies. These are the data layers that require effective sharing with other agencies and the public. The second list in Appendix 4 identifies the types of operational data that emergency management agencies and first responders use during a disaster event.

## Introduction

Two primary functions of government are to ensure the resiliency of local communities and the quality of people's lives. High quality geospatial data and technologies help government managers do this by allowing them to perform comprehensive analyses and provide increasingly better public services.

What is not always obvious is that nearly all government agencies are involved in a continuum of natural disasters that starts with the planning process and goes through the full spectrum of government services, including permitting, mitigation, enforcement, response, and recovery activities (see Figure 2). The geospatial data produced for those activities have a large number of 'downstream' uses related to disaster management. Planning, permitting, and public works agencies actually take the first steps in planning for and mitigating natural disasters. They are also directly involved in the recovery phase of large incidents. They accomplish their work through the application of appropriate laws, regulations, and best practices. They also apply national and local building codes and construction guidelines to minimize losses caused by natural disasters.

The emergency management and public safety communities typically carry out response and recovery phase activities. However, they often require assistance from other agencies like public works, health, natural resources, agriculture, and environment, which often provide expertise and other resources, including staff. To reduce duplication and waste, it is critical that all of these agencies freely exchange their properly documented geospatial data in standardized, open formats with all other levels of government and the public.

Agencies can also obtain geospatial data and tools from many public resources. In the following sections, this document identifies some of the most significant sources of public data and tools. It also provides the rationale for collaborating on data production, and explains the benefits of documenting, inventorying, distributing, and licensing data.

## What is the Continuum of Natural Disasters?

Planning, Mitigation, Response, and Recovery are the four generally recognized phases of emergency management. Most government staff are not geospatial experts, or experts in dealing with natural disasters. Instead, they are professionals in many other disciplines that happen to use geospatial tools to improve their workflow. Geospatial experts from the homeland security, emergency management, and public safety community wrote this document to assist these professionals, and to encourage them to become part of a complete solution when dealing with the continuum of natural disasters.

The photograph on the next page demonstrates the result of the entire government process at this location, and for this timeframe. The process did not ensure the public safety and welfare at this location and there are negative environmental consequences. This homeowner's well and septic system are at risk. They will also face structural problems, mold, and other health issues in the future unless they make significant repairs and modifications. Homeowners in this situation have unexpected living expenses during their evacuation, and the public safety community expends precious resources to evacuate and assist the homeowners at the taxpayer's expense. In addition to the above expenses, there are other public costs like increased insurance rates. Finally, the tax dollars diverted to disaster response and recovery programs can have profound effects on the national economy.

**Figure 1.** This flooded home is an undesirable result.
Source: http://massrealestatenews.com/

While this particular storm may have represented a record-breaking event 20 years ago, the new reality is that records are being broken with ever-increasing frequency and severity. This result began with the planning and zoning process, continued through the permitting process, and finished with the disaster response and recovery phases. This cycle will repeat until we effectively deal with the overall process shown in Figure 2.

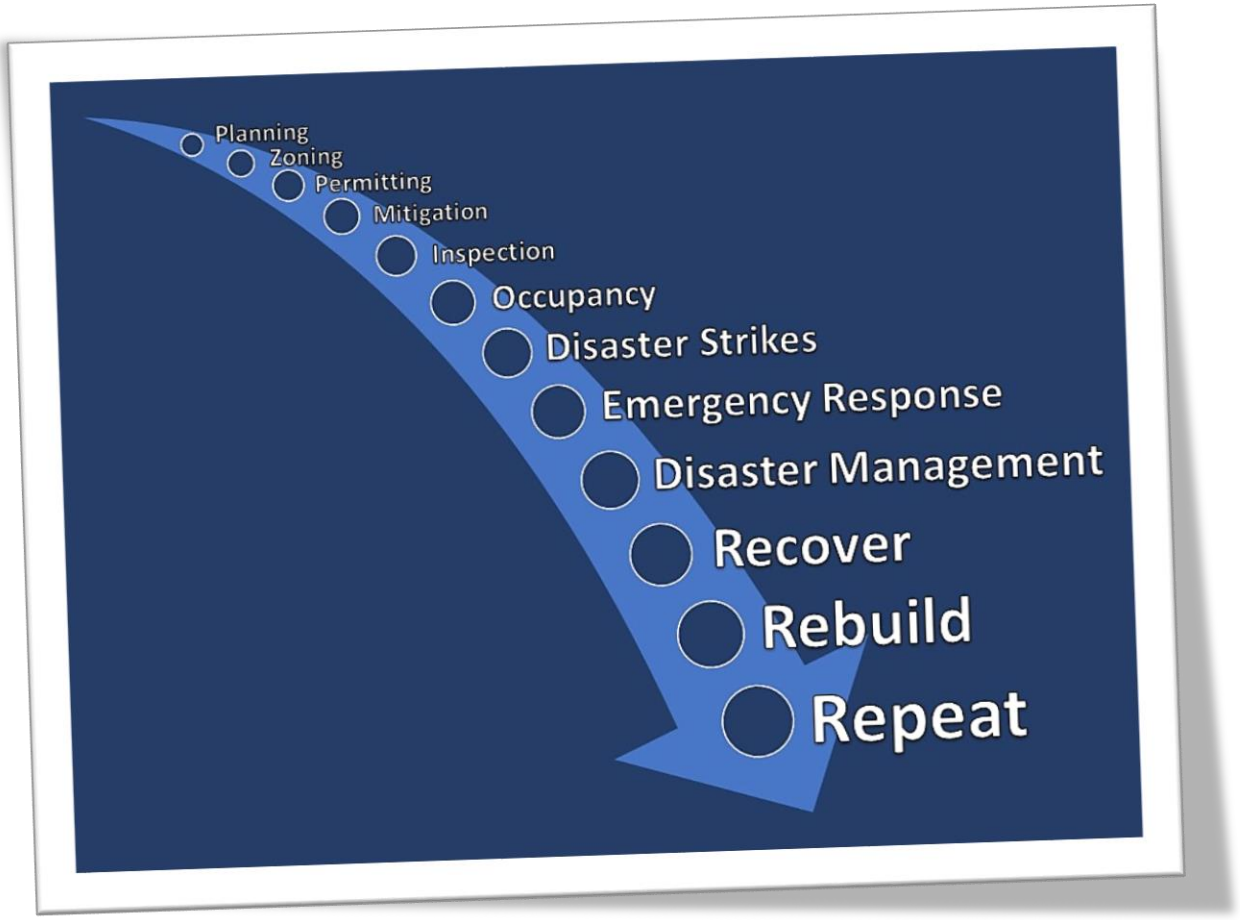


**Figure 2.** The Continuum of Natural Disasters.

## Why is this an Issue?

The United States sustained 188 weather and climate disasters between 1980 and 2015 where the overall damages and costs reached or exceeded $1 billion (including CPI adjustment to 2015) [1]. The total cost of these 188 events exceeded $1 trillion. We will take a close look at the numbers from 1980 through 2014 because the actual 2015 losses were not fully reconciled at the time of this report. The average economic loss per incident was $6.97 billion during this period, with the single highest loss being Hurricane Katrina at $152.5 billion. The average number of deaths per year is ~267 over this period with Hurricane Katrina having the highest single incident death toll of ~1,833 people. Incidents equal to or greater than a $1 billion loss were grouped in 5-year intervals in the chart below to demonstrate the dramatic increase in these trends.

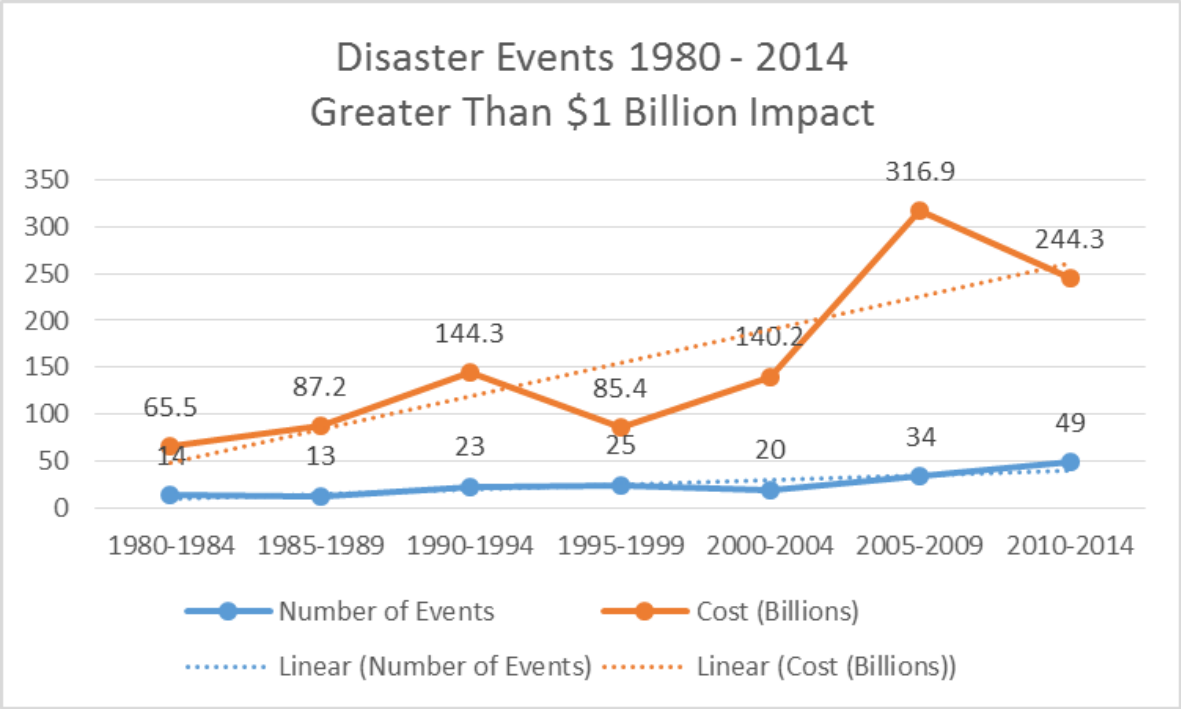


**Figure 3.** Disaster events from 1980 to 2014 with costs greater than $1 billion dollars.

Looking beyond the economic losses and the number of incidents identified above, the source data classify 24 of these disasters as drought-related and they account for 2,896 deaths. The collective planning, mitigation and response efforts were not adequate to prevent this large number of deaths for these long duration incidents. By contrast, it is much easier to understand the deaths associated with high energy, short duration incidents like tornados.

[1] http://www.ncdc.noaa.gov/billions/

To make these trends level off or reverse, government agencies and the public must work together to more effectively plan for and incorporate potential weather, climate, and geologic events into their decision-making process. Improving existing geospatial data and creating new types of geospatial data are critical first steps to help improve our understanding of these events. A good way to start is by reviewing the impacts and trends expected from climate change. The most authoritative information is the "*Our Changing Climate"* report (2014 National Climate Assessment) by the U.S. Global Change Research Program found at http://nca2014.globalchange.gov/. A Federal Advisory Committee guided the development of this report. The public and other experts, including a panel from the National Academy of Sciences, also reviewed the report.

Other valuable sources of information include the following web resources:

- *States At Risk: America's Preparedness Report Card,* prepared by Climate Central and ICF International, http://statesatrisk.org/.
- Climate Central web page at http://www.climatecentral.org/.

## Which Data are Most Important for Dealing with Natural Disasters?

After reviewing similar efforts to identify the types of data that are important for disaster management, the members of NSGIC's Geospatial Preparedness Committee and Resiliency Task Force created the matrix of *Data Layers by Event Type* found in Appendix 3. Their goal was to highlight the data layers routinely produced by local, regional, state, tribal, and federal agencies that are also useful when dealing with natural disasters. Appendix 2 explains the methodology used to create the data layer matrix, and provides a key to the national sources for these data found in the last column of the matrix. These sources should prove to be useful for all agencies, but particularly for those agencies with fledgling GIS programs.

The data in Appendix 3 should be the focus of existing and future partnerships to develop and maintain them. This does not mean that only these data layers are important or that you must have all of these data layers to effectively deal with natural disasters. Appendix 3 simply identifies the layers that agencies should share freely because they have great value to those individuals dealing with natural disasters. To help ensure that these data are considered as authoritative data, agencies should also prioritize them for production and maintenance through federal, state, tribal, and local partnerships.

Emergency managers and first responders routinely use the data found in Appendix 3 as they respond to and manage incidents. They also use operational data that typically represent real time 'status' information as an event unfolds (e.g. road closures and shelter capacities). Appendix 4 lists these data layers separately to avoid confusion with the data used on a daily basis by most government agencies.

## Documenting, Inventorying, and Finding Data

There are several ways to catalog and retrieve the relevant information (aka metadata) about geospatial data. They include both the manual and automated methods of cataloging found in many of the leading software packages. Metadata creation should adhere to one of the two most common standards from either the International Organization for Standardization (ISO) or the Federal Geographic Data Committee (FGDC) respectively known as ISO 19115-1 or the Content Standard for Digital Geospatial Metadata (CSDGM). However, JavaScript Object Notation (JSON) formats are becoming increasingly popular with open data efforts.

Each agency has its own method of cataloging and discovering geospatial data. Some legacy systems that are not standards-based may only meet internal purposes. Access to their information is dependent on the ability of the public to locate and navigate them due to their unique presentation of information. Open Data Portals and Data.Gov are much better solutions that make information easily discoverable.

Many excellent national and regional systems allow one to easily inventory, find, and share geospatial data. The following platforms can provide discovery and/or access to required geospatial information and tools.

**Data.Gov** – http://www.data.gov/

The U.S. General Services Administration, Office of Citizen Services and Innovative Technologies manages and hosts Data.gov. Data.gov follows the Project Open Data schema – a set of required fields (Title, Description, Tags, Last Update, Publisher, Contact Name, etc.) for every data set displayed on Data.gov. Under the terms of the 2013 Federal Open Data Policy, newly generated government data are required to be available in open, machine-readable formats, while continuing to ensure privacy and security.

**Geospatial Platform** - https://www.geoplatform.gov/

The GeoPlatform provides shared and trusted geospatial data, services, and applications for use by the public, and by government agencies and partners to meet their mission needs. Through the GeoPlatform, users have access to:

- A one-stop shop to deliver trusted, nationally consistent data and services
- Authoritative data to support informed decision making
- Problem-solving applications and services that are built once and can be used many times across multiple Federal agencies and other organizations
- A shared infrastructure to host data and applications
- A national and Federal focal point where governmental, academic, private, and public data and applications can be visualized together to inform and address national and regional issues

**DHS Homeland Security Information Network** – https://www.dhs.gov/homeland-security-information-network-hsin

The Homeland Security Information Network (HSIN) is the trusted network for homeland security mission operations to share *Sensitive But Unclassified* information. Federal, State, Local, Territorial, Tribal, International and Private Sector homeland security partners use HSIN to manage operations, analyze data, send alerts and notices, and in general, share the information they need to do their jobs. For more information about HSIN, please contact HSIN.Outreach@hq.dhs.gov.

**HIFLD Open Data** - https://hifld-dhs-gii.opendata.arcgis.com/

This website provides national foundation-level geospatial data within the open public domain that can be useful to support community preparedness, resiliency, research, and more. The data are available for download as CSV, KML, Shapefile, and are accessible via web services to support application development and data visualization

**NOAA Digital Coast** – https://coast.noaa.gov/digitalcoast/

This NOAA website focuses on helping communities address coastal issues and has become one of the most-used resources in the coastal management community. The dynamic Digital Coast Partnership, whose members represent the website's primary user groups, keeps the effort focused on customer needs. Digital Coast is a significant source for data, applications (tools), and training.

**NOAA nowCoast** – http://nowcoast.noaa.gov/

nowCOAST is a GIS-based web mapping portal displaying near real-time observations, analyses, tide predictions, model guidance, watches/warnings, and forecasts for the coastal United States. nowCOAST provides situational awareness on present and future environmental conditions for coastal and marine users by integrating data and information from across NOAA, other federal agencies and regional ocean and weather observing systems. For example, users can assess present conditions by creating maps of the latest in-situ weather/marine weather observations, weather radar reflectivity mosaics, cloud images from satellites, surface wind and sea-surface temperature analyses, and precipitation amounts for the last few hours. In terms of future conditions, users can obtain maps of critical weather and marine weather advisories, watches, and warnings, weather forecasts, tropical cyclone track and intensity forecasts, and forecast guidance of water levels, temperature, salinity, and currents from oceanographic forecast models.

**GIS Inventory** – https://www.gisinventory.net/

The GIS Inventory, maintained by the National States Geographic Information Council (NSGIC), is a tool for the entire GIS Community. Its primary purpose is to track data availability and the status of geographic information system (GIS) implementation in state and local governments to aid the planning and building of statewide spatial data infrastructures (SSDI). The GIS Inventory allows registered users to manually document their geospatial data, or automatically harvest their metadata catalogs based

on national standards. The GIS Inventory also exposes this information to Data.Gov (below) which makes it available to the Geospatial Platform (below). The GIS Inventory only provides direct access to data through user provided links.

**State Clearinghouse Sites** - https://www.nsgic.org/clearinghouse-nodes

The Clearinghouse Network is a community of distributed data providers who publish collections of metadata that describe their map and data resources within their areas of responsibility, documenting data quality, characteristics and accessibility. The Clearinghouse Sites publicize the availability of data within the NSDI. Users can search the metadata in these nodes to assess the extents and properties of available geospatial data.

**Great Lakes Information Network** - http://www.great-lakes.net/

The Great Lakes Information Network (GLIN) is a partnership that provides one place for people to find information relating to the binational Great Lakes-St. Lawrence region of North America. GLIN offers a wealth of data and information about the region's environment, economy, tourism, education and more. Thanks to its strong network of state, provincial, federal and regional partner agencies and organizations, GLIN has become a necessary component of informed decision-making and a trusted and reliable source of information for those who live, work or have an interest in the Great Lakes region.

**NASA Global Change Master Directory** http://gcmd.nasa.gov/

The mission of the Global Change Master Directory is to offer a high quality resource for the discovery, access, and use of Earth science data and data-related services worldwide, while specifically promoting the discovery and use of NASA data. The directory includes data from multinational sources and contributes to scientific research by providing stewardship of metadata and direct access to Earth science data and services.

## Benefits of Partnering on Data Development and Licensing Data

There are several benefits derived from leveraging resources for the production or acquisition of geospatial data and its continued maintenance. They include:

- Collaborating with other agencies to reduce data production costs.
- Contracting for larger acquisition areas can reduce acquisition costs by 30% (and more) depending on the type of data.
- Working with a consortium of government agencies leads to the widespread recognition that the data are authoritative.
- Using data produced by others, or licensed from the private sector, can significantly reduce costs when appropriate.

The following testimonials demonstrate actual cost savings realized by the identified sources and other more generalized benefits realized by partnering on data development.

## Examples of Cost Savings from Partnering and Licensing

**1)** "In 2005 we spent $36,000 to acquire color imagery for 56 square miles. In 2012 we participated in the GeoLibrary Orthoimagery Acquisition Program and paid just $9,262.00 for color imagery and additional infrared imagery, we saved $26,738.00 and received a superior product."

***Source:*** *Brett Horr, GIS Manager, Town of York, State of Maine*

**2)** "MassGIS partnered with the Massachusetts NRCS state office and with the Maine Geolibrary and Maine NRCS state office on a successful grant proposal to the USGS for 3DEP funding. That partnership nearly doubled the project area. The grant budget was based on a cost of $250/square mile. Prior to that, I had been hearing of per square mile costs of up to $350/square mile. There's no way we would have seen the $250/square mile price for just our project area."

***Source:*** *Neil MacGaffey, PMP, Acting Director, MassIT- MassGIS, Commonwealth of Massachusetts*

**3)** "The Location Based Response System (LBRS) is a program where State and Local governments partner to build and maintain high accuracy (+/- 1M) road centerlines and field verified address points in a concerted effort to reduce redundant mapping activities, cut spending, and create greater efficiencies in government. The state provides funding to local government to support the increased cost of maintaining the data to the State's standard and local government provides ongoing maintenance and local knowledge to ensure the data is authoritative and current.

The LBRS has enjoyed financial support from the U.S. DOT, USGS, NTIA, DHS, the Ohio Department of Transportation, the Department of Administrative Services, and the County Engineers Association of Ohio. To date, 80 of the state's 88 counties are voluntarily participating it the program. Through these partnerships, Ohio has developed an authoritative multi-use transportation network that marries a fully routable transportation network and inventory of all roads that includes data elements to support NG9-1-1 and the State's Master Address File and Enterprise Geocoding Service. Data developed through this program are available to the public and regularly consumed by federal agencies as well as private industry.

Aside from improved service delivery and being better stewards of taxpayers' dollars, why should a county participate in the Location Based Response System (LBRS)? According to David Burgei, GIS Administrator for Fairfield County, Ohio, the County used LBRS data to identify and provide proper verification of 863 households previously overlooked by the U.S. Census Bureau. Including these additional households in the Census count means an

estimated $6 million in additional federal funding that is distributed to Fairfield County each year for programs such as Head Start, Community Development Block Grants, Low Income Home Energy Assistance Programs, school lunch and breakfast programs, and child support enforcement. To date the Census Bureau has incorporated LBRS data for 72 Ohio counties."

***Source:*** *Jeff Smith, OSDI Manager, Ohio Geographically Referenced Information Program, DAS/OIT, State of Ohio*

**4)** "Licensing high resolution aerials from Google was five times cheaper than Utah's most recent custom acquisition in 2012. The lower per unit cost and the funding partnership formed across 14 agencies enabled the expansion of Utah's 6-inch imagery footprint from 2.5% of the state's area to full statewide coverage."

***Source:*** *Bert Granberg, Director, Utah AGRC, State of Utah*

## Examples of Generalized Benefits

**1)** "When agencies share data, lives are saved and public offices become more efficient. Sharing data encourages collaboration among agencies, provides for informed decision-making and reduces redundancy of data production. Further, planning and policy groups become better informed, particularly in terms of emergency calls and disaster response. We can be proud that all 92 counties are now sharing their map data, a major milestone that will benefit all Indiana taxpayers."

***Source:*** *David Vice, Executive Director of the Indiana Integrated Public Safety Commission*

**2)** "This year's most measurable impact of open data comes from the Maryland Department of Planning (MDP). For over 20 years, MDP sold its property map products. In August, MDP made property datasets available free via its own website and MD iMap. In the few months since the release, MDP has documented a significant increase in the number of users obtaining property map products. From July 1, 2013, through and including June 30, 2014, MDP distributed approximately 1,275 Md Property View and FINDER Quantum (MDP's open source data solution) DVDs. In the 3 ½ months since these data were made publicly available via its download website, MDP has already distributed 3,269 county and Baltimore City datasets. That is more than twice the amount of data distributed during the entire previous year."

***Source:*** *The [Maryland] Council on Open Data Annual Report, January 9, 2015, The Honorable Martin O'Malley, Governor; The Honorable Thomas V. Mike Miller, Jr., President of the Senate; and The Honorable Michael E. Busch, Speaker of the House.*

**3)** "Noble County has benefitted from use of the 2012 State imagery in various ways. Our Assessor's Office uses the imagery to verify assessment values for property, especially for farm property and to verify new ponds and new structure locations. I've used the updated

2012 imagery for addressing and for locating new road centerlines and building outlines. Our Surveyor's Office uses the imagery for drainage checks and drainage projects. The Building Dept. and Plan Commission use the imagery for approving building and zoning requests. Finally, the updated imagery assists with site location maps printed for the Economic Development manager. We also have placed the imagery on our public GIS website, thereby benefitting the public. These uses show how we can save money by viewing the imagery instead of making trips out to the field.

Noble County Government has benefitted in many ways from the State Imagery/LiDAR program and I would be in support for the continuation of this valuable program."

***Source:*** *Steven J. Hook, GISP, GIS Manager, Noble County, State of Indiana*

## Data Sharing

After a disaster strikes, government agencies typically share geospatial data without restrictions, even when they previously restricted access to other agencies within their own political structure. Disasters provide a short window of time when all agencies realize they are working toward the same goals. In these situations, 'sneaker nets' and other methods are often employed to move data between agencies. Unfortunately, it is difficult for agencies to use geospatial data in a disaster situation unless they are familiar with the data and have routinely used or participated in exercises with those data. Given this reality, government agencies should pursue the following actions in the suggested order of priority.

### 1) Open Data Portals

Ideally, states and their local governments should move to adopt Open Data Portals and freely contribute their data for use by all agencies and the public. Consult with the individuals responsible for Homeland Security concerns about the appropriateness of public disclosure for any questionable data sets. A national guideline already exists for use in evaluating data layers for appropriate disclosure. The "*Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns"* found at the following link were developed in 2005 by the Federal Geographic Data Committee (FGDC) - http://www.fgdc.gov/policyandplanning/Access%20Guidelines.pdf. This document provides excellent guidance on restricting access to geospatial data and provides a decision tree with complete explanations for each step of the process.

### 2) Unrestricted Data Sharing

Each state and local government should implement Executive Orders or Legislation that require unfettered access to geospatial data for all government organizations. These efforts must cite the importance of effective data sharing in advance of a disaster to protect the public welfare. This process MUST involve executives at all levels of government at the outset, including municipal, county, regional, tribal and state authorities. Points of contact,

or data stewards, must be clearly identified to share data with Federal agencies as appropriate.

### 3) Data Sharing Agreements

Implementing effective data sharing agreements is the least preferred option because they can require excessive effort and time to implement. There are long-standing legal conundrums related to liability, courts of jurisdiction, and redistribution of data that create these problems. In addition, data sharing agreements typically need periodic updating to remain in force. Most GIS programs have constrained resources and simply do not have the time or staff to implement data sharing agreements.

### 4) Non-Sharing Environment

Not sharing data violates the spirit of open government and diminishes everyone's ability to protect life and property during natural disasters. It also leads to costly waste and duplication of effort. In 2004, NSGIC estimated that the production of select base map data (e.g. orthoimagery, parcels, elevation data, road centerlines, and major critical infrastructure features) would cost ~$1,700 per square mile as a national average. Approximately 1/3 of this amount ($570 per square mile per year) is required for continuing data maintenance costs. These numbers come with the following caveats:

- They were based on large-area contracting costs (lower costs) and generated in 2005. Some costs have actually gone down since 2005.
- In highly populated areas, the costs are much higher, and in very rural areas, they are lower.
- This is for an ideal situation where ONE entity produces data to meet the most demanding business requirements - typically for use by municipal and county governments.
- This cost estimate does not include many other high priority data layers.

Federal, tribal, state, regional, and local governments sometimes produce similar data to meet their individual business requirements, even when sharing the costs of the higher precision data would be much more cost effective. Where this situation exists, the taxpayer may be paying for the same data two or three times.

## Data Sharing Myths

Agencies work to meet their own missions, but they share common interests when they work together to effectively manage disaster situations. The following are three common 'myths' related to data sharing that still persist in some government agencies. They come from NSGIC's Geospatial Data Sharing – Guidelines for Best Practices. A 'reality check' follows each of the myths.

### Myth - "Organizations can pay for GIS operations through geospatial data charges."

Overhead costs associated with receiving and managing payments; bundling and delivering data; and follow-up support to consumers can be significant. Even when adequately monetized and factored into the charge, these costs represent staff hours that can be utilized more efficiently to conduct core agency business.

Perhaps more significant is the loss of the following data sharing benefits:

- Improved data quality as it is vetted, corrected and improved by the community
- Greater opportunities to leverage resources by partnering or building upon related data
- Reduced duplication of effort and competition for scarce funds
- Increased numbers of complementary data resources that may support your mission
- Respect for your organization as a valued data producer

### Myth - "Data cannot be shared in the interest of homeland security and personal privacy."

Critical infrastructure, though important to protect, is generally visible and easily identified and located. Imagery cannot be put 'back in the can' after being publicly availability for years. Government agencies must generalize and group personal information (e.g., individual health, economics, education, etc.) so that users cannot derive information about specific individuals. However, in most cases, limiting access to information that is visible, previously available, or significantly generalized does not protect the public. If data are too sensitive for public access, agencies can still produce and publish information about the data (i.e. metadata). Metadata describes the data without revealing sensitive information. Metadata simply allows scientists and other appropriate users of the data to discover its existence and follow the procedures designated in the metadata to request access to the data.

To aid agencies in assessing data sharing risks, The Federal Geographic Data Committee (FGDC) Homeland Security Working Group developed a decision-tree that balances security risks with the benefits of data sharing. The FGDC's "*Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns"* explains the importance of maintaining a free flow of government information and provides a detailed method for applying the risk assessment decision-tree. The document is available at http://www.fgdc.gov/policyandplanning/Access%20Guidelines.pdf.

### Myth - "If we share our data, others may misuse it or blame us for mistakes."

Public data support public business endeavors, and data sharing is an exercise in accountability, not a liability concern. Liability for reasonable data errors should not be a

concern for government agencies. The value of data sharing to both the provider and the consumer far outweighs any risk.

Good data documentation and well-drafted disclaimers and agreements will minimize data misuse and abuse. Providing data consumers with metadata that fully describes the data's intended purpose, completeness, accuracy, resolution, currency and use limitations, reduces the opportunity for misapplication and shifts the burden of appropriate use to the consumer. If geospatial staff work with their legal advisors to develop effective documentation, their geospatial product deliveries can clearly articulate responsibilities and liabilities for both the data provider and the consumer from the start. Such documentation need not be lengthy, complex or overly legalistic.

Data consumers can be required to assent to a warranty waiver before gaining access to the data. Assent may be as simple as checking an acceptance box on a web site. In other cases, a data provider may wish to consider the use of a more detailed agreement that clearly articulates the intended purpose and limitations of the data and the data consumer's waiver of all warranties in connection therewith. Such agreements limit liability, thereby increasing an agency's willingness to make the data more easily available.

Appropriate metadata, disclaimers, and agreements used as data management best practices will inform the consumer of any data limitations.

## Next Steps

Geospatial professionals, program managers, executives, and elected officials can protect the public's welfare and safety far more effectively by taking the following positive steps.

1) **SHARE** the geospatial data from your organization or jurisdiction with other levels of government and the public by using 'open' systems. Think about the enormous costs associated with geospatial data and the multipliers on those costs if other levels of government have to create the same data. Not doing this can lead to waste and duplication.
2) **PLAN** and **TRAIN** for the types of natural disasters that are most likely to strike your region and adapt your response based on these efforts. Then plan for the unexpected disasters. Planning and training efforts will uncover weaknesses in your plan and help to identify the types of data and capabilities needed to become more resilient.
3) **PARTNER** with other organizations to create spatial data products. Initially, it can be a challenge, but the rewards are great. Once various jurisdictions come together and overcome their issues (perceived or real), every future effort will become progressively easier. Developing trust is a difficult but rewarding process.
4) **GOVERN** a fair and sustainable process with others. If there are no mechanisms for governance, encourage their development. Working together to improve the quality and accessibility of geospatial data has great rewards.

5) **CONTACT** your State GIS Coordinator to get involved in statewide coordination efforts. (https://www.nsgic.org/state-representatives)
6) **COORDINATE** within your jurisdiction and with other levels of government. Get involved with the state's GIS Council, or learn more about its activities.

Good Luck!

## Appendix 1. Contributors to this Report

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- **Will Melville**, Senior GIS Analyst, Maryland Emergency Management Agency (State of Maryland)
- **Kenny Miller**, Deputy Geographic Information Officer, Department of Information Technology (State of Maryland)
- **Bruce Oswald**, Homeland Security Liaison (NSGIC)
- **Michael Ouimet**, Manager, Critical Information Systems, Department of Public Safety (State of Texas)
- **Jon Paoli**, GIS/Information Technology Specialist, Iowa Homeland Security and Emergency Management Agency (State of Iowa)
- **Nicholas Schmidt**, Chief, Science and Geospatial Division, Office for Coastal Management (NOAA)
- **Jim Sparks**, Geographic Information Officer (State of Indiana)
- **Phil Worrall**, Executive Director (Indiana Geographic Information Council, Inc.)
- **Demetrio Zourarakis**, Remote Sensing and GIS Analyst, Division of Geographic Information (State of Kentucky)

## Appendix 2. Methodology Used to Create the Data Matrices in Appendices 3 and 4

The panel of experts identified in Appendix 1 are from the emergency management and homeland security communities. They each have extensive experience in dealing with natural disasters.

After a literature search failed to identify a comparable product, the Expert Panel assembled the data matrices in Appendices 3 and 4 beginning with the following sources:

- Standard Operating Guideline (SOG) documents for Tornados, Coastal Storms, and Wildfires produced by the National Alliance for Public Safety GIS Foundation (NAPSG) which can be found at http://www.napsgfoundation.org/all-resources/standard-operating-guide-templates/.
- GIS Needs by Event Type Matrix produced by the State of Missouri for its Emergency Operations Center.
- Homeland Security Infrastructure Program (HSIP - now known as HIFLD Open and Secure). See more information at: http://www.dhs.gov/infrastructure-information-partnerships
- Incorporations from other efforts identified during the literature search.

The disparate data layer names from these sources were normalized and then entered into Appendix 3 using the overarching data categories from *ISO Standard 19115-1 Geographic Information – Metadata*, which is published by the International Organization for Standardization (ISO), Geneva, 2003. The members of the Expert Panel independently identified omissions and commissions. Then they reviewed the matrix as a group to make modifications and determine their concurrence with the results.

If individual data layers in Appendix 3 are available from public sources for the entire nation, the last column of the table will identify them using the following key. A "P" will follow the source if it provides partial but significant coverage.

1. **HIFLD Open Data** - https://hifld-dhs-gii.opendata.arcgis.com/
2. **NOAA Digital Coast** – https://coast.noaa.gov/digitalcoast/
3. **NOAA nowCoast** – http://nowcoast.noaa.gov/
4. **Geospatial Platform** - https://www.geoplatform.gov/

Finally, an asterisk (*) appears after each data layer name if that data layer is considered a high priority for managing natural disaster events

## Appendix 3. Important Data by Natural Disaster Event Type

| ISO CATEGEORY<br>Data Layer Name | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BIOTA** | | | | | | | | | | | | | | | |
| Fisheries Distribution and Habitat | | | X | X | | | | X | X | X | X | | X | | 2 |
| Flyways (Migratory Birds) | | | | X | | | | | | | | | X | X | 4 |
| Vegetation Maps | | | X | X | X | X | | X | X | | | | | | 2P, 4 |
| Wildlife Species Distribution and Habitat | | X | X | X | X | X | X | | | X | | | X | X | 2P, 4P |
| Endangered Species | | X | X | | | X | X | X | X | X | X | | | | 1P, 4 |
| **BOUNDARIES** | | | | | | | | | | | | | | | |
| Evacuation Assembly Areas | X | X | X | | | X | X | X | X | X | X | | X | | |
| Evacuation Zones | X | X | X | | | X | X | | X | X | X | | | | |
| Fuel models | | | | | | X | | | | | | | | | 4P |
| Municipal and County Boundaries * | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 1, 4 |
| PSAP Service Areas * | X | X | X | | | X | X | X | X | | X | | | | |
| State Boundaries | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 1, 4 |
| Tribal Land Boundaries | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 1, 4 |
| **CLIMATOLOGY \| METEROROLOGY \| ATMOSPHERE** | | | | | | | | | | | | | | | |
| Precipitation (Historic) | X | X | X | X | | X | | | X | X | | | | | 4 |
| Weather Forecasts and Predictions (NOAA NWS) * | X | X | X | X | X | X | X | | X | X | | X | | | 3 |
| **ECONOMY** | | | | | | | | | | | | | | | |
| Businesses * | X | X | X | X | | X | X | X | X | X | X | X | X | X | 1P |
| Business Impact Analysis | X | X | X | X | | X | X | X | X | X | X | X | X | X | |
| **ELEVATION** | | | | | | | | | | | | | | | |
| Bathymetry | | X | X | | | | | | | X | | | | | 1P, 2, 4P |
| Digital Elevation Model (DEM) * | | X | X | | | X | X | X | X | X | X | | | | 2P, 4 |
| LiDAR (LAS/LAZ FILES) | | X | X | | | X | X | X | X | X | X | | | | 2P, 4P |
| Topography (CONTOUR LINES) * | X | X | X | | | X | X | X | X | X | X | | | | 4 |
| **ENVIRONMENT** | | | | | | | | | | | | | | | |
| Environmental Sensitivity Index (ESI) maps (NOAA) | | X | X | | | X | X | | | X | | | | | 2P, 4P |
| Evapotranspiration | | | | X | | | | | | | | | | | 4 |

| ISO CATEGEORY<br>Data Layer Name | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Superfund Sites | | X | X | | | X | X | X | X | X | X | | | | 4 |
| **FARMING** | | | | | | | | | | | | | | | |
| Agricultural Uses | X | X | X | | | | X | | | | | | X | X | 4P |
| Confined Feeding Operations | | X | X | X | | | X | | | | | | X | X | |
| Crop Layers | | X | | X | | | X | | | | | | | X | 4P |
| Disposal (Landfill or Incinerator) | | X | | | | | X | | | | | | X | X | 1, 4 |
| Livestock | X | X | X | X | | | X | | | | | | X | X | 4P |
| Poultry Operations | | X | | X | | | X | | | | | | X | X | 1P, 4P |
| | | | | | | | | | | | | | | | |
| **GEOSCIENTIFIC INFORMATION** | | | | | | | | | | | | | | | |
| Bedrock Geology * | | | | | | | | X | X | | | | | | 4 |
| Karst Terrain | | | | | | | | X | X | | | | | | 4P |
| Liquefaction Potential | | | | | | | | X | X | | | | | | 4P |
| Shake Map (USGS) | | | | | | | | X | X | | | | | | 4P |
| Slope Data | X | X | X | | | X | | X | X | X | | | | | 4P |
| Soils Data | | X | X | | | | | X | X | | | | | | 4P |
| Strong Motion Data (CESMD) | | | | | | | | X | X | X | | | | | 4P |
| **HEALTH** | | | | | | | | | | | | | | | |
| Adult Day Care (SP) | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Daycare Facilities | X | X | X | | X | X | X | X | X | X | X | X | X | | 1 |
| Dialysis Center (SP) | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Emergency Medical Services (Ambulances and Paramedics) | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Hospitals (SP) * | X | X | X | | X | X | X | X | X | X | X | X | X | | 1 |
| Mental Health Facilities (SP) * | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Nursing Homes (SP) * | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Pharmacies * | X | | X | | | X | X | X | X | X | X | X | X | | 1 |
| Urgent Care Facility (SP) * | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Vulnerable Populations - Single Layer of the Sensitive Populations (SP) listed above. | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| | | | | | | | | | | | | | | | |

| ISO CATEGEORY<br>Data Layer Name | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IMAGERY \| BASE MAPS \| EARTH COVER** | | | | | | | | | | | | | | | |
| Land Use, Land Cover, Remote Sensed Data | X | X | X | X | X | X | X | X | X | X | X | | | | 2P, 4 |
| Oblique Imagery | | X | X | | | X | X | X | X | X | X | | | | 2P |
| Ortho Imagery * | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 2P, 4 |
| **INTELLIGENCE \| MILITARY** | | | | | | | | | | | | | | | |
| National Guard Units | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| **INLAND WATERS** | | | | | | | | | | | | | | | |
| FEMA Flood Zones and Elevations - DFIRM Data * | X | X | X | | | X | | | | X | | | | | 1, 4 |
| Historic Flooding Extents and High Water Marks * | X | X | X | | | | | | | X | | | | | |
| Hydrography (NHD) * | | X | X | X | | X | X | | X | X | | | | | 1, 2, 4 |
| Locks | | | X | | | | | X | | | | | | | 1, 4 |
| Levee Locations | | X | X | | | | X | X | | X | | | | | 1, 4 |
| River Stage Levels | X | X | X | X | | | | | | | | | | | |
| SLOSH Boundaries | | X | | | | | | | | | | | | | 2P, 4P |
| U.S. Army Corps of Engineers (USACE) Hurricane Inundation Maps | | X | | | | | | | | | | | | | 2P, 4P |
| USGS River/Stream Gauges * | | X | X | | | | | | | | | | | | 1 |
| River Miles | | | X | | | | | | | | | | | | 4 |
| Hydrologic Unit Code Boundaries (Watersheds - HUC) | | | X | X | | | X | | | | | | | | 1 |
| Wetlands (NWI) | | X | | | | | | | | X | | | | X | 2P, 4 |
| **LOCATION** | | | | | | | | | | | | | | | |
| Address Points/Ranges * | X | X | X | X | X | X | X | X | X | X | X | X | X | | 4P |
| Archaeological sites | | X | X | | | X | X | X | X | X | X | | | | 4P |
| Ball fields | X | X | X | | X | X | X | X | X | X | X | | X | | |
| Beaches - Public | | X | X | | | | X | | X | X | | | | | 2P |
| Cemeteries | | X | X | | | | X | X | X | X | | | | | 4P |
| Food and Water Distribution * | X | X | X | X | X | X | X | X | X | X | X | | X | | 1P |
| Hazardous Material Sites (SARAH Title 3 Sites) * | X | X | X | | | X | X | X | X | X | X | | | | |
| Hazardous Material Storage and Processing (NOS) * | X | X | X | | | X | X | X | X | X | X | | | | 1P, 4P |
| Historic Fire Incidents * | | | | | | X | | | | | | | | | |

| ISO CATEGEORY<br>Data Layer Name | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Historic Structures and Boundaries | | X | X | | | X | X | X | X | X | X | | | | 4P |
| Landmarks * | | X | X | | | | X | X | X | X | | | | | 1P, 4P |
| Parks and Campgrounds * | X | X | X | | | X | X | X | X | X | X | | | | 4P |
| **OCEANS** | | | | | | | | | | | | | | | |
| NOAA NWS National Data Buoy Center | | X | | | | | | | | X | | | | | 1P, 3 |
| Tide Charts | | X | | | | | | | X | X | | | | | 3 |
| **PLANNING \| CADASTRE** | | | | | | | | | | | | | | | |
| Parcel Boundaries w/Appraisal Data * | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 4P |
| **SOCIETY** | | | | | | | | | | | | | | | |
| Population - Daytime | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Population - Nighttime | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Population - Seasonal | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Population Data - U.S. Census * | X | X | X | X | X | X | X | X | X | X | X | X | X | | 4 |
| Population (ACS Child and Elderly Populations) | X | X | X | X | X | X | X | X | X | X | X | X | X | | 4 |
| **STRUCTURE** | | | | | | | | | | | | | | | |
| Building Footprints * | | X | X | | | X | X | X | X | X | X | X | | | 4P |
| Colleges and Universities * | X | X | X | | | X | X | X | X | X | X | X | X | | 1, 4 |
| Correctional Facilities - Adult | X | X | X | | | X | X | X | X | X | X | X | X | | 1P, 4P |
| Correctional Facilities - Youth | X | X | X | | | X | X | X | X | X | X | X | X | | 1P |
| Critical Facilities with Generators | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Critical Infrastructure (HIFLD) * | X | X | X | | | X | X | X | X | X | X | X | X | | 1P |
| Critical Infrastructure (Local and State Identified) * | X | x | X | X | X | X | X | X | X | X | X | X | X | X | |
| Dam Inventory * | X | X | X | X | | | X | X | X | X | | X | X | | 4 |
| Emergency Operation Centers (Local, State, Federal) * | X | X | X | | X | X | X | X | X | X | X | X | X | | 1P, 4P |
| Fire Stations | X | X | X | | X | X | X | X | X | X | X | X | X | | 4P |
| Gas Stations | X | X | X | | X | X | X | X | X | X | X | X | X | | 4P |
| Government Office Buildings * | X | X | X | | | X | X | X | X | X | X | X | X | | 1P |
| Grocery Stores (Retail) * | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Homes with Basements | | X | X | | | | X | X | X | X | | | X | | |
| Mass Care Centers from Existing EOC Plan * | X | | X | | X | X | X | X | X | X | X | X | X | | |

| ISO CATEGEORY<br>Data Layer Name | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Places of Worship * | X | X | X | | | X | X | X | | X | X | X | X | | |
| Police Stations | X | X | X | | | X | X | | X | | | X | X | | |
| Public Safety Answering Points (9-1-1 Call Centers) | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Restaurants | X | | X | | | | X | X | | | | X | X | | |
| Schools K-12 * | X | X | X | | | X | X | X | X | X | X | X | X | | 1P |
| Shelter Sites - Designated, Potential, Pet, Food Service * | X | X | X | | X | X | X | X | X | X | X | X | X | | |
| Siren Locations and Sound Buffers | | | | | | X | | | | X | | X | X | | |
| Stadiums and Other Large Recreational Facilities | X | X | X | | | X | X | X | X | X | X | X | X | | 1P |
| **TRANSPORTATION** | | | | | | | | | | | | | | | |
| Airports * | X | X | X | | | X | X | X | X | X | X | X | X | | 1P, 4P |
| Boat Ramps | | X | X | | | | | | | X | | X | X | | |
| Bridges and Tunnels | | X | X | | | | X | X | X | X | X | X | X | | 1 |
| Evacuation Routes (Including Contra-flow Routing) * | X | X | X | | | X | X | X | X | X | X | X | X | | 1P |
| Ferry Lines and Terminals | | X | | | | | X | | | X | | X | X | | 1, 4 |
| Helicopter Landing Zones * | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Marinas | | X | X | | | | X | X | | X | | X | X | | |
| Mass Transit - Bus Routes and Stops * | X | X | X | | | X | X | X | X | X | X | X | X | | 1P, 4P |
| Mass Transit - Subway and Light Rail Routes and Stops * | X | X | X | | | X | X | X | X | X | X | X | X | | 1P, 4P |
| Mile Markers (Highways and Major Waterways) * | X | | X | | | | X | X | | | | | | | |
| Navigable Waterways (NOAA Nautical Charts) | | X | X | | | X | | | | X | | X | | | 1P, 2 |
| Navigation Channels | | X | X | | | | | | | X | | X | | | 2 |
| Port Facilities (Mooring, Docks, Piers, Cargo) | | X | X | | | | X | X | X | X | | X | X | | 1, 2P, 4 |
| Railway Lines and Stations * | X | X | X | | | X | X | X | X | X | X | X | X | | 1, 4 |
| Road Centerlines (Public and Private Roads) * | X | X | X | | | X | X | X | X | X | X | X | | | 4 |
| School Bus Routes | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Street Maps - Detailed * | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Traffic Counts and Traffic Flow | X | X | X | | | X | | X | X | X | X | X | | | |
| **UTILITIES \| COMMUNICATIONS** | | | | | | | | | | | | | | | |
| Cell Towers | | X | X | | | X | X | X | X | X | | | | | 1P, 4 |

| ISO CATEGEORY<br>Data Layer Name | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hydrants (Wet and Dry) | X | | | | | X | | | | | | | | | |
| Internet Hubs and Lines | | X | | | | X | X | X | X | X | | | | | |
| LNG Distribution Lines | | | | | | | | X | X | | | | | | 1P |
| LNG Storage Facilities | | X | X | | | X | X | X | X | X | X | | | | |
| Oil Pipelines | | | | | | | X | X | X | | | | | | 1P |
| Oil Storage Facilities | | X | X | | | X | X | X | X | X | X | | | | |
| Power Plants - Nuclear | | X | X | | | X | X | X | X | X | X | | | | 4 |
| Power Plants- Conventional | X | X | X | | | X | X | X | X | X | X | | | | 1P, 4P |
| Power Transmission Lines | X | X | | | | X | X | X | X | X | X | | | | 1P |
| Propane Storage Facilities | | X | X | | | X | X | X | X | X | X | | | | |
| Radio Communication | X | X | X | | | X | X | X | X | X | X | | | | 1P |
| Sanitary Sewers * | | X | X | | | X | X | X | X | | | | | | |
| Sewage Treatment Plants (Public) * | X | X | X | | | X | X | X | | X | X | | X | | 1P |
| Stormwater Facilities (Basins, Lines, Outfalls) * | | X | X | X | | X | X | X | X | X | X | | | | |
| Telecommunications Facilities and Lines (Land) | X | X | X | | | X | X | X | X | X | X | | | | 1P |
| Utility Pipelines | | X | | | | X | X | | X | | | | | | 4P |
| Water Distribution Lines (Potable and Public) * | | X | | X | | X | X | X | X | | | | X | | |
| Water Intakes (Potable and Public) | | X | X | | | X | X | X | X | X | | | X | | 4P |
| Water Pumping Stations (Potable and Public) * | | X | X | | | X | X | X | X | X | | | X | | |
| Water Reservoirs (Potable and Public) | | X | X | | | X | X | X | X | X | | | X | | 4 |
| Water Storage Towers (Potable and Public) * | | X | | | | X | X | X | X | | | | X | | |
| Water Treatment Plants (Potable and Public) * | | X | | | | X | X | X | X | X | X | | X | | |
| Water Wells - Potable | | X | X | X | | X | X | | X | X | | | X | | |

## Appendix 4. Important Operational Data for use during Disaster Events

| INCIDENT SPECIFIC OPERATIONAL INFORMATION (Not an ISO Category) | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Access Control Points | | X | X | | | X | X | X | X | X | X | | X | | |
| Acquisitions | | X | X | | | X | | | X | X | | | | | |
| Activated Evacuation Zones | | X | X | | | X | X | X | X | X | X | | X | | |
| Activated Staging Areas | X | X | X | | | | X | X | X | X | X | | X | | |
| Airport Closures | X | X | X | | | X | X | X | X | X | X | | X | | |
| Bridge Closures | | X | X | | | | X | X | X | X | X | | X | | |
| Building Damage Assessments | X | X | X | | | X | X | X | X | X | X | | | | |
| Burning Bans - County and State | | | | X | | X | | | | | | | | | |
| Cell Phone Outages | X | X | X | | | X | X | X | X | X | X | | X | | |
| Civil Air Patrol and Other Post-Event Oblique Photographs | X | X | X | | | X | X | X | X | X | X | | | | |
| Clear Cut and Fire Impacted Areas | | X | X | | | X | | X | X | | | | | | |
| Communications Trailers | X | X | X | | | X | X | X | X | X | X | | | | |
| Damage Cost Estimates (PA) | X | | X | | | X | X | X | X | X | X | | | | |
| Damage Path/Area (Estimated) | X | | X | | | X | X | X | X | X | X | | | | |
| Deaths (Fatality Locations) | X | X | X | | X | X | X | X | X | X | X | | X | | |
| Debris Removal Sites | X | X | X | | | X | X | X | X | X | | | | | |
| Decontamination Site | | | | | | X | | | | | | | X | | |
| Disaster Declarations (County and State) | X | X | X | | | X | X | X | X | X | X | | X | | |
| Disaster Recovery Centers | | X | X | | | X | X | X | X | X | X | | | | |
| Donation Drop-Offs | X | X | X | | | X | X | X | X | X | X | | | | |
| Embargo Area | | | | | | | | | | | | | | X | |
| Evacuation Routes (With Contra-flow Routing) | | X | X | | | X | X | X | X | X | X | | X | | |
| Event Location with Buffer Areas | | X | X | | | X | X | X | X | X | X | | X | | |
| Facilities Closure Information (e.g. Day Care, Nursing Homes, Assisted Care Facilities, Universities, Hospitals, Clinics, Urgent Care, Mental Health, Dentists, Schools, Shelters, Government Offices, Correctional and other Facilities) | X | X | X | | X | X | X | X | X | X | X | | X | X | |

| INCIDENT SPECIFIC OPERATIONAL INFORMATION (Not an ISO Category) | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ferry Stoppages | | X | | | | | X | X | | X | | | | | |
| Fire Locations | | X | | | | X | X | X | | | X | | | | |
| Flood Extents | X | X | X | | | | X | X | X | X | | | | | |
| Health Case Locations | | | X | | X | | X | X | X | | | | X | | |
| Hot, Warm and Cold Zones | | | | | | X | | | | | | | | | |
| Ice Accumulations | X | X | X | | | | | | | | | | | | |
| Imagery - Oblique | | X | | | | | X | X | X | X | | | | | |
| Incident Command Post | X | X | X | | X | X | X | X | X | X | X | | X | X | |
| Incident Location and Extent of Tactical Area (Point, Line, or Polygon) | X | X | X | | | X | X | X | X | X | X | | X | X | |
| Individual Assistance Registrations Aggregated by 1km | | X | X | | | X | X | X | X | X | X | | | | |
| Levee Breaches | | X | X | | | | X | X | | X | | | | | |
| Logistics Staging Areas (LSA) | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Long Term Housing Sites | | X | X | | | X | X | X | X | X | X | | | | |
| Map Books for Field Teams | X | X | X | | | X | X | X | X | X | X | | | | |
| Medical Assistance Teams (all types) | | X | X | | | X | X | X | X | X | X | X | X | X | |
| Medical Supply Staging | X | X | X | | | X | X | X | X | X | X | X | X | | |
| Outages (e.g. Power and Telecommunications) | X | X | X | | | X | X | X | X | X | X | X | | | |
| Plume Forecasts (e.g. Fire, Chemical, etc.) | | | | | | X | | | | | X | | | | |
| Point of Dispensing, DHSS | X | X | X | | | X | X | X | X | X | X | | X | | |
| Point of Distribution (Equipment, Generators, etc.) | X | X | X | X | X | X | X | X | X | X | X | | | | |
| Port Closures | | X | X | | | | X | X | X | X | X | | | | |
| Post Event Aerial Imagery | | X | X | | | X | X | X | X | X | X | | | | |
| Public and Individual Assistance Requests and Status | X | X | X | | | X | X | X | X | X | X | X | | | |
| Rail and Subway Closures or Stoppages | X | X | X | | | X | X | X | X | X | X | | | | |
| Reception & Care Center (RCC) | X | X | X | | | X | X | X | X | X | X | | X | | |
| Repetitive Loss Facilities | | X | X | | | X | | | X | X | | | | | |
| Requests for Assistance | X | X | X | X | X | X | X | X | X | X | X | | X | X | |
| Rescues | X | X | X | | | X | X | X | X | X | X | | X | | |
| Resource by Funding Source | X | X | X | | | X | X | X | X | X | X | | | | |

| INCIDENT SPECIFIC OPERATIONAL INFORMATION (Not an ISO Category) | SNOW, ICE, WINTER STORM | TROPICAL CYCLONE | FLOOD | DROUGHT | HEATWAVE | WILDFIRE | TORNADO | EARTHQUAKE | LANDSLIDES & MUDSLIDES | TSUNAMI | VOLCANIC ACTIVITY | SOLAR FLARE (MAJOR EMP) | PANDEMIC HUMAN | PANDEMIC AGRICULTURE | POTENTIAL DATA SOURCES (See Appendix 2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource Request Status | X | | X | | | | X | X | X | | | | X | | |
| Responder Reception Centers | X | X | X | | | X | X | X | X | X | X | | X | X | |
| River Levels (Current and Forecasted) | | X | X | X | | | | | | | | | | | |
| Road Closures | X | X | X | | | | X | X | X | | | | | | |
| Road Construction | X | X | X | | | X | X | X | X | X | X | | | | |
| Roads Cleared (AVL in Snow Plows) | X | X | X | | | X | X | X | X | X | X | | | | |
| Safe Buildings for Responders | X | X | X | | | X | X | X | X | X | X | | X | | |
| School Zones | | X | X | | | X | X | X | X | X | X | | | | |
| Search and Rescue Grids | X | X | X | | | X | X | X | X | X | X | | | | |
| Shelter Supply Needs (e.g. Food, Water, Fuel, Clothing, Medical, Pharmacy) | X | X | X | | X | X | X | X | X | X | X | | X | | |
| Shelters - Location and Status | X | X | X | | X | X | X | X | X | X | X | | X | | |
| Sink Holes | | | | | | | | X | | | | | | | |
| Snow Accumulations | X | | | | | | | | X | | | | | | |
| Staging Area | X | X | X | | | X | X | X | X | X | X | | X | X | |
| State Area Coordination Center (SACC) | X | X | X | | | X | X | X | X | X | X | | X | X | |
| Status by County | X | | X | | | X | X | X | X | X | X | | X | | |
| Storm Reports - NOAA Storm Prediction Center | X | X | X | | | | X | | X | | | | | | |
| Supplies (Sandbags, Emergency Generators, Medical Supplies, Food, Water, Etc.) | X | X | X | | X | X | X | X | X | X | X | | | | |
| Temporary Morgues (e.g. Ice Arenas and Other Facilities) | X | X | X | | | X | X | X | X | X | X | | X | | 1P |
| Traffic Control Points | X | X | X | | | X | X | X | X | X | X | | X | | |
| Transportation Resources (e.g. Buses with Wheelchair Access, Ambulances, etc.) | X | X | X | | | X | X | X | X | X | X | | X | | |
| Vessel Locations (AIS) | | X | | | | | | | | X | | | | | |
| Volunteer Reception Center | X | X | X | | | X | X | X | X | X | X | | X | | |
| Warming and Cooling Centers | X | | | | X | | | X | X | | | | X | | |
| Weather RADAR and Current Conditions | X | X | X | | X | X | X | X | X | X | | | | | 3 |

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