Geospatial Support for Disaster Operations Guide

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FEMA

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CHAPTER 1: ORGANIZATION

Purpose

The purpose of the Federal Emergency Management Agency's (FEMA) *Geospatial Support for Disaster Operations Guide* is to facilitate the development and dissemination of Geospatial Information Systems (GIS) capabilities or geographic products and services during disaster operations. The *Geospatial Support for Disaster Operations Guide* provides direction on resources, organization, and management of geospatial capabilities across FEMA's incident management (IM) and incident support (IS) organizations and aligns geospatial functions at the incident, regional, and national levels.

Scope and Applicability

The intended audience for the *Geospatial Support for Disaster Operations Guide* includes all FEMA staff assigned to geospatial positions (e.g., the "geospatial community") to promote cooperation and interoperability. This guidance applies during all disaster incidents, including those involving Presidential declarations under the Stafford Act, as well as non-Stafford Act incidents that require a coordinated federal response. The *Geospatial Support for Disaster Operations Guide* also informs the required training, position task books (PTB), and course development for FEMA Qualification System (FQS) positions and may be used as a resource by FEMA's state, local, tribal, and territorial (SLTT) partners for developing their own National Qualification System (NQS) requirements. The positions and functions described in the *Geospatial Support for Disaster Operations Guide* will vary depending on incident needs, including factors such as incident size, complexity, and other considerations. Compliance with this guidance is mandatory for the entire FEMA geospatial community.

Supersession

This document supersedes the *Remote Sensing Standard Operating Procedures*, June 1999.

Authorities and Foundational Documents

A number of foundational documents provide statutory, regulatory, and executive guidance for FEMA disaster response. Chapter 4 provides additional information on the key directives that guide the development of GIS products.

Figure 1 shows how the *Geospatial Support for Disaster Operations Guide* maps directly to related doctrine.

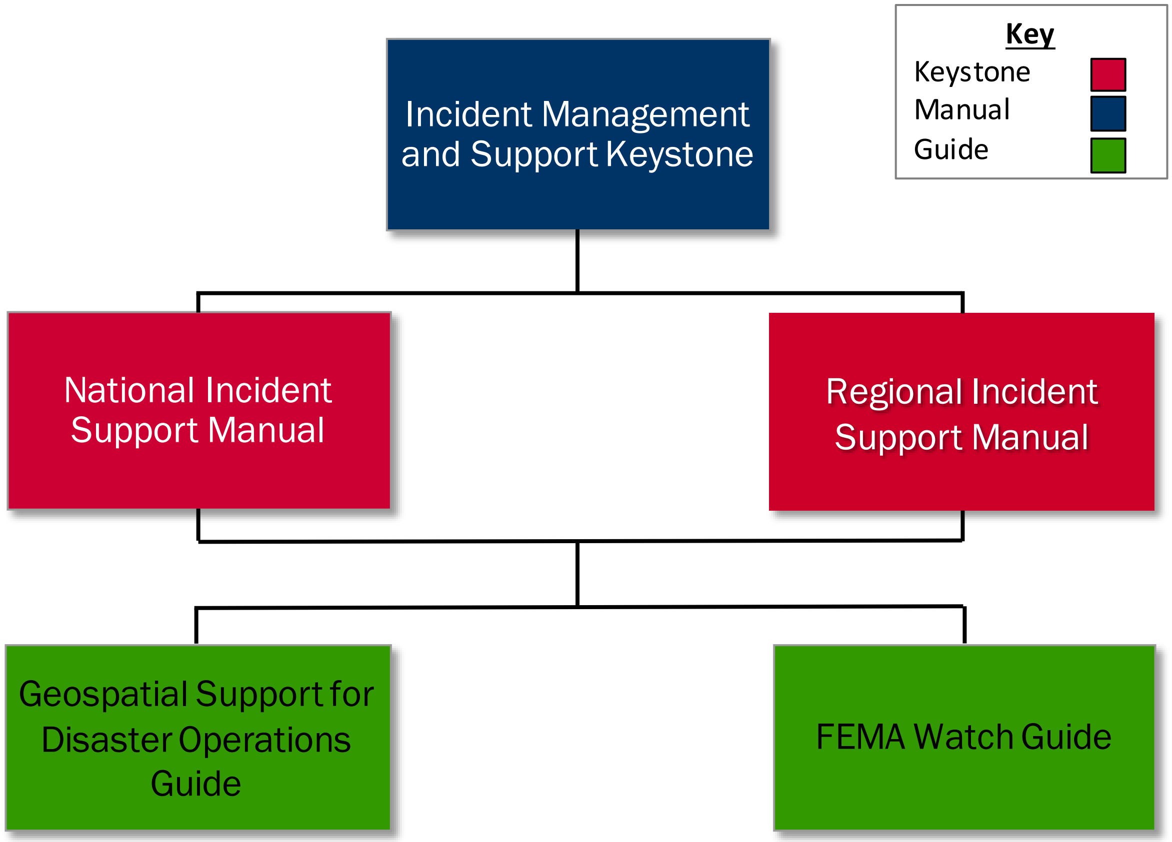


Figure 1: Doctrine Map

Key foundational documents include the following:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended, 42 U.S.C. 5121-5207)
- Title 44 of the Code of Federal Regulations, "Emergency Management and Assistance"
- Homeland Security Act (Public Law 107-296, as amended, 6 U.S.C. §§ 101 et seq.)
- Homeland Security Presidential Directive 5, 2003
- Post-Katrina Emergency Management Reform Act of 2006 (Public Law 109-295), October 4, 2006
- *National Response Framework*, May 2013
- *National Disaster Recovery Framework*, June 2016
- *National Incident Management System*, October 2017
- *The Federal Emergency Management Agency Publication 1*, November 2010
- *Incident Management and Support Keystone*, January 2011
- Presidential Policy Directive 8: National Preparedness, March 2011
- *National Preparedness Goal*, September 2015
- *FEMA Incident Management Handbook (FEMA B-761),* November 2017
- *FEMA Incident Action Planning Guide*, January 2012
- Homeland Security Geospatial Concept of Operations (GeoCONOPS), v5.0, June 2013
- *FEMA Directive – Use of the United States National Grid (USNG),* October 2015

- FGDC-ISO-19115, “International Organization for Standardization Geospatial Metadata Standards,” 2003
- FGDC-STD-016-2011, “United States Thoroughfare, Landmark, and Postal Address Data Standard,” February 2011
- OMB Circular A-16, “Supplemental Guidance Stages of the Geospatial Data Lifecycle,” August 2002
- USR Program Directive 2014-013, “Search Operations Data Collection and Reporting Standards,” September 2104

Document Management and Maintenance

The FEMA Response Geospatial Office is responsible for the management and maintenance of this document. Comments and feedback from FEMA personnel and stakeholders regarding this document should be directed to the Response Geospatial Office at FEMA headquarters (HQ).

CHAPTER 2: OVERVIEW OF GEOSPATIAL SUPPORT

GIS efficiently captures, stores, updates, analyzes, manipulates, and displays geographically referenced information (i.e., data identified by location). Geospatial analysts use GIS software, hardware, standard procedures, and established analytical methods to conduct spatial analyses, manage datasets, and communicate information to advise decision makers throughout the disaster life cycle.

Requirements for Data-Driven Decision Making

Effective geospatial analysts must be able to supply accurate, timely, and actionable information to decision makers. There are three requirements for making data-driven decisions:

- **Understand Capabilities**: Geospatial analysts should know the specific capabilities of FEMA components and interagency, intergovernmental, non-profit, and private sector resources, including geospatial roles and responsibilities.
  - Example: Analysts should be familiar with the *Geospatial Support for Disaster Operations Guide* and possess a working knowledge of the datasets and tools available for conducting geospatial analysis, which sets a foundation for providing effective geospatial support during disasters.
- **Understand Community Conditions**: Analysts should be familiar with pre-incident information on SLTT disaster histories; threats, hazards, risks, preparedness assessments; critical infrastructure locations; and demographic characteristics.
  - Example: Analysts should know how to predictively assess and determine response needs, including timing and estimating the amount of needed resources before or as a disaster is occurring (i.e., storm surge models can be used to anticipate flooding and identify priority areas for evacuation).
- **Understand Incident Conditions**: Analysts should understand current and post-incident information, post-disaster damage assessments, and ongoing situational awareness of current and anticipated operating conditions.
  - Example: In response to Hurricanes Harvey, Irma, and Maria, analysts used geospatial damage assessments to gain early situational awareness of the incidents. In addition, geospatial damage assessments aided in the declaration process and supported the Individual Assistance (IA) program to expedite millions of dollars in rental assistance to thousands of disaster survivors.

Geospatial Support in the Disaster Life Cycle

The timely delivery of disaster relief is key to reducing suffering and returning normalcy to survivors and communities. FEMA and its partners use a full complement of geospatial analytic capabilities to anticipate and mitigate disaster impacts. Geospatial technology provides decision makers, planners, first responders, and recovery experts with the time and information needed to attain a deeper understanding of a community's disaster risk, allowing them to identify emergency management options before, during, and after an incident.

Preparedness

Geospatial analysis and models using predictive analytics inform communities of risk in advance of an event, allowing them to build resilience, anticipate hazards, and provide early warning.

- **Threat and Hazard Identification:** GIS is commonly used to identify potential threats and hazards present in a geographic area. For example, exercise planners use this information to inform exercise priorities and the scenario development process. FEMA planners also use this information to conduct regional Threat Hazard Identification and Risk Assessments (THIRA).
- **Risk Analysis:** Geospatial analysis and modeling is conducted as part of the risk assessment process supporting THIRA, operational planning, mitigation, and exercise development. Sophisticated geospatial models are used to estimate losses to life, property, and the economy and to support other hazards and exposure models.
- **Planning:** Geospatial analysis and modeling outputs are incorporated into the planning process to inform planners and decision makers of threat and hazard exposure and potential impacts on vulnerable populations, infrastructure, response resources, and other planning factors. The Model and Data Inventory (MoDI) is FEMA's interactive catalog of authoritative models and datasets for response planning and operational decision making for catastrophic events.

Response

FEMA and first responders use geospatial tools and methods to estimate impacts, allowing for well-informed and timely decision making.

- **Event Forecasting:** Geospatial tools are used to forecast and track the progression of notice events. With GIS-enabled forecasting, managers and decision makers can pre-plan and stage resources just prior to a notice event.
- **Estimating Impacts:** Geospatial analysis is used to estimate impacts on people, populations, critical infrastructure, supply chains, and other lifeline factors. As an incident unfolds, GIS is used to dynamically monitor a situation and update impact estimates to inform decision making across operational periods.
- **Unified Geospatial Support:** FEMA is equipped with a distributed, credentialed, and diverse cadre of on-call geospatial analysts and managers that identify and fulfill ad hoc and pre-determined requirements supporting operational decision making.
- **Operational Coordination:** Managers and decision makers use standard maps and GIS-enabled decision-support tools to provide situational awareness on resources deployed, staged, and available to support response operations (e.g., FEMA's force

laydown map, which provides senior leaders with a high-level view on command and control operations).

- **Field Operations:** FEMA and SLTT first responders use GIS-based field data collection and situational awareness applications on the ground during an incident. First responders, such as search and rescue teams, use field data collection applications to gather basic information on mission operations and track responder status and safety. Field-oriented situational awareness applications provide field managers with a strategic view of field operations status and mission monitoring.

GIS Incident Journals

The geospatial community regularly creates Web-based story maps that automate Geospatial Framework (GeoFramework) products. The GeoFramework, developed as a guideline for creating standard map products throughout the incident life cycle, consists of 21 standard map products used by decision makers to address questions during a disaster response. These products are organized under six main product categories:

Incident-Level Geospatial Support

GIS offers mission support that spans all phases of incident operations and is a critical asset to incident operations. A key role of the Geospatial Information Unit (GIU) at the incident level is to continually promote and educate others on the value and utility of GIS and remote sensing products. The Geospatial Information Unit Leader (GIUL) should conduct a series of briefings early during incident operations to explain the types of GIS and remote sensing decision-support products available, as well as the procedures to request products and services. The GIUL should develop a close working relationship with the Situation Unit Leader (SITL) and other program areas, while continually looking for opportunities to assist them with GIS and other decision support products.

- **Hazard Map:** Size of the affected area
- **Federal Support:** Description of who is involved and the financial impact
- **Population:** Number of people exposed or impacted
- **Buildings:** Number of buildings exposed or damaged/destroyed
- **Transportation:** Overview of damage to the transportation network
- **Lifelines:** Status of community lifelines (e.g., infrastructure and essential facilities)

GIS Incident Journals are organized into the same six product categories as the GeoFramework but avoid the challenges of leveraging standalone Portable Document Format (PDF)-based maps by updating products in real time as new information becomes available. For example, the Hurricane Incident Journal automatically updates the Hazard Map with each new National Hurricane Center Advisory released. These real-time updates provide an agile platform from which analysts can rapidly respond to the changing situation and monitor the event for situational awareness. Additional map products within the GIS Incident Journals leverage predictive modeling data, real-time traffic information, and call volumes to estimate individual assistance needs. The Hurricane Decision Support Architecture, or "whiteboard," links critical decisions with analytical products, particularly for Essential Elements of Information, which use map products within the GeoFramework to drive decision making. The GIS Incident Journals support FEMA's mission to integrate GIS-based situational awareness with planning factor criteria to inform proactive and expedient decision making. Refer to Appendix E for more information on the GeoFramework guide and categories.

Recovery

Geospatial technology supports planning, grant determination, monitoring, and evaluation to bring expedited relief to disaster survivors. Observed geospatial information collected in the field and from remotely sensed data can be used to validate against forecasted and estimated damage to support recovery program delivery. Geospatial damage assessments of individual homes are used to expedite IA grants by automatically sending payments to survivors or help in-field inspectors to more efficiently perform traditional inspections. Observed data from geospatial assessments assist in providing direct resources for Public Assistance (PA) by estimating or identifying effects to public infrastructure and supporting SLTT recovery efforts.

- **Geospatial Damage Assessments:** GIS-based modeling and remote sensing supports rapid assessments, initial situational awareness, and expedited recovery planning. Geospatial Damage Assessments are routinely used to expedite decision making around individual disaster assistance grants.
- **Mobile Applications:** FEMA personnel executing Preliminary Damage Assessments (PDA) and programs, such as Disaster Survivor Assistance (DSA), leverage mobile technologies to validate needs and ensure assistance is reaching survivors in a timely manner.

Table 1 provides additional information on common geospatial roles and functions, analytical contributions, and products developed to support survivors and decision making throughout the disaster life cycle.

Table 1: Geospatial Community Roles and Functions Throughout the Disaster Life Cycle

Resilience Geospatial Support	Response Geospatial Support	Recovery Geospatial Support
Inform communities at risk to help build resiliency, anticipate hazards, provide early disaster warnings, and calculate potential economic and population impacts	**Estimate and measure disaster impacts to support well-informed, timely response decision making**	**Support estimation and validation for making recovery grant determinations to bring expedited relief to survivors**
• **Threat and Hazard Identification** o Geospatial Information Systems (GIS) are used to identify potential threat and hazards present in a geographic area. • **Risk Analysis** o Geospatial analysis and modeling is conducted as part of the risk assessment process supporting Threat Hazard Identification and Risk Assessment (THIRA), operational planning, mitigation, and exercise development. • **Deliberate Planning** o Geo-enabled plans inform decision making prior to and during disasters and quantify threats and hazards exposure and potential impacts, including but not limited to affected populations, critical infrastructure exposure, and resource requirements. • **Model Development** o Develop, test, and automate models for use in future or imminent notice disasters.	• **Event Forecasting** o Geospatial tools are used to forecast and track the progression of a notice event as it unfolds. • **Estimating Impacts** o GIS is used to dynamically monitor a situation and update impact estimates to inform decision makers. • **Unified Geospatial Support** o On-call analysts form a distributed, credentialed, and diverse geospatial team that helps to identify and fulfill ad hoc and prescribed requirements. • **Operational Coordination** o Standard maps and GIS-enabled decision-support tools are used by managers and decision makers on resources deployed, staged, and available to support response operations. • **Field Operations** o GIS-based field data collection and situational awareness applications are used by FEMA and state, local, tribal, and territorial (SLTT) first responders on the ground during an incident.	• **Geospatial Damage Assessments** o Modeling and remote sensing quicken the conduct of Preliminary Damage Assessments (PDA) to expedite recovery planning and program delivery. • **Mobile Applications** o PDAs and the Disaster Survivor Assistance (DSA) program leverage mobile technologies to validate needs and ensure timely delivery of assistance to survivors. • **Geospatial Data Collection** o Geospatial programs monitor and track the progress of debris removal, augmenting the allocation of debris removal resources and resulting in expedited inspections of critical infrastructure and survivor resettlement. • **After-Action Summary** o Identify best practices, new datasets, new models, improvements to workflow, etc.
• **Example:** Emergency managers regularly use GIS to assess, plan for, and mitigate risk based on threat and hazard exposure in a given location.	• **Example:** Urban search and rescue (US&R) teams regularly use GIS-based tools to prioritize and assign search areas and monitor resource status in real time.	• **Example:** Geospatial damage assessments are routinely used to inform decision making and expedite Individual Assistance (IA) grants.

Geospatial Support for Unified Operations

Greater collaboration among FEMA's professional geospatial workforce facilitates transparency, promotes successes, and better informs investment and operational decisions. The unified operations concept empowers FEMA to use existing resources through shared services and analytics support. FEMA's geospatial community engages in the unified operations concept to achieve the following goals:

Goal 1: Advocacy

The geospatial community advocates for the efficient and effective use of geospatial capabilities within FEMA and the emergency management community by leading and promoting external collaboration and information sharing. FEMA sets priorities for acquiring geospatial data, establishes partnerships to ensure the availability of geospatial data for operations, and leverages existing geospatial knowledge and capabilities obtained from external partners.

Goal 2: Education

FEMA's geospatial community educates, trains, and promotes awareness of geospatial capabilities across the emergency management community, supports and promotes the development of internal GIS training and certification, and works with the National Preparedness Directorate to use geospatial capabilities in THIRA, planning, and exercises.

Goal 3: Data Sharing

FEMA captures, catalogs, and shares geospatial data; identifies information collection requirements; creates guidance for and documents all of FEMA's enterprise geospatial data holdings and data sources; and establishes FEMA-wide policies to ensure that geospatial data is current, well organized, well documented, and available to all mission partners. FEMA also coordinates interagency data sharing to ensure effective contributions from other federal agencies to streamline and improve data collection and increase efficiency and transparency.

Goal 4: Decision Making

FEMA analyzes, produces, and disseminates products that enhance situational awareness and enable expeditious and effective decision making. The geospatial community identifies and assesses internal and external solutions for accessing, acquiring, managing, distributing, and standardizing geospatial data to meet FEMA requirements, establishes priorities for geospatial investments based on identified needs, and exploits information streams through critical analyses. FEMA encourages the geospatial community to apply technical knowledge of geospatial capabilities to enhance FEMA-wide analytics and business processes.

Guiding Practices for GIS in Data Analytics

This section identifies guiding practices used in GIS and data analytics that provide a framework for using geospatial capabilities to inform data-driven decisions. When applied, these guiding practices can help geospatial analysis to effectively support disaster survivors, manage risk, and aid in decision making.

- **Coordinating Analytical Efforts and Priorities for Disaster Operations:** Consumers and producers of analytical products should work collaboratively to synchronize analytical priorities and products to meet the high demand and time-sensitive requirements of disaster operations.

- Geospatial analysis (e.g., storm surge and flood zones models) can help identify disaster risks and aid in making key operational decisions about evacuations and personnel and commodity deployments and locations and predict the extent of disaster damage.
- Coordination among FEMA program areas, divisions, and analysts, as well as with interagency partners from federal, state, and local government; academia; and the private sector is critical to providing top-quality analytics and actionable information for decision support.

- **Using Authoritative and Best Available Data:** Authoritative data is owned or produced by legislatively delegated and reliable authorities and should be a primary source with which to model and prepare geospatial products. Oftentimes in the high-paced operational tempo of a disaster, assessing the authoritativeness of a data set is difficult, resulting in the best available data being used.
  - Authoritative data can come from government agencies, national laboratories, subject-matter experts (SME), think tanks, and others that collect and manage data on stream gauges, critical facilities, special populations, evacuation routes, resources, and other data sets used to develop a GIS product.
- **Standardizing Analysis and Reporting Processes:** Establishing a standardized, repeatable process for requesting and conducting analysis or retrieving data facilitates faster decision making and allows for efficient use of limited analytical resources.
  - Geospatial staff should be properly trained on the necessary tools and resources to quickly and accurately produce geospatial products and reports, such as maps, risk analyses, and damage assessments.
  - Geospatial staff are encouraged to document work flows and procedures for replication as standard operating procedures (SOP) that support consistency and serve as training resources.
- **Validating Analysis and Data Throughout the Disaster Life Cycle:** To improve and refine the quality of geospatial analysis in the field, products should be peer reviewed whenever possible.
  - Geospatial staff may use post-incident historic data or hindcasting to identify where over- and under-estimation occurred.
  - Geospatial staff may use a best available scenario or forecast data for non-disaster projects or real time disaster analytics.

- Geospatial staff should understand and communicate to customers the timelines for data and imagery collection during an event and the time required to transition imagery for observation-based analyses.

- **Widely Shared Analytical Products and Data:** Sharing data and applications across incident, regional, and national coordination levels makes data more available.
  - Cloud-based platforms provide a common environment that provides situational awareness for FEMA and the broader SLTT community. Common cloud-based platforms (such as Disasters.Geoplatform.gov) serve as a single, accessible platform for reporting and record management.
- **Value-Added Approach to Analysis:** Stakeholders are responsible for ensuring continued efforts to improve the analytics process across FEMA.
  - Ensuring that GIS products are valuable and useful to FEMA and its partner SLTT agencies aids in informing decision making and accountability.
- **Ensuring Data Accessibility:** Ensuring the accessibility of data across FEMA divisions to inform timely analysis and data-driven decision making.
  - FEMA components should ensure data is maintained and shared in standard interoperable formats, includes required metadata, is regularly updated, and that limitations to using it are clearly identified.
- **Using and Protecting Personally Identifiable Information (PII):** While FEMA's goal is to share information broadly and make data widely available to FEMA and interagency partners, it must also ensure the privacy of PII that it collects.
  - Datasets and information containing PII can contain valuable information for the production of geospatial products but must be used without violating privacy laws.

CHAPTER 3: GEOSPATIAL RESOURCES

This chapter identifies FEMA's geospatial resources and organizational construct at IS and IM facilities; it also identifies required and optional training available for geospatial employees. Appendix C: Incident Titles, as well as the *National Incident Support Manual, Regional Incident Support Manual,* and the *Incident Management Handbook*, contains additional information on incident-level geospatial staffing and organization.

FEMA Geospatial Working Group (GWG)

The FEMA Geospatial Working Group (GWG) serves as the principal mechanism to share communications about incident-related support, upcoming events, and training opportunities for the FEMA geospatial community during steady-state and operational periods. Membership includes representatives from each FEMA region, Long-Term Recovery Offices, and HQ program offices. The GWG also extends membership in an advisory capacity to other federal agency partners with liaison officers (LNO) at FEMA. The GWG holds a monthly synchronization call to coordinate activities and ensure the entire FEMA geospatial cadre shares relevant information.

Mission Statement

The GWG supports FEMA and the whole community with world-class geospatial information, services, and technologies to prepare for, protect against, respond to, recover from, and mitigate against all hazards.

Vision Statement

The GWG is the Nation's leading coordination group in providing and empowering geospatial data and analysis that informs decision making, reduces duplication, and improves cost efficiency in support of emergency management.

For general questions about the GWG, email: GWGWorking@fema.dhs.gov.

The FEMA GWG's objectives include the following:

- Identifying best practices for technology and analytic development;
- Providing a framework and mechanism for regional-, program-, and HQ-level communication during preparedness and activation postures; and
- Providing FEMA-related activities and best practices to the broader Department of Homeland Security (DHS) GWG.

Core Functions

To realize its mission, vision, goals, and objectives, the FEMA GWG focuses on the core functions shown in Figure 2. The core functions are grouped into eight categories, each with its own set of roles.

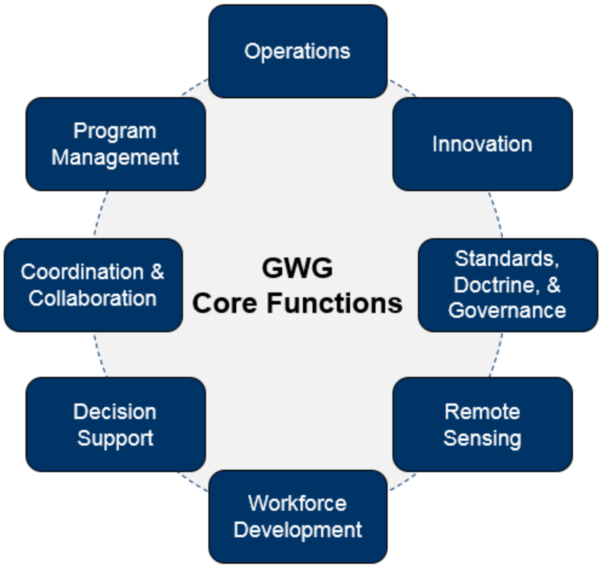


Figure 2: FEMA Geospatial Working Group Core Functions

1. **Operations:** Analyze data and develop geospatial decision-support products, coordinate data from multiple sources, and lead the innovation of new GIS-enabled capabilities and tools.
2. **Innovation:** Encourage and recognize new ideas for improved operations, support the efforts of the FEMA Innovation Team, and assist in the coordination, dissemination, integration, and promotion of advanced geospatial tools and techniques.
3. **Standards, Doctrine, and Governance:** Lead development of standards and doctrine, advise executive governance bodies, and develop lines of authority for geospatial-related decisions.
4. **Remote Sensing:** Perform outreach to the whole community and use comprehensive knowledge of remote sensing and image processing techniques to improve business processes across FEMA.
5. **Workforce Development:** Lead the advancement of geospatial training, exercises, and adjustments to the NQS, including career tracks, training content, and mentoring of geospatial professionals; ensure new criteria are available to larger audiences; and conduct outreach to increase awareness of training available to the community.
6. **Decision Support:** Provide enhanced situational awareness, conduct modeling and analysis, and present dynamic analysis to enable more intelligent decision making.
7. **Coordination and Collaboration:** Organize and partner with stakeholders to develop geospatial best practices; facilitate the free exchange and dissemination of information across FEMA, as well as across the whole community; be an integral contributor to the directorates; and promote awareness for the value of geospatial capabilities.
8. **Program Management:** Lead management of GIS programs and commercial contracts; support geospatial software licensing for the offices, directorates, and programs; and support operational security.

GWG Sub-Working Groups

A sub-element of the GWG is focused on routine development, communication, and coordination for specific topics needed to advance the FEMA GWG. These development efforts help to inform FEMA's strategy to provide top caliber service to survivors by putting the right people in the right place, using the right analysis at the right time, and using the best available information.

FEMA's GWG functional teams provide a forum to advance the following topic areas:

- **Resource Support**: Provide a forum to train, educate, and advance the GIS cadre through standardization and professional development strategies.
- **Production and Analysis:** Examine hard copy (paper) and Web-based design, standardize GIS product templates for PDF/print maps and Web-based applications, and encourage the development of governance structures to manage cross-regional relationships and responsibilities to level-specific events.
- **Data Management:** Develop standard data management and enterprise processes for archiving and retention and develop and implement a data-sharing strategy, including coordination with state and local governments.
- ***Technology Integration:*** Create an end-to-end, design-to-development strategy and method for the integration of geospatial tools within FEMA.

Headquarters Geospatial Support

FEMA HQ plays a lead role in acquiring and coordinating the requisite geospatial resources to support a full range of geospatial services across all FEMA divisions, program offices, other federal agencies, and the emergency management community at large. When the National Response Coordination Center (NRCC) is activated in response to an incident, HQ provides various specialized reports, spatial analyses, decision-support tools, and remote sensing analysis and works in coordination with other Situational Awareness Section (SAS) products to develop a common operating picture. The following positions advance these objectives.

Geospatial Information Officer (GIO)

The GIO provides leadership and expert advice regarding the application of actionable GIS for planning, decision making, and execution of response and recovery operations in support of programmatic and business intelligence applications for FEMA. This includes the development of processes, policies, and strategies based on a common core of software, standards, processes, and methodologies.

The GIO is also responsible for establishing effective and sustainable working relationships with a wide variety of public and private sector whole community partners, managing project reviews and approvals, overseeing funding and procurement processes that promote consistent and comprehensive strategies, and fostering the implementation of GIS-related standards.

The GIO represents FEMA as the senior geospatial representative and primary point of contact (POC) for multiple interagency partnerships, including the National Geospatial-

Intelligence Agency (NGA), the Department of Defense (DOD), and the National Oceanic and Atmospheric Administration (NOAA).

Remote Sensing Coordinator

The Remote Sensing Coordinator provides advice and assistance to HQ, regional, and field personnel regarding remote sensing technologies, platforms, and acquisition processes.

The Remote Sensing Coordinator oversees and trains the NRCC Remote Sensing Specialists (RMSP), who perform remote sensing collection management and provide collection management authority during major incidents.

The position is responsible for serving as the collection management authority, who coordinates with FEMA offices, programs, and interagency partners for remote sensing acquisition, processing, exploitation, production, and dissemination support prior to activation of the NRCC, Regional Response Coordination Centers (RRCC), National Incident Management Assistance Teams (N-IMAT), or Joint Field Offices (JFO).

The Remote Sensing Coordinator assists the FEMA GIO with processing of requests for the use of NGA analytical teams or deployable personnel.

The Remote Sensing Coordinator collaborates with the DHS Intelligence and Analysis Directorate Geospatial Intelligence (GEOINT) collections staff for tasking of National Technical Means (NTM) systems or commercial satellites on contract to the NGA.

Modeling Coordinator

The Modeling Coordinator provides leadership, coordination, expert advice, and guidance regarding the development and application of complex exposure, risk, and loss models for multiple hazards; supports disaster response, mitigation planning, expedited damage assessments, urban search and rescue (US&R), preparedness activities, exercises, and long-term recovery operations. This includes the development of innovative scientific methods and geospatial techniques, hydro-meteorological forecast and geophysical engineering models, hazard-vulnerability relationships, and predictive risk analytics across multidisciplinary resources.

The Modeling Coordinator is responsible for establishing effective and sustainable working relationships among program areas and partners from federal, state, and local government; academia; and the private sector and leads coordinated interagency modeling and data collection efforts during emergency response and recovery operations. This includes the development and implementation of modeling resources, training, standardized data collection and derived-analytics mission assignments, and interagency agreements. These collection efforts also include expert reach-back support for analytical modeling and data products used for planning, situational awareness, risk communication, and non-disaster projects.

Mapping and Analysis Center (MAC)

The principal focus of the Mapping and Analysis Center (MAC) is to provide response-oriented geospatial analysis during steady-state and operational periods; however, the MAC may also be tasked to provide support on a one-time, recurring, or ongoing basis. The MAC also provides reach-back mapping and analytic support to various FEMA programs, regions, and incident support operations (e.g., the NRCC, RRCC, and/or JFO operations). To successfully fulfill this mission, the MAC has a staff of highly skilled GIS and RMSPs.

For more information, contact FEMA-MACMAPS@fema.dhs.gov.

Recovery GIS Team

The Recovery GIS team's role is to integrate geospatial analysis into the decision-making processes within the Recovery Directorate. The Recovery GIS team coordinates with HQ, regional, and field recovery staff to best determine the level of support they can provide to help serve the needs of the IA and PA programs during disaster incidents. The Recovery GIS team also collaborate with the entire FEMA GIS community to help identify sources of data and types of geospatial analysis to best support FEMA.

National Watch Center (NWC) GIS Team

The NWC GIS team's mission is to provide initial geographical data and visual information for all incidents, both natural and man-made. Using GIS capabilities, the NWC GIS team assists with FEMA's 24/7 situational awareness response efforts. GIS products are shared within the FEMA/DHS GIS community, other federal agencies, state emergency management, and the public GIS domain.

Office of Chief Information Officer (OCIO) – Expeditionary Enterprise Engineering (E3)

The E3 team provides survivor-centric support of the FEMA enterprise through field-based integration and implementation of emerging technologies, which enable citizens and first responders to prepare for, protect against, respond to, recover from, and mitigate all hazards.

The E3 team establishes and supports technology cultivation practices for development of deep field-based solutions and addresses challenges adversely affecting the whole community. While deployed to the field, the E3 team collaborates with stakeholders to identify, design, build, field test, and deliver solutions that expedite the delivery of survivor services while subjected to adverse, high stress, austere environments. When not deployed, the E3 team leverages the FEMA Laboratory to refine, build, and foster acceptance of collaborative, targeted solutions and services based on data-driven analytics.

Regional Geospatial Support

FEMA has 10 regional offices located throughout the country, each led by a Regional Administrator (RA). These regional offices work closely with other federal agencies and strategic partners, as well as SLTT officials, who support FEMA's mission and core competencies. When an RRCC is stood-up in response to an incident, the Regional Geospatial Coordinator (RGC) and GIU provide geospatial support.

Regional Geospatial Coordinator

The RGC is responsible for engaging and maintaining relationships with geospatial stakeholders within their region, both within FEMA and among SLTT and intergovernmental partners. Illustrative examples of the outreach and engagement activities that RGCs should engage in include the following:

- Developing a regional GIS Working Group composed of regional staff, GIS practitioners, risk analysts, and representatives from regional branches. Meetings should be held monthly to share information and foster collaboration.
- Developing an external partner GIS Working Group composed of geospatial representatives from each of the region's constituent states, a National Guard representative for each state, a federal geospatial lead for the region, and members of the regional GIS Working Group. Webinars or meetings should be held bi-monthly to share information and foster collaboration.
- Attending quarterly meetings with state planning partners and delivering briefings on current GIS activities and initiatives.
- Attending quarterly Regional Interagency Steering Committee (RISC) meetings and delivering briefings on geospatial capabilities, best practices, and lessons learned.
- Holding bi-annual, in-person or Webinar meeting with all regional GIS staff members.
- Traveling to the region's constituent states to conduct in-person meetings with state GIS partners.
- Participating in state-led exercises when possible and working to incorporate states into regional- and national-level exercises.
- Maintaining an ArcGIS Online group for sharing data among geospatial partners.

Regional GIS Resource Center (RGRC)

A Regional GIS Resource Center (RGRC) should be located in the Response Division or other program office that can provide FEMA and region-wide umbrella services and inform operational incident decision making. To be most effective, an RGRC should be proactive in undertaking collaborative efforts such as face-to-face meetings and GIS workshops with critical stakeholders to manage information sharing and product requirements. FEMA regions, HQ, and critical stakeholders at the local, state, and federal levels are key to an effective RGRC. Additionally, an RGRC does the following:

- Ensures FEMA supports its steady-state mission, including mitigation and preparedness efforts;
- Supports the ability for a region to quickly transition to life-saving and life-sustaining efforts within the response and recovery mission areas; and
- Is equipped to support HQ (virtually), as well as multi-regional operations in the event of a catastrophic incident.

Creating a standard, unified RGRC across each of the 10 FEMA regions requires commitments of personnel and equipment. Figure 3 provides an example of the staff an RGRC should employ, but the staff can be customized to meet the needs and resources of particular FEMA regions.

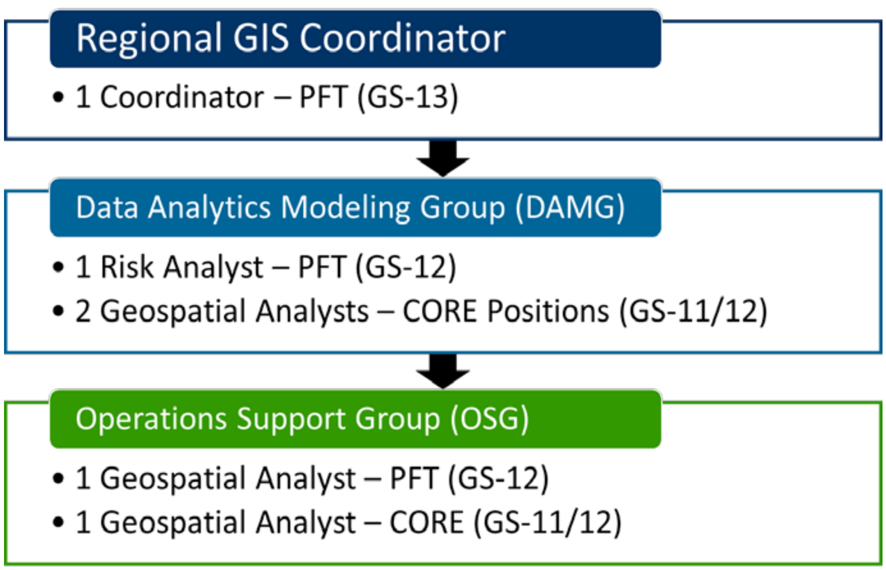


Figure 3: Example Regional GIS Resource Center Staff

The following list provides a suggested model for staffing and equipping an RGRC:

- **Personnel**: A team of six personnel should staff each RGRC. Three Permanent Full-Time (PFT) (General Schedule [GS] 12/13) positions help to establish a solid foundation of permanent employees to build and maintain the GIS infrastructure. The PFT positions will be supported by three additional career ladder (GS 11/12) Cadre of On-Call Response and Recovery Employees (CORE), who will bring specific backgrounds to the RGRC.
- The team should be led by an RGC: a PFT staff person at the supervisory GS-13 level. The RGC should oversee two operational teams: the Data Analytics Modeling Group (DAMG) and an Operations Support Group (OSG).
    - The DAMG should be staffed by three personnel: one PFT risk analyst (GS-12) and two CORE geospatial analysts (GS 11/12).
    - The OSG would be staffed by two geospatial analysts: one PFT at the GS-12 level and one CORE at the GS-11/12 level.

- **Equipment**: Each RGRC must have standard hardware and software. Geospatial analysts require high-end workstations to perform routine and complex spatial analysis. Given the nature and complexity of these tasks, baseline and standard computers issued to non-GIS staff are not suitable for performing intensive computational tasks. Standardization is essential to the ability of FEMA to simultaneously support multiple Level I, II, or III incidents in a virtual environment or function in a devolution environment.

The risk associated with not properly equipping geospatial staff with the proper hardware and software include an inability to meet core competencies, incomplete or sub-standard analysis for programmatic requirements, or a delay of analysis (days to weeks) because of geospatial staff seeking alternative approaches in conducting the requested analysis.

For a complete list of technical specifications, see the OCIO's One-One-One page: https://intranet.fema.net/org/ms/ocio/aees/Pages/OneOneOne.aspx.

Chapter 4: Data Policies, Sources, and Management

Data management, including geospatial data management, is a priority for FEMA leadership as it strives to conduct and use better analytics and to make more informed operational decisions for the deployment of resources and delivery of survivor assistance. Historically, FEMA's data management occurred without consistent policies and procedures in place. The *Geospatial Support for Disaster Operations Guide* is intended to fill that gap by establishing firm data management standards, structures, and procedures that the FEMA geospatial community is responsible for implementing and sustaining.

Standards and Directives

Several directives issued by FEMA, FEMA's program offices, and interagency geospatial organizations provide key guidance on geospatial operations, data sources, and metadata.

FEMA Directive (FD) 141-1 Archiving and Presentations: Uses, Standards, and Responsibilities

To comply with FD 141-1, in consultation with Records Management, place all geospatial data in one folder, file share, or server and create a spreadsheet or other catalog of all the geospatial data for each region and for HQ. This catalog will, at a minimum, contain the following:

1. **Dataset Name:** The official name of the dataset from FEMA, contractor, or other data provider. This includes open source datasets from non-governmental organizations and other governmental organizations and datasets that have a handling caveat.
2. **Source:** The name of the organization, agency, company, or other entity supplying the data.
3. **Currency Date:** The date that the dataset was received or last updated.
4. **Refresh Rate:** How often the dataset is pulled, received, or edited.
5. **Description:** A description of the dataset.
6. **Classification:** The overall classification of the dataset. Only unclassified datasets can reside on the unclassified network.
7. **Handling Caveat:** A caution on how to handle and disseminate the data.
8. **Creation:** Was the dataset created or modified by FEMA (Yes/No)?
9. **Location:** The location of the dataset. This location should be in the Universal Naming Convention (UNC) format. For Microsoft Windows, the typical UNC naming convention is: \\ComputerName\SharedFolder\Resource.

If the dataset is created by, for, or modified by FEMA, the data must be retained as a FEMA record. In a situation where the data is modified or analyzed by FEMA for the creation of reports, tables, maps, or other forms of analysis, as per FEMA's Records Disposition

Schedule (FEMA Manual 141-1-1b), this altered data should be stored temporarily and can be deleted when no longer needed. This temporary data should be reviewed annually to prevent the unnecessary storage of large amounts of data.

If the dataset was not specifically created by, for, or modified by FEMA but was used for the creation of a map or analytical product, the data is the record of the data provider or owner and does not need to be retained. FEMA does not have to maintain a permanent record for data pulled from another agency, but it must transfer that database annually to the National Archives for record management, as per FEMA's Records Disposition Schedule (FEMA Manual 141-1-1b).

According to FEMA Manual 141-1-1, Section 2-10, during a Presidential declared disaster, a declaration of an incident of national significance, as defined by the National Response Plan, or an executive, congressional, or judicial order to retain or freeze all records associated with the incident, a special records collection (SRC) will be established. The incident folder will serve as the SRC.

Required Standards for Review

- FGDC-ISO-19115: Geographic Information – Metadata
- FGDC-STD-001-1998: Content Standard for Digital Geospatial Metadata (CSDGM)
- FGDC-STD-016-2011 United States Thoroughfare, Landmark, and Postal Address Data Standard
- Program Directive 2014-013: US&R Search Operations Data Collection and Reporting Standards
- FEMA Directive 092-5: *Use of the United States National Grid (USNG)*

Data Sources

FEMA geospatial analysis has access to a variety of data sources, including the following:

- **Local Data:** The preferred foundational datasets for geospatial operations are local datasets. Local datasets contain data maintained by the institution or agency that owns or directly manages the data (e.g., public school locations provided by the county or state). Locally managed datasets are preferable to nationally aggregated data or datasets maintained by third-party entities.
- **Event Data:** Event data is new information created as part of a disaster operation. This information should be stored according to standard storage and naming conventions identified in this chapter.
- **Enterprise Data Warehouse (EDW) Data:** EDW is a central repository that holds data from a wide variety of FEMA sources, including databases for IA, PA, and Hazard Mitigation Assistance program data.
- **National-Level Datasets:** If no local information is available, it is acceptable to use national-level datasets such as Homeland Infrastructure Foundation-level Data

(HIFLD), U.S. Geological Survey (USGS) national data, Environmental Systems Research Institute (ESRI) data, and others.

Data Management

Effective data management is the foundation for a successful information sharing and exchange environment within FEMA and among its mission partners. FEMA's geospatial community has developed the following geospatial data management best practices for storing and cataloging geospatial information. Table 2 outlines the three main types of data, identifies their primary function, and provides brief examples.

Table 2: Types of Data

Type of Data	Primary Function	Examples
Base Data	• Consists of all data that has been prepared and organized to be used for creating maps, analysis, etc.	• ESRI • HIFLD • Census • Hazards United States (HAZUS)
Ad Hoc Data	• Consists of information pulled for a one-time use or a derivative dataset created from an analysis or study of an ad hoc request. • This dataset maintains no further use for an occurring disaster or planning for a disaster and would not be useful as a base map.	• Drive-time dataset created by a request for a non-event or disaster-related activity • Hazard exposure map (intersecting parcels with hazard data)
Disaster Support Data	• Data created in support of an occurring or ongoing disaster. Must be retained and archived based on the archival procedures in the Archive Section.	• Flood depth grid • Hazard-characterizing datasets

Network Drives

Several systems already exist that maintain FEMA's geospatial data stores. The "J," "K," and "L" network drives are operated by OCIO and are a focal point of data storage and operations. For access to these drives, please contact the HQ Data Management team.

- **"J" Drive**: This drive operates as the main production drive for disaster operations. When an event is occurring, a location will be created on this drive to support all ongoing operations.
- **"K" Drive**: This drive is the location for all of FEMA's static storage. Copies of FEMA's base datasets reside in this location.
- **"L" Drive**: This drive maintains copies of software used for geospatial operations.

WebEOC

The FEMA Crisis Management System (i.e., WebEOC), a cloud-based platform, is one of FEMA's Mission Essential Systems that provides a common operating picture and situational awareness for FEMA, SLTT, and federal interagency partners during disaster operations. The

FEMA Crisis Management System is the system of record for reporting and records management.

Databases

Several databases and data stores are maintained at FEMA. Because this changes frequently, contact the data steward for an updated list of connections and databases.

Data Life Cycle

The data life cycle of base geospatial datasets will depend on the release cycle of the dataset. When copying a new base geospatial dataset into the data share, place a notepad document into its directory detailing the date the source was obtained, the date it was created, and the date that this data needs to be reviewed for replacement. The data steward should check data shares on a quarterly basis at a minimum, regardless of the listed time for replacement. Follow the procedures identified in FD 141-1 if the data requires maintenance.

Storage Plan

FEMA HQ, regions, JFOs, and other elements shall maintain the same folder structure as identified in the *Geospatial Support for Disaster Operations Guide*. The baseline folder structure shall be maintained so that analysts that report to various regions and incident locations can efficiently begin working without adjusting to an entirely different folder structure environment.

To manage changes to the standard folder structure, data stewards take requests for adjustments that are taken under consideration by FEMA's data community.

Continuity of Operations

A Continuity of Operations Plan is a contingency plan that describes how operational elements will relocate, maintain essential operations, and reconstitute their operation, if necessary. The Planning Support Unit Leader (PLSL) within the Planning Section writes and coordinates the Continuity of Operations Plan. On an annual basis, the Geospatial Information Unit Leaders (GIUL) should back up a full copy of baseline data needed to ensure products can be replicated.

Metadata Field Population

FEMA strives to include Federal Geographic Data Committee (FGDC)-compliant metadata to meet the standards set by the larger geospatial community. The reference documents provided in the following link explain and encourage data providers to meet this standard: http://www.fgdc.gov/metadata/documents/MetadataQuickGuide.pdf.

Data providers should use “NA” (for Not Applicable) text for elements that are unable to be populated. This allows automated checks to pass over these values instead of catching them as blanks or errors when no values are input.

Per Executive Order 12906 and OMB Circular A-16 Revised (2002), FEMA datasets should be documented in compliance with FGDC-endorsed metadata standards, such as the International Organization for Standardization (ISO) 19100 series.

References and Additional Information

Refer to the following published FGDC materials for additional information:

1. Metadata Recommendations Supporting Data Discovery and Use in Data.gov and the Geospatial Platform (https://cms.geoplatform.gov/sites/default/files/document_library/DataGov%26GeoPMetadataRecommendations_Published20170614%20%281%29.pdf)
2. National Geospatial Data Asset (NGDA) Metadata Guidelines (https://cms.geoplatform.gov/sites/default/files/document_library/NGDA_Metadata_Guidelines_v3.pdf)
3. Example CSDGM Metadata Record (https://cms.geoplatform.gov/sites/default/files/document_library/ofr-98-38.zip)
4. Example ISO format (Extensible Markup Language [XML]) Metadata Record (https://cms.geoplatform.gov/sites/default/files/document_library/ofr-98-38-iso.zip)
5. How to Get Your Open Data on Data.gov (http://www.digitalgov.gov/resources/how-to-get-your-open-data-on-data-gov/)
6. ISO Metadata Standards (https://www.fgdc.gov/metadata/iso-standards)

Data Ownership

A data steward will be designated for each area of operations by the GIO. There is a data management team at FEMA HQ under the direction of the GIO, one data steward is located within each FEMA region, and a data steward is designated for each JFO. The HQ-level data management team is available to provide reach-back support if an element needs assistance in maintaining an element’s geospatial data store. The Data Governance Board has developed several documents that address the data steward’s responsibilities for operations.

Data steward responsibilities include the following:

- Coordinating with the other data stewards throughout FEMA;
- Notifying users of major structural changes to data stores (e.g., removal, updates, or replacement of major data sources);
- Managing user access to data systems, in coordination with Information Technology (IT);

- Keeping information in the data steward’s data shares current and organized according to stablished data management standards; and
- Eliminating data duplication by staying current on new datasets created on the shares.

Ownership of Publicly Available Resources

Resource owners will likely require a basic use policy for most internal resources and a more comprehensive policy for resources made publicly available. A matrix or table must be maintained of all publicly available resources, including but not limited to the owner, custodian, policies, date of resource publishing, date of last content update or audit, and date of last metadata update or audit. The matrix should be a “living” document, regularly updated and stored in the documentation portfolio. For more information, see Chapter 7: Production and Dissemination.

Product Management

File Naming Conventions

The following paths and fields will be applied to all file names, where applicable, depending on whether the file is intended for incident support or incident management. Table 3 provides an explanation of and examples for each of the name components. Geospatial analysts should ensure that all final map products adhere to this standard.

Table 3: File Naming Components

Component	Description	Examples
GeoFrameworkMapNumber	The number that corresponds to the map product in the GeoFramework	6_EssentialFacilities_20170901_1700
GeoFrameworkMapName	The GeoFramework map name	6_EssentialFacilities_20170901_1700
YYYYMMDD	• Four-digit year • Two-digit month • Two-digit day	6_EssentialFacilities_20170901_1700
HHHH	Time of production in 24-hour format local time	6_EssentialFacilities_20170901_1700

File Naming Convention

Geospatial analysts should use the following naming template for their final map products: GeoFrameworkMapNumber_GeoFrameworkMapName_YYYYMMDD_HHHH.

File Naming Exceptions

During an incident or steady-state, exceptions to the standard file naming convention will need to be made. Changes are expected, and users should not try to force an ad hoc or alternative map into one of the GeoFramework map types. If you have a custom map for an event, the convention will adjust as follows: MapName_YYYYMMDD_HHHH.

Policies, Rights, Practices for Access, and Sharing

Access to regional geospatial data share drives and geospatial data share at HQ should be coordinated through the Geospatial Data Steward of the location in which the share drive is located. All GIS professionals should have access to the HQ and regional geospatial data shares. To gain access to the HQ geospatial data shares, contact the HQ Data Management team; for WebEOC, contact the WebEOC team. Policies for security are maintained by the Office of the Chief Information Officer, but the Geospatial Data Steward for the drive may provide guidance for your location.

Data Handling

When interacting with geospatial data, it is important to take note of the handling and safeguarding requirements. Table 4 provides definitions of unclassified data that a geospatial analyst may encounter.

Table 4: Unclassified Data Types

Handling Requirement	Authorities	Definition
For Official Use Only (FOUO)	Department of Homeland Security (DHS) Management Directive System: "Safeguarding Sensitive But Unclassified (FOUO) Information"	Unclassified information of a sensitive nature which could adversely impact a person's privacy or welfare, the conduct of federal programs, or other programs or operations essential to national interest
Personally Identifiable Information (PII)	DHS Handbook for Safeguarding Sensitive Personally Identifiable Information, March 2012	Information that permits the identity of an individual to be directly or indirectly inferred
Sensitive PII	DHS Handbook for Safeguarding Sensitive Personally Identifiable Information, March 2012	PII which if lost, compromised, or disclosed without authorization could result in substantial harm, embarrassment, inconvenience, or unfairness to an individual

CHAPTER 5: MODELING CAPABILITIES

Models are a computational tool that processes, analyzes, collates, simulates, or enables the visualization and understanding of data. Modeling involves integrating known demographic, infrastructure, exposure, engineering, geographic, and historical events with expected characteristics generated by a specific incident, including hazardous materials releases, ground shaking, flood inundation, or wind. The product of this integration is an estimate of the effects an incident will have on societies and the environment, which are used for problem solving and decision support.

Models are normally developed in steady-state using best available datasets and methodologies. Model results are tested with data from past disaster events and verified with available data, such as damage assessments, flood depth grids, imagery, etc. This gives users an understanding of the accuracy and confidence level regarding a model's outputs. GIS-based models can then be scripted and automated to provide consistent deliverables in future disaster events. FEMA routinely activates these models to see what damage may occur if there is a high risk of severe weather, flooding, or a tropical storm or hurricane.

As shown in Figure 4, raw data or information flows through iterative steps of data collection and data processing (i.e., event characterization models/analysis and consequence models/analysis). The iterative collection and processing of information supports operational decision making through impact estimates and decision support tools that help to identify mission-specific requirements.

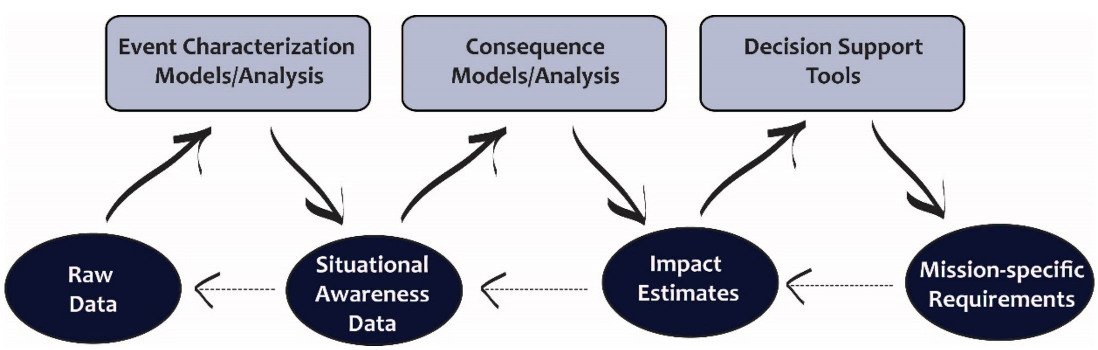
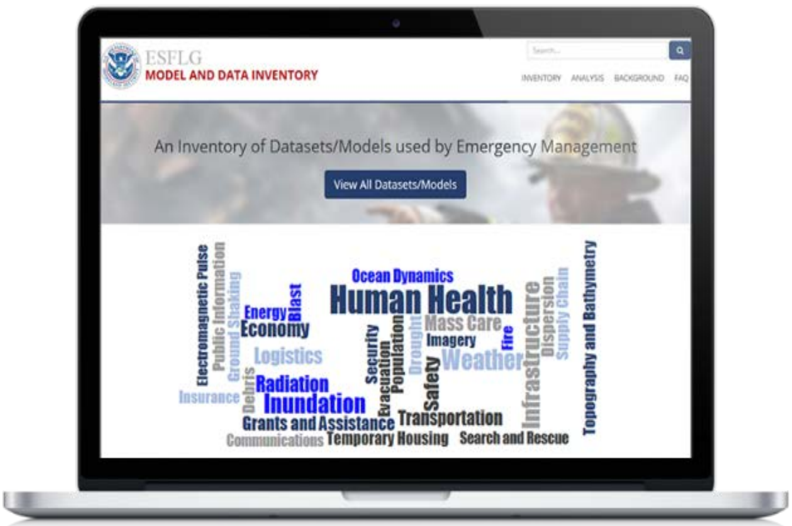


Figure 4: Modeling Information Framework

The ability to estimate consequences with reasonable accuracy allows decision makers to initiate preparations for identifying and mobilizing resources required for responding to anticipated impacts. The ability to prepare in advance of an actual incident can significantly reduce the time required to deliver critical resources to affected areas and help mitigate potential impacts. Models are often the best sources of information for planning factors in the immediate aftermath of an incident.

Modeling and Data Working Group (MDWG)

The MDWG is a sub-working group to the Emergency Support Function Leadership Group with a mission to identify consistent, reliable, and authoritative models and datasets for response planning and operational decision making for catastrophic events. The MDWG has worked to assess the current modeling systems in use, including their owners, requirements, consumers, production processes, and means of public messaging. This information captured is maintained in the MoDI (Figure 5).



For more information or to join the MDWG, contact FEMA-MDWG@fema.dhs.gov.

Model and Data Inventory

The MoDI is a Web-based catalog of individual models and datasets, including quick summaries, technical details, and contact information to support end users and technical specialists. Each entry is tagged with information about when the dataset or model is most effective during emergency response operations and for which hazard(s), core capabilities, and emergency support functions it is applicable to.

The MoDI is an interactive tool that provides an analyst with the framework categorization, description, access constraints, required data inputs, and contact information for all known modeling and data resources for steady-state planning and real time operational response.

Model and Data Validation

Validation is the process of determining that a model or simulation implementation and its associated data accurately represent the developer's conceptual description and specifications. Validation is used to keep inventory up to date and relevant to mission requirements. Field data collection and remote sensing are used to verify and evaluate model analyses.

Coordination

It is essential that modeling efforts be well-coordinated and carefully implemented in emergency management. The use of slightly different data sets can produce vastly different outputs. This can lead to ineffective decision making, lower confidence in models, and ultimately result in negative outcomes for disaster survivors. Analysts must ensure there is consensus regarding which set of data is used when using a model in support of exercises and emergency response operations.

Using the HAZUS Model for Response and Recovery Operations

The HAZUS model estimates the impacts of flood, hurricane winds, hurricane surge, tsunami, and earthquake events. HAZUS can be quickly used to support response operations for all five supported hazards, assuming that hazard data sets are available from FEMA's partner science agencies.

Disaster response modeling can be done rapidly for earthquakes using USGS ShakeMap hazard data, for hurricane winds using NOAA National Hurricane Center HURREVAC data, and for Tsunami's using momentum flux and depth grid information from the NOAA Pacific Marine Environmental Laboratories and Nation Tsunami Warning Center.

The HAZUS model's disaster response use in riverine and coastal flooding events is more challenging because the availability of authoritative flood hazard data sets from these events is inconsistent. Flood hazard models are commonly developed by a variety of Federal partners (e.g., FEMA, USGS, NOAA, U.S. Army Corps of Engineers, and the National Water Center) but are often not available in a timely manner, and the validity of these various models should be researched to determine the best available source. In addition to disaster response applications, HAZUS is frequently used for mitigation planning, catastrophic planning, flood risk analysis, and a variety of other risk assessment efforts.

HAZUS predictive impacts gauge event-specific financial burden from several sources, including economic loss (e.g., direct losses from damaged structures, lost jobs, and business interruptions), damage to infrastructure and buildings, and casualties (tsunami and earthquakes only). Other impacts include the displaced population seeking shelter, the number and type of essential facilities damaged (e.g., hospitals and schools), tons of debris accumulation, and the estimated number of trucks needed to remove debris. Some interagency users have developed methods to interpret and/or process HAZUS outputs to estimate additional event impacts, such as temporary housing resource needs, affected populations, and personnel required to field Small Business Administration loan applications.

HAZUS incorporates data from several external sources. The American Hospital Association Hospital Location Data is included as an internal dataset. Transportation infrastructure and network data is used from the Department of Transportation, National Transportation Atlas Database. Elevation data from the USGS National Elevation Dataset are accessed directly from the model for flood modeling. Education data is from the Integrated Postsecondary Education System Data and the Department of Education Common Core Data. As HAZUS inventory data is updated in 2018/2019, the inclusion of enhanced general building stock data through building footprints and the addition of the Open HIFLD library for infrastructure are being explored.

CHAPTER 6: REMOTE SENSING CAPABILITIES

Remote sensing is the science of obtaining data about objects or areas from a distance. Remotely sensed data may be collected from airborne, space-based, or terrestrial systems and can enhance pre- or post-disaster situational awareness and assessment, help answer incident-specific Critical Information Requirements (CIRs), or provide measurements and observations to validate, refute, or refine analytical models. Remotely sensed data helps drive more accurate, useful, and timely decision making for response and recovery operations.

Response Operations

- **More efficient evacuations:** Visible and motion imagery is used to monitor evacuation routes and to detect survivor encampments or gathering places.
- **More timely and comprehensive situational awareness:** When conditions permit, a single post-incident satellite image may provide information about conditions and impacts over thousands of square kilometers. Likewise, airborne sensors aboard manned and unmanned aircraft can provide more timely and comprehensive information about the size and scope of a disaster than isolated ground teams or survivors.
- **Better focused and more timely deployments and employment decisions:** Imagery, Light Detection and Ranging (LiDAR), and Radio Detection and Ranging (RADAR) can be used to locate areas of worst impact, identify degraded or impassable routes, enable more efficient routing of US&R teams and supply convoys, hasten and focus deployments of national assets and logistics, and support site selection analyses.

Link Between Modeling and Remote Sensing

Modeling and remote sensing concepts are intrinsically linked in emergency management. Given time constraints, these two disciplines combine to estimate—and later validate or confirm—disaster impacts expeditiously and methodically. Modeling natural hazards risk and impacts relies on expert opinions, engineering parameters, data collection and development, along with many mathematical or statistical assumptions about the natural and built environment. To the extent possible, loss and impact models rely on well-tested, proven coupling with atmospheric or geophysical instrumentation and sensors, affording emergency managers the ability to estimate extensive requirements and resource needs with confidence. Uncertainties exist in a model, however, and observation data serves to stanch uncertainties by confirming model estimates. Field-verified data, such as HWMs, and remote sensing provide the means for evaluating and validating model results.

Recovery Operations

- **Expedited declaration recommendations and Presidential declarations:** Imagery-derived damage assessments can help confirm state or tribal assessments, help expedite FEMA's validation of declaration requests, and enable timelier Presidential declaration decisions.
- **Reduced housing inspection costs:** Imagery-derived damage assessments can be completed faster than ground inspections and can greatly reduce the cost of delivering IA to disaster survivors.

Common Emergency Management Applications

While remotely sensed data is especially important during disaster response and recovery, Table 5 identifies how this data can be employed across the entire emergency management mission spectrum.

Table 5: Common Applications of Remotely Sensed Data

Mission Area	Common Applications of Remotely Sensed Data
Prevention	• Satellite and aerial imagery can be used to detect and monitor terrorists and their associated conveyances and facilities. • Remotely sensed data supports prevention mission planning and execution.
Protection	• Imagery can be used to assess and monitor critical infrastructure and key resources that may be threatened by man-made or natural disasters. • Remotely sensed data supports protection mission planning and execution. • Satellite-derived weather and climate data enables early warning and monitoring of dangerous weather events (e.g., hurricanes, tornadoes, and floods) and helps predict mudslides, wildfire outbreaks, and flooding or drought.
Mitigation	• The Flood Insurance and Mitigation Administration (FIMA) uses historical and current imagery to detect temporal changes to urban areas and infrastructure sectors. • FIMA's RiskMap program relies heavily on elevation data collected by aerial and space-based sensors for advanced flood modeling, flood zone designation, flood insurance updates, and flood map production. • Imagery, Light Detection and Ranging (LiDAR), and Radio Detection and Ranging (RADAR) support long-term risk analyses. • Imagery, LiDAR, and RADAR data can be used to validate and refine hazard impact models and modeling applications.

Mission Area	Common Applications of Remotely Sensed Data
Response	• Remotely sensed terrestrial, atmospheric, oceanographic, and climate observations enable planning, early warning, forecasting, and monitoring of dangerous weather events or conditions (e.g., hurricanes, tornadoes, floods, mudslides, Red Flag warning areas). • Visible and Infrared (IR) imagery support wildland and urban fire detection and monitoring and support burned area analyses and mudslide predictions. • Analysis of pre-disaster, disaster, and post-disaster imagery and radar data supports response and recovery planning, situational awareness, modeling, and decision making by the following: o Locating and assessing size and scope of disaster areas o Confirming and characterizing severity and patterns of damage o Detecting air, water, and soil pollution or toxic contamination o Assessing the impact of drought on vegetation, hydrology, and wildland fire fuel stores o Identifying inundation extents and flood impacts o Locating and analyzing debris fields o Detecting and assessing damage to roadways, bridges, airports, and seaports o Identifying and characterizing impacts to critical infrastructure, public buildings, and dwellings
Recovery	• High resolution aerial and satellite imagery is used to validate modeled damage assessments, which can expedite house-by-house inspections. Inundation modeling from remotely sensed data can be used to expedite rental assistance disbursements through early identification of inaccessible communities.

Remotely Sensed Data Acquisition and Utilization

During disasters, FEMA's processes for obtaining and using remotely sensed data generally follow FEMA disaster life cycle information management principles, the DOD intelligence doctrine, and the intelligence process.

Planning and Direction

For Significant[1] Notice Incidents

In anticipation of an RRCC or NRCC activation, personnel from the Response Planning GIS Office, including the Remote Sensing Coordinator, establish initial remote sensing collection and production requirements and priorities in conjunction with Response Operations and GIS personnel from the FEMA NWC and Regional Response Coordination Staff (RRCS), Planning Section, SAS, and GIS Unit (GISU) personnel at the affected FEMA region(s), who, in turn, will coordinate collection requirements with affected state or tribal officials.

For Significant No-Notice Incidents

In anticipation of or upon activation of an RRCC pursuant to a large no-notice incident, RRCS, Planning Section, SAS, and GISU personnel at the affected FEMA region will convey remote sensing collection and production requirements and priorities to personnel at the FEMA NWC, who, in turn, will coordinate requests with the FEMA Response Planning and

[1] An incident which, because its severity, size, location, and actual or potential impact on public health, welfare, and infrastructure, requires an extreme or high amount of direct federal assistance for response and recovery efforts.

Exercise Division and FEMA Response Planning GIS personnel, to include the Remote Sensing Coordinator. In situations where the FEMA region(s) are unable to provide timely input, the FEMA Remote Sensing Coordinator or their representative may initiate remote sensing data acquisitions in anticipation of a formal request from the impacted region(s) or state(s).

Team Augmentation

If NRCC or RRCC GISU staffing is insufficient to enable development and management of remote sensing collection and production requirements, either organization should request augmentation by GEOINT or collections management specialists. NRCC or RRCC staff members would prepare the Resource Request Form (RRF) and coordinate this Mission Assignment (MA) with DOD liaison personnel.

Remotely Sensed Data and Production Requirements

RRCS, Planning Section, SAS, and GISU personnel at the affected FEMA region (or NRCC, if activated), in conjunction with analysts and the Remote Sensing Coordinator from the Response Planning GIS Office, shall review existing regional and national plans (or incident-specific annexes) for preliminary CIRs and Essential Elements of Information (EEI) that could be wholly or partially answered by remotely sensed data or products. If CIRs or EEIs do not exist or are insufficient, the aforementioned staff should collaborate to develop them.

Remotely Sensed Data Collection and Production

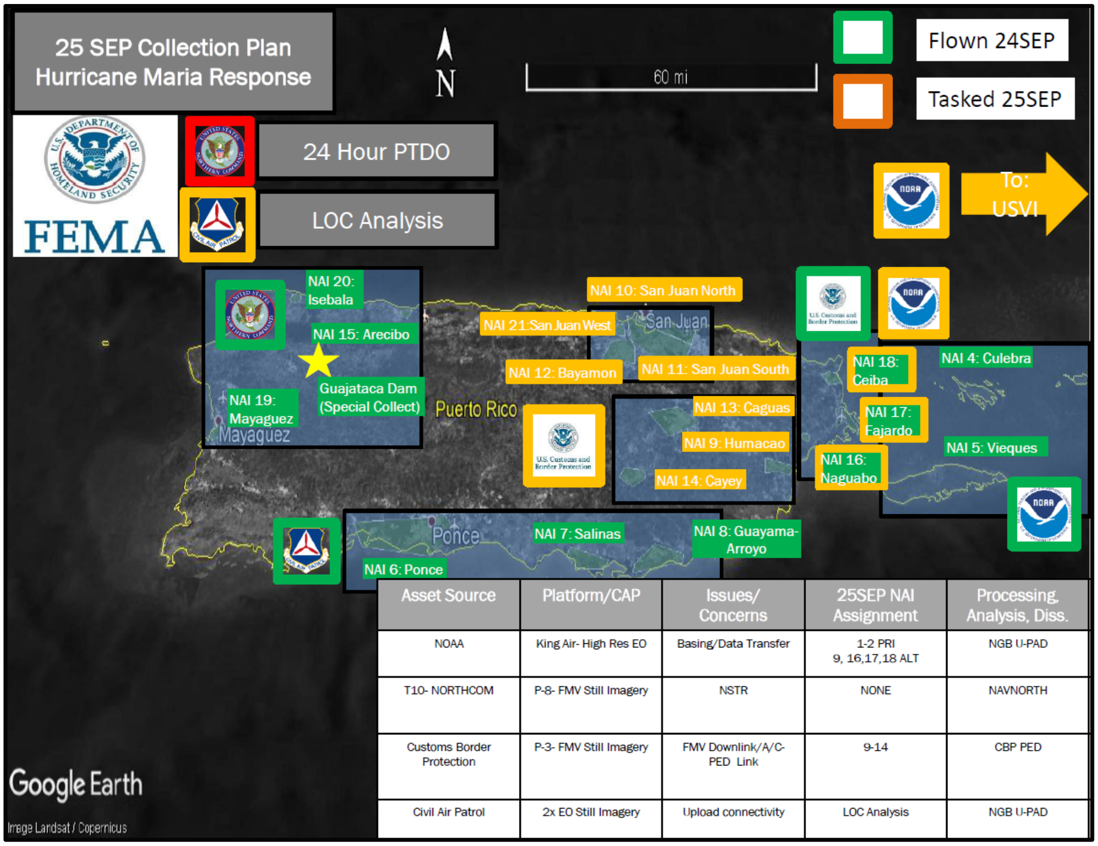
The NRCC RMSP or remote sensing collection management team, if formed, supports the RRCS and then the Federal Coordinating Officer (FCO)/Unified Command System (UCS) once the RRCS stands down. Ideally, the NRCC and RRCC staff develop echelon-specific remote sensing collection and production requirements and incorporate them into their daily information collection plans that accompany regional and national support plans.

As a minimum, echelon-specific remote sensing collection planning should identify the following:

- Prioritized areas of interest (AOI) and points of interest for data collection;
- Available and tasked platforms and sensors;
- Associated CIRs, EEIs, and observables;
- Collection dates and times for the next 96 hours;
- Remotely sensed data processing requirements and resources; and
- Related exploitation, analysis, production, and dissemination requirements, priorities, and delivery timelines.

Remotely Sensed Data Collection and Production Tools

NRCC and RRCC GIS analysts or RMSPs should develop graphical remote sensing collection plans and maintain consolidated remote sensing collection matrixes similar to the example shown in Figure 6.



Asset Source	Platform/CAP	Issues/ Concerns	25SEP NAI Assignment	Processing, Analysis, Diss.
NOAA	King Air- High Res EO	Basing/Data Transfer	1-2 PRI 9, 16,17,18 ALT	NGB U-PAD
T10- NORTHCOM	P-8- FMV Still Imagery	NSTR	NONE	NAVNORTH
Customs Border Protection	P-3- FMV Still Imagery	FMV Downlink/A/C-PED Link	9-14	CBP PED
Civil Air Patrol	2x EO Still Imagery	Upload connectivity	LOC Analysis	NGB U-PAD

Figure 6: Example Graphical Remote Sensing Collection Plan

Collection Requirements and Collection Operations Management

Once the appropriate RRCC or NRCC leadership develops and approves the remote sensing data collection and production plan, RRCC or NRCC GIS or remote sensing personnel prepare the RRF, as necessary, to mission-assign federal remote sensing partners, or RRCC or NRCC leadership coordinates to issue contracts that enable remote sensing activities. The Remote Sensing Coordinator, NRCC RMSP, or designees shall assist regions, N-IMATs, and JFOs, as necessary. The FEMA echelon that controls the disaster fund surge account approves resource expenditures.

The Regional Operations staff, NRCC Geospatial Technical Group Supervisor (GTGS) RMSP, or the FEMA Remote Sensing Coordinator ensure that remote sensing collection requirements are reviewed, validated, and renewed for each operational period until no longer required. Regional and national remote sensing collection plans and priorities will be discussed at daily GIS Coordination Calls and daily Interagency Remote Sensing Coordination Calls (IRSCC), if established.

A primary task for the RRCC, NRCC, and UCG or JFO remote sensing or GIS staff during disaster response and recovery operations is to monitor daily remote sensing operations for duplications and mission accomplishment. Personnel must attempt to prevent unnecessary or duplicative data acquisitions, when possible. At the end of the operational period, unmet

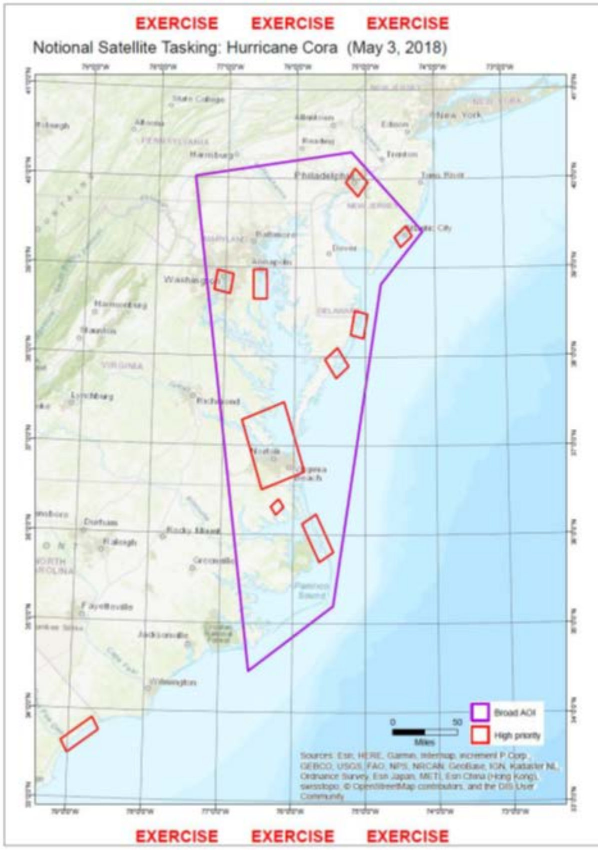


Figure 7: Notional Priority Areas for Data Collection

Identifying and Prioritizing Collection

When identifying information needed to develop a product, use the best available hazard, community infrastructure, and social vulnerability datasets to rapidly and accurately delineate areas for collection. Additionally, identify areas for data collection (AOI) according to preliminary models that estimate damage likelihood and the vulnerability of the population, and optimize data collection efforts and avoid duplicative collections.

remote sensing collection requirements will be revalidated, reprioritized, and carried over to the next operational period for collection, if valid.

Figure 7 shows a broad AOI with accompanying high priority areas of impact.

The GIS or remote sensing staffs should help amend MAs and contracts, as necessary, to ensure that remote sensing acquisition assets remain available to support IS or IM activities.

Sensor and Platform Selection

Interagency partners generally refer to remote sensing devices as “sensors” or “sensor systems,” which are contained in or carried aboard platforms such as aircraft or satellites. RRCC and NRCC GIS or RMSPs must consider a consumer’s data requirements (CIRs, EEIs, and observables) when selecting collection platforms and sensors.

Sensors can be passive or active:

- **Passive sensors** record natural energy reflected or emitted from objects or surfaces. The most common source of energy detected by passive sensors is reflected sunlight. Passive sensors are often classified or referred to by the portion of the electromagnetic spectrum they collect or operate in, such as visible, infrared (IR), or microwave.
- **Active sensors** use system-generated stimuli to collect data about objects and the Earth’s surface. For example, a LiDAR system projects one or more laser beams onto a surface and measures the time required for the laser energy to reflect back to the sensor. Synthetic Aperture Radar (SAR) is another common active sensor.

Table 6 identifies commonly used sensors and collection systems.

Table 6: Commonly Used Sensors and Collection Systems

Sensor	Desired Data	Collection Systems	Notes
Visible	Photographs	• Optical cameras. • Electro-Optical (EO) (digital) cameras, including Unmanned Aerial System (UAS) telephones or portable device cameras.	• Chemical film or digital media. • Hand-held or fixed systems. • May include integrated geo-tagging capability. • Photographs can be post-processed to add geo-tags. • Collected at vertical or oblique angles. • True color, red-green-blue.
Visible	Motion Imagery and Video (or Screen Captures)	• Day-night video cameras. • Mobile device video cameras. • Hand-held video cameras. • UAS video cameras.	• Higher-end systems may include integrated geographic data or on-image geographic referencing. • Provides chronological record along flight path. • May be real time, near-real time, or time-delayed, depending on communications and transmission equipment.
Visible	Interactive 360° Images Scenes	Vehicle or human-mounted cameras and Global Positioning System (GPS) equipment capture 360 ○ overlapping images that when stitched together provide a 360° view around a reference point.	Processed imagery can be posted and made available for use in mapping applications shortly following acquisition.
Visible	Electro-Optical/Infrared (EO/IR) Video (or Screen Captures)	Forward Looking Infrared Radar (FLIR) video camera and day-night video camera in a single pod.	• Higher-end systems may include integrated geographic data or on-image geographic referencing. • Provides chronological record along flightpath. • May be real time, near-real time, or time-delayed, depending on communications and transmission equipment. • Useful for detecting individuals.
Visible	Electro-Optical Panchromatic Imagery	Charged Couple Device on satellites, aircraft, or large unmanned aerial systems.	• Single image band is formed by using the entire visible spectrum commonly visualized in a greyscale image. • Often higher resolution than multispectral data, useful for detecting levels and patterns of damage within disaster areas, identifying debris fields, and determining the extent of flooding.

Sensor	Desired Data	Collection Systems	Notes
Visible/Infrared	Multi-Spectral Imagery	Derived by simultaneously measuring reflected or emitted energy across a variety of relatively narrow spectral bands ranging from ultraviolet to the thermal-infrared.	Useful for analyzing changes to an area before and after an event, detecting pollution in or toxic contamination of water and soil, assessing the impact of drought on agriculture, and providing a broad indication of flood inundation.
Visible/Infrared/ Microwave	Hyper-Spectral Imagery	Hyper-spectral systems collect cross-spectrum data for each pixel in the scene, with the purpose of finding objects, identifying materials, or detecting processes.	Useful for detecting pollution in or toxic contamination of water and soil or assessing the impact of drought on agriculture.
Infrared	Infrared Imagery	Passive instruments designed to detect naturally emitted short-, mid-, or long-wave radiation naturally emitted by various objects. May be obtained day or night.	Useful for determining wildland fire lines, hotspots, fire boundaries, and assessing damage to vegetation; supporting search-and-rescue activities, discriminating oil on water, and discriminating land from water.
Microwave	Radar Imagery	Synthetic Aperture Radio Detection and Ranging (RADAR) systems send and receive microwave pulses to determine the range and location of remote objects by measuring the returned signals.	• Detecting objects at distances where sound or visible light emissions are weak or non-existent. • Day or night capable. • All-weather capable.
Light Detection and Ranging (LiDAR)	Point Cloud	Light Detection and Ranging (LiDAR) is similar to RADAR, but instead of transmitting radio waves LiDAR transmits laser light pulses. A telescope receives the backscattered light, and a detector measures the intensity to produce a three-dimensional (3D) image.	• Operate as profilers and scanners during day or night conditions. • Serve as a ranging device to determine elevations (topography) and depths (in water).

Remote sensing platforms are most commonly categorized into space-based, airborne, and ground-based platforms. Table 7 outlines the advantages and disadvantages of space-based and airborne platforms.

Table 7: Advantages and Disadvantages of Space-based and Airborne Platforms

Advantages and Disadvantages of Space-based Data Acquisition	
Advantages	**Disadvantages**
• Rapid coverage of very large areas. • Consistent orbits and revisit times. • Rapid collection, sometimes in a matter of seconds. • Commercial and civil satellite data is generally taken vertically so it is easier to integrate with other GIS datasets.	• Mostly fixed, inflexible overflight times. • Single-scene acquisitions can be prohibitively expensive. • Passive sensors are adversely affected by clouds, smoke, and darkness.
Advantages and Disadvantages of Airborne Data Acquisition	
Advantages	**Disadvantages**
• Responsive. Can be redirected en route to changing situations or requirements. • Higher resolution data. Because they fly closer to the ground, these systems can generally collect more detailed and accurate data.	• Large area acquisitions may require multiple days of flying or multiple platforms. • Flights can be grounded or adversely impacted by excessive wind, turbulence, thunderstorms, clouds, and fog. • Passive sensors will be ineffective or less effective through smoke, clouds, and haze.

Space-based Platforms: A wide variety of remote sensing devices are mounted aboard unmanned satellites, manned space stations, and manned orbiters. Such platforms can carry multiple sensing devices that might act together or independently. Examples include RadarSat II, LandSat 8, and the International Space Station.

Airborne or Aerial Platforms: Sensors are carried aloft by manned and unmanned aircraft, including small Unmanned Aerial Systems (sUAS). As with space-based platforms, aircraft may carry multiple sensor types or systems. Examples include Civil Air Patrol (CAP) aircraft or military helicopters with onboard digital photographers or fixed digital or optical cameras.

Ground Platforms: Cameras and sensors can be mounted on poles, structures, people, and vehicles. Ground-based data collections can be very accurate and responsive but are subject to disaster, weather, safety considerations, transportation disruptions, and communications outages.

Interagency Remote Sensing Resources

Remote sensing partners are numerous, including DOD (Title 10) and National Guard (Title 32) military forces and numerous civil agencies, as described in the following sections.

National Technical Means Imagery Systems and NGA-Sponsored Commercial Satellites

FEMA can request data from national imaging systems, referred to collectively as National Technical Means. The data is generally classified, but NGA may approve downgrading and release of derivative disaster-related data. Requestors are encouraged to use these national assets judiciously. Consistent with Executive Order 12333 (Intelligence Oversight), all executive agencies must have an NGA-approved Proper Use Memorandum (PUM) that governs the collection, use, and storage of NTM data by agency personnel. FEMA's annual PUM is executed by FEMA's GIO.

The NGA Commercial Source Office also provides disaster-related commercial satellite data collected by select commercial satellite systems under contract to NGA. All requests for NGA or NTM imagery should be coordinated with the FEMA Remote Sensing Coordinator or their designee and processed through the DHS Intelligence and Analysis Collection Requirements Division and DHS Departmental Requirements Officers.

Civil Air Patrol (CAP)

CAP is a nonprofit corporation chartered by Congress, established by Public Law (Sections 201-208 of Title 36 U.S.C.), and designated as a volunteer civilian auxiliary of the U.S. Air Force (USAF) by Section 9441 of Title 10 U.S.C. CAP is organized into a national HQ, eight geographic regions, and 52 wings (one wing in each state [including the District of Columbia], as well as Puerto Rico). CAP members serve voluntarily without personal compensation. Under 10 U.S.C. 9441, CAP may be employed in fulfilling the non-combat mission of the USAF, which includes defense support to civil authorities in disasters and emergencies.

CAP aircraft and personnel are staged throughout the country and can often provide the most rapid and cost-effective digital image collection solution. Although states can also sponsor CAP imagery collections, the crews are provided federal insurance and benefits when flying under federal or USAF sponsorship. CAP's mix of sensors includes hundreds of hand-held digital cameras for oblique image collection, hundreds of fixed Garmin Virb cameras for true color vertical image collection, and six geographically referenced, high-resolution hyper-spectral sensors. Each RGC is responsible for coordinating CAP activities with the designated POC within their region. Those coordinators can, at the discretion of their RA, establish agreements with individual CAP wings within their FEMA region. The RGCs should also assist and encourage state emergency management agency GIS coordinators to incorporate CAP into their state emergency operations plans.

If FEMA tasks CAP during disaster operations, FEMA is responsible for reimbursing the auxiliary for fuel costs when incurred in the performance of FEMA-requested missions. FEMA shall ensure that adequate funds are obligated prior to the authorization of a mission. All requests for CAP support must be coordinated through appropriate MA channels.

National Oceanic and Atmospheric Administration (NOAA)

FEMA personnel may mission-assign NOAA's National Geodetic Survey Remote Sensing Division to acquire emergency response imagery, including natural color and IR data. NOAA will host this imagery on its NGS Website and will generally service-enable its data for consumption by GIS systems and make data available via the USGS' Hazards Data Distribution System (HDDS) archive. NOAA also maintains bathymetric LiDAR sensors for its fleet of aircraft and frequently employs it for coastal LiDAR collections.

International Charter for Space and Major Disasters

The International Charter for Space and Major Disasters represents a consortium of space agencies that have agreed to provide satellite information in support of worldwide disaster response. As of 2018, the charter's membership has grown to 16 space organizations managing more than 30 Earth-observing satellites. The USGS serves as the conduit for emergency management agencies in the United States that require access to international satellite data during a disaster. The USGS is also designated as the U.S. authorized user for the charter, with the USGS Disaster Response Coordinator serving as the POC. (For more details regarding the international charter and samples of information products that the members have provided, go to http://www.disasterscharter.org/.) To activate the charter, the GIUL or RGC should coordinate with the FEMA GIO or Remote Sensing Coordinator, who will coordinate with the USGS Disaster Response Coordinator.

European Commission (EC) Copernicus Program

Through a U.S. European Commission Cooperation Arrangement, FEMA is able to activate the EC's Copernicus Emergency Management Service (Copernicus EMS), which provides timely and accurate geo-spatial information derived from European satellites, including Italy's COSMO-SkyMed constellation and the European Space Agency's Sentinel (visible and SAR) satellites. GIULs who require Copernicus data and products should coordinate with the FEMA GIO, Remote Sensing Coordinator, or designees.

For more information on the program, visit http://copernicus.eu/main/emergency-management.

Department of Defense (DOD) Platforms

When planning remote sensing data collections by DOD or National Guard aircraft, consult the National Guard Joint Force Headquarters Incident Awareness and Assessment (IAA) Handbook, available via the FEMA Remote Sensing Coordinator.

Commonly used agencies and assets are identified in Table 8.

Table 8: Common Interagency Partner Systems

Data Type	DOD System	National Guard Bureau (NGB) System	Interagency System
Electro-Optical (EO)/Infrared (IR) Full Motion Video (FMV)	P-3/P-8	OH-58	Civil Air Patrol (CAP) FMV (Pred-Sur)
	MQ-1	UH-72	CBP Predator-B
	MQ-9	RC-26	CBP P-3
	USAR UAS	ANG RPA/ARNG UAS	Contracted FMV
Electro-Optical	U-2	Eagle Vision	
	RQ-1/4 GlobalHawk		
	OC-135	FMV-Capable Aircraft	
	FMV-Capable Aircraft		
IR Images or Screen Captures	RQ-1/4 GlobalHawk	FMV-Capable Aircraft	Commercial Satellites

Data Type	DOD System	National Guard Bureau (NGB) System	Interagency System
	FMV-Capable Aircraft		
Hyper-spectral			Environmental Protection Agency (EPA) ASPECT
			CAP ARCHER
Multi-spectral		Eagle Vision	EPA ASPECT
			Commercial Satellites
Synthetic Aperture Radar	RQ-1/4 GlobalHawk	Eagle Vision	Commercial Satellites
		ANG MQ-9	
		ISTARS	
LiDAR			NOAA King Air/Twin Otter
Gamma	WC-135		EPA ASPECT

Unmanned Aerial Systems (UAS)

UAS' are another tool in the remote sensing toolbox, uniquely suited for certain specialized missions such as imaging operations in contaminated or hazardous areas, local search and rescue reconnaissance, and long-dwell missions that require near-continuous imaging support or frequent platform revisits over specific areas of interest.

When UAS-collected images, elevation data, or video are required, FEMA can mission-assign various UAS-equipped federal departments and agencies, including DOD, the U.S. Customs and Border Protection, the Department of the Interior's Bureau of Land Management, and the Department of Agriculture's U.S. Forest Service. All UAS imagery shall be obtained in a manner that ensures its accessibility across the response and recovery enterprise in conjunction with other GIS information. The specific imagery collection platform shall be determined based on the most effective and efficient means of accessing and operationalizing the imagery or data. FEMA-sponsored UAS images will be uploaded to the FEMA image uploader or distributed as Open Geospatial Consortium-compliant image services for consumption by FEMA GIS application. While UAS platforms can support equipment delivery and serve as temporary communications platforms, the *Geospatial Support for Disaster Operations Guide* does not address those capabilities or usage requests.

For more information regarding UAS for remote sensing data collection, contact the FEMA GIO's UAS program advisor.

Data Collection Operations Management and Air Operations Branch Coordination

When field, regional, or national-level emergency managers require aircraft to support response or recovery operations, FEMA will generally co-locate an air operations liaison, branch, or unit with the state, regional, or Unified Coordination Group (UCG) or JFO. FEMA Air Operations Branch personnel help enable and schedule flights, to include manned or unmanned aerial remote sensing operations.

The Federal Aviation Administration (FAA), not FEMA, is the ultimate authority for all operations in the national airspace, including the airspace over disaster sites. Typically, the FAA will establish temporary flight restrictions over disaster sites to ensure safe and controlled aircraft operations. In most cases, lifesaving and life-sustaining air missions will take precedence over remote sensing operations.

During each operational period, RRCC or NRCC remote sensing or GIS personnel must coordinate with the Air Operations Branch and provide them visibility of planned airborne collection operations. Air Operations Branch personal will assist GIS and remote sensing personnel by coordinating with the FAA for access into restricted airspace and by helping deconflict airspace for crew and asset safety.

If the Air Operations Branch is not activated, remote sensing personnel should coordinate directly with the Operations Section Chief at the field level or the Resource Support Section Chief at the regional or national level. The *FEMA Air Operations Guide* provides detailed information on the Air Operations Branch and Unit's remote sensing missions.

Processing, Exploitation, and Production

Remotely sensed data often requires unique processing to remove or correct atmospheric interference and to account for distortions caused by the curvature of the Earth and camera or sensor systems. Aerial and satellite imagery may require additional processing, such as de-speckling, geo-referencing, color matching, mosaicking, or orthorectification to maximize their utility or interoperability with other GIS layers and images.

In addition to the visual information that an analyst can discern from viewing images, a variety of products can be automatically or semi-automatically generated from remotely sensed data. These products are listed in Table 9.

Table 9: Remote Sensing Products

Product	Description	Potential FEMA Uses	Flood	Hurricane	Tornado	Earthquake	Improvised Nuclear Device (IND)
Flood Extent	Use image classification on Synthetic Aperture Radar (SAR) or multispectral imagery to identify water and delineate extent of flood zone.	• Modeled flood depth grid validation • Damage estimation	X	X			
Feature Identification: Debris	Use change detection based on reflectance (multispectral) or backscatter/amplitude/coherence (SAR) to identify areas where structures and buildings have been damaged, destroyed, or washed away.	• Damage estimation • Debris detection • Debris volume estimation • Debris removal planning	X	X	X	X	X
Debris Volume Estimation	Estimate volume of debris from post-event elevation data (e.g., LIDAR [Light Detection and Ranging], stereoimagery).	• Debris volume estimation • Debris removal planning	X	X	X	X	X

Product	Description	Potential FEMA Uses	Flood	Hurricane	Tornado	Earthquake	Improvised Nuclear Device (IND)
Feature Identification: Soil Moisture	Detect areas where soil is saturated before a flooding event using SAR backscatter/amplitude or multispectral reflectance values.	• Flood forecasting • Landslide prediction • Wildfire mitigation	X	X			
Feature Identification: Potential Shelter Locations	Identify open, dry, safe areas for support/relief purposes and temporary shelter.	• Temporary shelter planning • Relief supplies distribution planning	X	X	X	X	X
Normalized Difference Vegetation Index (NDVI)	Assess whether the target region contains live green vegetation or not. Identify areas of dead vegetation post-flooding event.	• Wet debris estimation (several weeks post-event)	X	X			
Feature Identification: Displaced Persons Camps	Identify where displaced people are concentrating. Feature identification: blue tarps, tents, etc.	• Support/relief planning • Rescue efforts	X	X	X	X	X
Damage Assessment (Critical Infrastructure and Residential Infrastructure)	Use post-event orthorectified optical imagery and/or elevation data (e.g., LiDAR, stereo imagery) to identify and assess damages to structures and buildings.	• Damage assessment	X	X	X	X	X
Ground Deformation	Detect vertical ground displacement using pre- and post-event Interferometric SAR images (InSAR).	• Damage assessment • Debris estimation				X	
Landslide Detection	Detect creeping and landslides using pre- and post-event Interferometric SAR images (InSAR).	• Landslide prediction • Landslide detection	X	X		X	
Radiation Detection	Detect and map radiation/unstable isotopes using unmanned helicopter (drone) electromagnetic radiation (EMR) measurements.	• Response planning operations					X
Identify Isolated Areas	Use imagery to identify isolated areas by detecting damaged roads, bridges, and other pathways.	• Response planning operations	X	X	X	X	X
Routing Map	Use imagery to detect unsafe/damaged roads, bridges, and other pathways to find safest way into damaged or destroyed cities.	• Response planning operations	X	X	X	X	X
Hot Spot/Thermal Mapping	Identify hot spots in buildings and debris to mitigate fires using thermal infrared imagery.	• Fire rescue • Wildfire detection				X	X

National Guard Unclassified Processing, Analysis, and Dissemination Teams

FEMA Response GIS Office MAC personnel can provide limited, short-duration remote sensing exploitation and analysis support. For major disasters, FEMA will require augmentation from interagency partners via MAs or through coordination with interagency exploitation teams. During the 2017 hurricane season, for example, a substantial number of Title 10 and Title 32 GEOINT analysts exploited CAP, NOAA, satellite, and commercial airborne imagery for FEMA and the greater response and recovery community. Analytical support can be requested via regional defense coordinating officers or DOD/U.S. Northern Command (NORTHCOM) LNOs to the NRCC.

Additional Interagency Exploitation and Production Partners

Many interagency partner organizations are available to provide analytical and exploitation assistance to FEMA, including the International Charter for Space and Major Disasters, EC Copernicus, USGS, NOAA, the National Aeronautics and Space Administration (NASA), Customs and Border Protection, U.S. Coast Guard, the National Reconnaissance Office, and NGA. Requests can be discussed on daily IRSCCs.

CHAPTER 7: PRODUCTION AND DISSEMINATION

This chapter provides guidance on the standard markings used on GIS products, strategies to disseminate the products, and standards associated with incident maps. FEMA's geospatial community uses a 10-second principle, meaning that for all products produced, it should take the reader less than 10 seconds to fully understand the meaning of the product. It is important that in addition to the standard markings each product must have, every product contains a clear and intuitive summary of what it is specifically intended to show the reader. Figure 8 and Figure 9 show two different objectives but in easily understandable layouts.

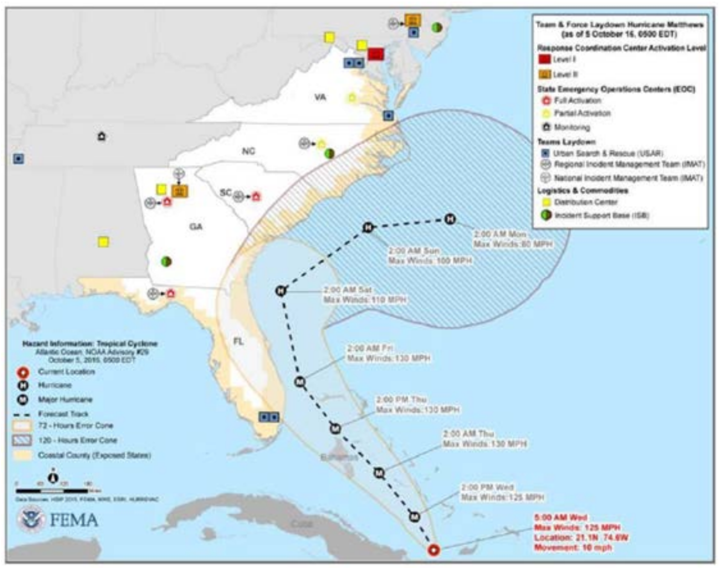


Figure 8: Example Map Product with Clear and Concise Information on Force Laydowns

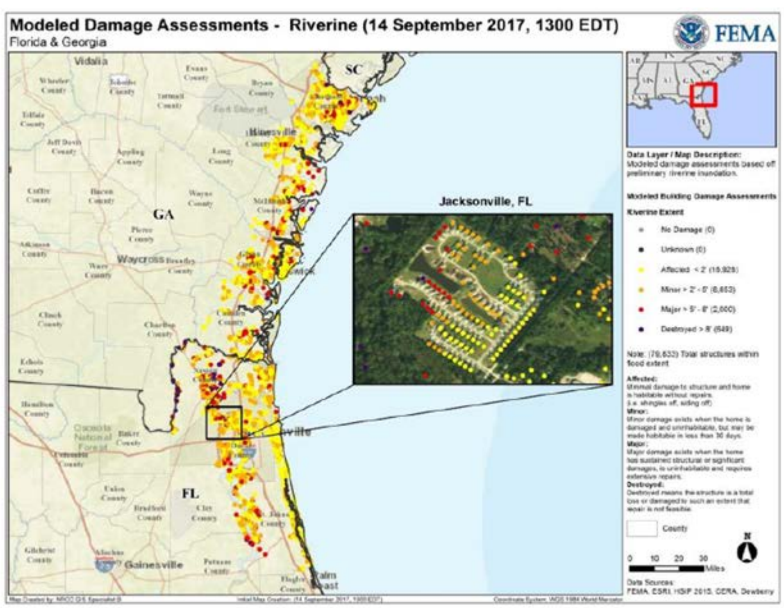


Figure 9: Example Map Product Showing Modeled Damage Assessments

Required Map Elements

Map Elements

- Title (includes incident name, map theme, geographic extent, and data time/date stamp)
- Legend
- Scale bar
- Logos and data disclaimers
- Logo and data disclaimer to recognize data sources
- Logo and data disclaimer to recognize county group/department/division
- File Location – provide the full path name for the network location of the map document, e.g., C:\GIS\Incidents\yyyy_IncidentName\YYYYMMDD\Products\ yyyymmdd_hhmm_IncidentName_Subjectmatter_Agency_Size_Orientation.mxd
- North arrow
- Projection (name of the projection, datum, and units)
- Data sources (who, what, where, when, why, and how)
- "Time Sensitive Data" disclaimer stamp for all maps that are time sensitive
- "DRAFT" stamp if map is a draft

Markings

The appropriate disclaimers are important for geospatial products. Disclaimers can reinforce the credibility of products, verify the intention and integrity of the requestor's data, and control information. All handling and marking instructions should come from the data provider and should be applied in a manner consistent with FEMA's responsibility to provide information to FEMA's mission partners in the least restrictive format possible, thereby enabling those partners in their roles in FEMA's mission. Table 10 provides examples of markings and disclaimers and respective descriptions.

Best Practice: Markings for Large Scale Products

Most map products developed at 1:100,000 scale or greater will not require markings or disclaimers, although this should be verified with the data provider and cleared with the Disaster Field Counsel (DFC), as appropriate. If such a scale is not possible, one alternative would be to normalize IA applicant data over the U.S. National Grid at 1-km intervals.

Table 10: Example Markings and Disclaimers

Type of Marking	Description	Example Marking or Language
Privacy Act Disclaimer	Protects against unauthorized disclosure of records that contain a person's name or other personally identifiable information (PII).	*"This document may contain information protected under the Privacy Act of 1974, 5 U.S.C. §552a (2000). Neither this document nor the material contained therein may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the prior permission of FEMA."*
For Official Use Only (FOUO)	FOUO is used to describe handling and safeguarding of unclassified information. Where there is uncertainty as to a person's need to know, the holder of the information will request dissemination instructions from their next-level supervisor or the information's originator. Classified information is not considered FOUO; FOUO is not to be considered classified information.	**UNCLASSIFIED//** **FOR OFFICIAL USE ONLY**
Law Enforcement Sensitive (LES)	LES information is defined as unclassified information of a sensitive and proprietary nature that, if disclosed, could cause harm to law enforcement activities, such as jeopardizing investigations, compromising operations, or causing life-threatening situations for confidential informants, witnesses, or law enforcement personnel.	***"LAW ENFORCEMENT INFORMATION NOTICE:*** *This product contains Law Enforcement Sensitive (LES) information. No portion of the LES information should be released to the media, the general public, or over non-secure internet servers. Release of this information could adversely affect or jeopardize investigative activities."*
Environmental Special Considerations Data (ENVAS)	ENVAS usually requires a special disclaimer in coordination with other source agencies.	*"Map Products and Data Developed through the ENVAS Application are designated SENSITIVE, and are for INTERNAL USE ONLY. Per the conditions of the Memorandum of Understanding and Use Agreements with Source Agencies, Distribution of these Products is RESTRICTED."*
Custom Disclaimers	Special issues at the Joint Field Office (JFO) may require specific disclaimers to be developed. These are worded in coordination with program personnel who are involved with the final products. The disclaimer should also include the authorized position (Federal Coordinating Office [FCO], Director, Section Chief, etc.) within the organization authorized to release the information.	***"FOR INTERNAL USE ONLY:*** *This product may be protected by one or more copyrights and license restrictions. Neither this document nor the material contained herein may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the prior written permission of the FEMA Federal Coordinating Officer."*

Product Format Conventions

Share completed map products with requestor(s) and the SAS in Joint Photographic Experts Group (JPEG) or PDF via the geospatial library in WebEOC or via email. Figure 10 shows an incident-dependent Geospatial Library Workflow.

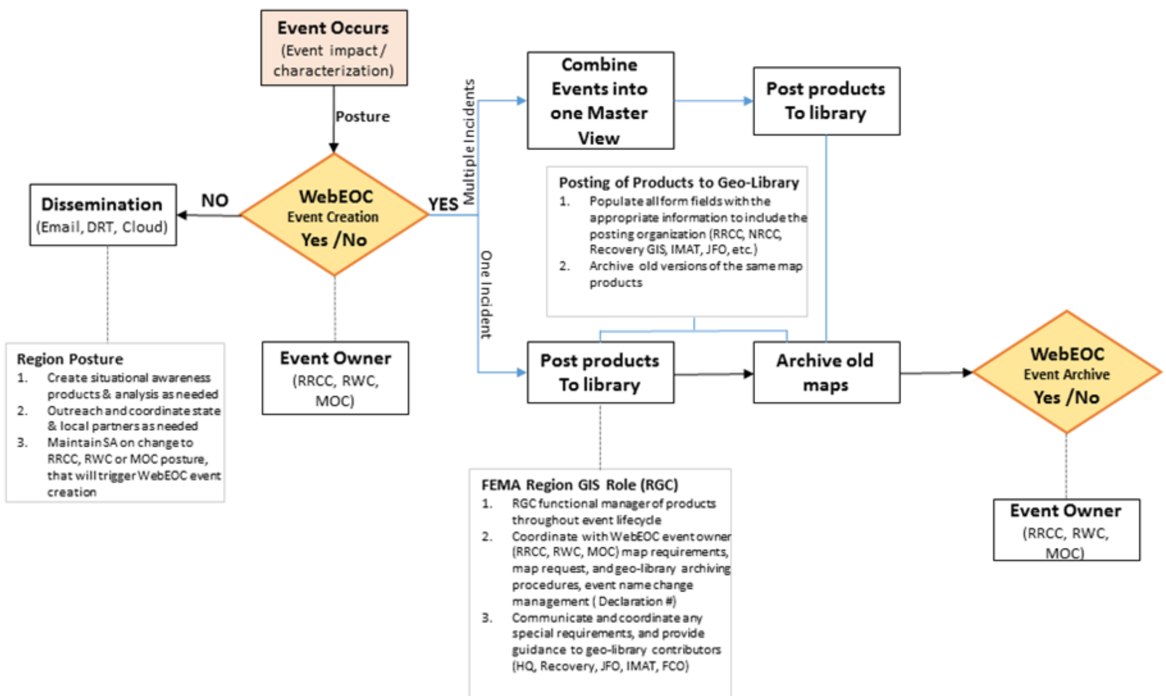


Figure 10: Incident Dependent Geospatial Library Workflow

For non-Web maps, export maps with 100 dots per inch (DPI) resolution to keep the file size small in order to ease data sharing and reduce the load on networks unless higher resolution is necessary to view detail. A total of 300 DPI is recommended for hard copy print maps.

Map Symbology

The use of standard symbols in disaster operations ensures consistent interpretation of mapping products across multiple echelons (federal, state, local, tribal, and territorial) responding to an incident.

To ensure clear communication, common map conventions (e.g., blue for hydrologic features) should be observed, if possible, and national symbology standards should be used where appropriate (e.g., Homeland Infrastructure Foundation Level Data). The choice of symbol size is at the discretion of the analyst producing the final product.

The GIUL will ensure that standard map symbology is in alignment with supporting elements (e.g., IS GIS teams), as well as field elements (e.g., US&R GIS support). The GISP will use standard GIS map symbology and, if applicable, standard map symbol colors but may adapt the symbology for map readability while maintaining the essential design of the standard symbols.

Quality Assurance and Quality Control

Because of the short suspense of map requests sometimes required in a response environment, it is imperative that maps are checked for accuracy and completeness before dissemination. The GIUL is chiefly responsible for reviewing and approving final maps produced by a GIS specialist(s) before dissemination to requestor(s). The GIS specialist(s) performs the initial quality assurance/quality control (QA/QC) of data and maps, checking for data gaps, errors, attribution, and map design cartographic elements.

During the QA/QC process, identified inaccuracies in data or maps should be updated as soon as possible, but the inaccurate information should not be deleted from the disk drive. Instead, add a tag to the file name indicating that it is bad data and should not be used. A record of released bad data may need to be accessed at some point during or after the incident.

Standard Map Products

The standard map products section outlines the product objectives, target audience, data content, and cartographic requirements for those map products. These map products communicate incident-specific details, as well as general environment and infrastructure information to support emergency management operations.

The hard copy and Geospatial PDF (GeoPDF) map product has long been used in emergency management; therefore, there are more standards surrounding its use. Each map product includes a short list of some of the example datasets commonly used for each type of product. The example datasets are limited, and agencies should be sure to include specific data needed depending on the type of incident and hazard.

Product Dissemination

This section focuses on the mechanisms for disseminating GIU products: the successful result of a GIS project’s completion. GIU products can be divided into two categories: Web-based and print or PDF.

Web Maps and Applications

Web maps are most easily understood and consumed using Web mapping applications that can be configured for specific workflows. For example, a Web map can be served through a mobile application (e.g., Survey123) configured for conducting damage assessment in the field. Monitoring the data collection can be accomplished through another Web mapping application (e.g., Operations Dashboard) configured specifically for this purpose. A wide variety of Web mapping application configurations support emergency management workflows.

- Benefits: Web maps are created once by GIS staff and then can be quickly disseminated and updated in near-real time to many users simultaneously. Additional functionality is available through Web maps that allow groups of users to collaborate on the creation and maintenance of maps in real time. Further, Web maps can be embedded into existing Websites providing additional users with interactive capabilities.
- Limitations: The primary limitations associated with Web maps is that they require a device, power, and, in some cases, connectivity to the Internet (although some Web maps can be used "offline").

Web Strategy

The Web strategy is a concept developed by FEMA to effectively share geospatial information between agencies and partners. It includes assets from FEMA, the U.S. Department of the Interior, and DHS, among others.

FEMA seeks to automate the integration of data and the production of maps and reports in the development of a real time disaster analytics platform to provide crucial decision support for hurricane response planning. The new Web-based system, known as the Hurricane Journal, provides a centralized series of interactive dashboards and maps for accessing, visualizing, and sharing critical data to determine the following:

- What geographic areas will be potentially impacted
- Whether federal support will be needed
- What resources are needed to support survivors
- What buildings are affected
- Which essential facilities are threatened

To accomplish this, FEMA devised a robust data gateway that reads in live data feeds from internal and external sources and processes the data for analysis, display, and dissemination through Web services to a cloud-based Web application for user access. The Hurricane Journal provides a curated set of authoritative data in real time to decision makers across FEMA and federal, state, local, and non-profit communities that need to work together during disaster events, improving FEMA's response to disasters by enabling wider understanding of complex data to inform key decisions to be made faster and in a more consistent manner.

Key Features

- Real Time Data Updates – Latest hurricane advisories from the National Hurricane Center
- Comprehensive Impact Data – Population, buildings, transportation, and infrastructure
- Analyze Specific Hurricane Threats – Examine and compare surge and wind exposure
- Flexible Analyses and Visualizations – Examine regional or local impacts, and make comparative analyses

- Intuitive Dashboard Interface – Interactive reports, maps, and charts with easy-to-use controls

Decision Chart on Using Web-Based Platforms

Figure 11 shows the decision process to determine which Web-based GIS platforms to use.

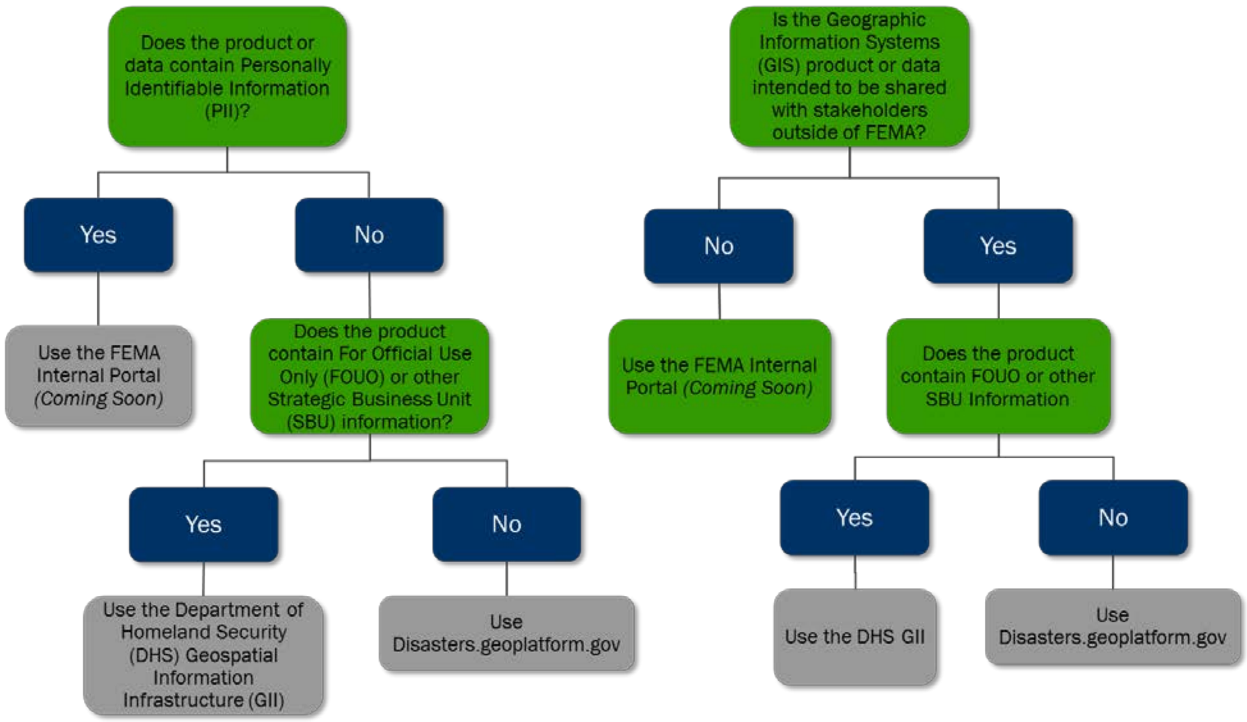


Figure 11: Decision Chart on Using Web-Based Platforms

Geospatial Platform

The Geospatial Platform is a web-based capability supported by the FGDC, providing shared and trusted geospatial data, services, and applications. Government agencies and partners use this platform to meet their mission needs, including publishing data and maps and communicating information to the public.

This Website is a public location where FEMA geospatial information, such as declared counties, shelters, disaster recovery centers, and damage assessments, is posted. This information must be as follows:

- Public (at the federal, state, local, tribal, and territorial levels),
- Highly curated, and
- Authoritative.

This initiative helps to provide authoritative federal geospatial resources to the public in a well-managed, highly available, consistent way.

More information can be found at http://disasters.geoplatform.gov.

FEMA Internal Portals

Internal portals, either at HQ or within a given region, provide on-premises portals where internal FEMA geospatial information can be posted. Internal portals are restricted to internal users and requirements but contain a sandbox environment ideal for testing, simulations, staging, etc. Additionally, the internal portals can contain FOUO, internal, and public information; do contain an active directory; and are open to all content (e.g., unstructured or uncurated content).

Geospatial Information Infrastructure

The Geospatial Information Infrastructure is a DHS resource for sensitive but unclassified FEMA geospatial information. This information can encompass topics such as chemical, biological, radiological, nuclear, and explosives hazards or Information Modeling and Atmospheric Assessment Center (IMAAC) modeling and hazard prediction products. The Geospatial Information Infrastructure serves as a platform for FOUO and public information, as well as identifying where federal resources (e.g., team location, commodities, and incident support bases) are positioned.

Hard Copy or PDF

Hard copy or PDF products include the graphical output of projects such as a PDF or another common graphic format. That output includes tabular reports and summaries of data. There are multiple avenues to share this information, and the following information describes some of the standard dissemination methods currently utilized throughout FEMA.

The default location for FEMA to post final products will be the "Geospatial Library" within FEMA's WebEOC.

Common FEMA Shared Drives and Databases

FEMA HQ maintains shared drives for securely storing geospatial data and products.

For access, email the FEMA Enterprise Service Desk (HLPFEMAFEMA-Enterprise-Service-Desk@fema.dhs.gov). In the body of the email, list the aforementioned drives and request to be added to the "**GIS Staff AD**."

Regional and incident shared drives also exist to share data at those levels. All users deployed to those areas to support operations (whether at the RRCC, JFO, or another related facility) should request access from the RGC or JFO GIUL, respectively.

Check with the local regional leader or JFO leader for access to common share drives and common databases. However, ensure that when using these common share drives and databases to follow the folder structure procedures discussed in Appendix D.

Publishing Data

Data can be published to and registered on multiple platforms to meet mission requirements. Typically, the ArcGIS server is required to host data services, while Web mapping platforms display those services. FEMA uses a multi-tiered approach to publishing services depending on the privacy and security constraints of the data or the size of the dataset. Table 11 provides a data publishing decision matrix.

Table 11: Data Publishing Decision Matrix

Data Hosting Solution	Purpose	Releasability
GeoPlatform	To provide the ability to quickly upload a small number of records for geospatial visualization that can support a large number of simultaneous users	Public
FEMA Server	To provide a fully managed custom solution to a FEMA office to securely provide data within the FEMA Enterprise Network (FEN) that can support a limited number of simultaneous users	Sensitive But Unclassified

Geospatial Service Guidelines

Authoritative Stable Services

These are the services and resources that FEMA publishes in an official capacity, frequently marketed as available to outside agencies or individuals. These services do not allow a service function that modifies the served data from a client. FEMA staff control all modifications to the served data, usually on official FEMA systems.

Authoritative Live Services

These are also live services and resources that FEMA publishes in an official capacity. The key difference is that a client application or Representational State Transfer (REST) operations with the appropriate privileges can update these services. Authoritative live services, while not necessarily error prone, do invite more opportunity for error because of real time updates from actors independent of the FEMA network.

Offering an authoritative service should be thought of as an informal “contract” with users to whom the service is marketed. Authoritative services are typically relatively few in number and require the utmost care in maintenance. The owner and custodian(s) of such a service are obligated to ensure its continued existence and accuracy, to provide adequate notice to the user base in the event of scheduled or unscheduled downtime or in the event of deprecation, and to provide updates on changes in service parameters (e.g., URL modifications or REST operation changes).

Ad Hoc Services

These are services and resources of a less permanent nature. Because of FEMA’s incident-based, response-driven workflow, there is a regular need for unique services related to events, incidents, disasters, or other projects. These services follow a shorter life cycle, which is explained in detail later in this chapter.

Every service created should have its backup Map Document file and Map Service Definition file stored in a navigable inventory, which is explained in detail later in this chapter.

Dissemination and Access for FOUO Information

Access to FOUO information is based on a "need-to-know" basis as determined by the holder of the information. Where there is uncertainty as to a person's need to know, the holder of the information will request dissemination instructions from their next-level supervisor or the information's originator. The holder of the information will comply with all access and dissemination restrictions. A security clearance is not required for access to FOUO information. FOUO information may be shared with other agencies; federal, state, tribal, or local governments; and law enforcement officials. Check with local, regional, or incident-level geospatial leaders about access to common shared drives and databases.

Ownership of Services

Service ownership within an organization is a key concept for users, contributors, publishers, and administrators to understand and participate in. The better an ownership policy is understood, socialized, and abided, the better organized a system will be.

The recommended geospatial ownership model is composed of three distinct but related elements: resource, owner, and custodian.

Resource

A Web service includes but is not limited to the following:

- REST
- Simple Object Access Protocol (SOAP)
- Web Coverage Service Interface Standard (WCS)
- Web Feature Service Interface Standard (WFS)
- Web Map Service Interface Standard (WMS)
- Web Map Tile Service Implementation Standard (WMTS)
- Web Positioning Service Interface Standard (WPS) services
- Geoprocessing services
- Geometry services
- Geocoding services
- Globe or image services
- Keyhole Markup Language (KML) services
- Map services published by FEMA or on behalf of FEMA on a server and made available to client applications

Owner

The individual, board, leadership committee, or other body responsible for dictating and enforcing a use policy (or policies) on a resource.

Owners typically set use policies applying to multiple resources in the form of written rules or as digital security limitations (e.g., additional permissions/access for a resource to certain roles or user groups within the enterprise identity manager). Owners might also create special use policies for an individual or subgroup of resources under their ownership. These policies, along with owner contact information, shall be described in the resource metadata. For more information, see the Metadata Standards directive in Chapter 4.

Custodian

The individual or team responsible for maintaining the served content of a resource, ensuring it is always up to date with the best available data that meets policy guidelines and ensuring continued compliance with all policies even as they change over time and for taking the steps necessary to resolve all issues impacting resource availability and uptime.

A resource custodian is typically the creator or author of the resource. It is the responsibility of the custodian to complete the resource metadata and store it in an accessible format, including custodian contact information, owner, and applicable policy information. It is also the responsibility of the custodian to update the resource metadata within a reasonable amount of time should the information change.

Updating Services and the Publishing Life Cycle

Users will need to have a specific need in order to receive public publishing rights to disasters.geoplatform.gov. This environment is set up to display final or the most up-to-date authoritative services and GIS data FEMA has. An internal portal environment is being created for all users to store and work with their data for all day-to-day products that do not need to be displayed publicly.

Nominating a Dataset or Service for Authoritative Status

The ArcGIS Online environment allows users with administrator roles to mark organizational data as **Authoritative** or **Deprecated** from the item overview screen. Item owners can mark their own data as deprecated as well. Items marked as authoritative will have a green badge on the item overview screen, and those marked as deprecated will have a red badge. Organizational users can use the status filter to search for only authoritative data to add to their own maps.

This same functionality will soon be coming to the disasters.geoplatform.gov environment in a future update.

Service Life Cycle

Each type of service has its own life cycle. Authoritative stable services are final products that will not be changed and are subject to audit over a 180-day life cycle. Authoritative live services are products that will be updated through a client application and are subject to audit over a 90-day life cycle. Ad hoc services are usually set up specifically for an event response and have a much shorter life cycle, audited at 30 days.

Application Life Cycle

Created applications are only as useful as the data they contain. The creator of the application, hosted on disasters.geoplatform.gov or ArcGIS Online, needs to ensure the services and data are authoritative and use the most up-to-date data if the intention is for the application to be made viewable to the public. Once data contained in the application has been deprecated, it is the responsibility of the application owner to replace that data with the newest data or remove the application entirely from public view.

Hard Copy

This type of product includes maps, plots, and other physical products obtained as a result of a geospatial production request. After a production request is completed and the customer notified, the customer receives the hard copy products in the GIU to complete the request process.

Strategies for distributing large hard copy map caches may be required when multiple area field offices, incident command posts, or Disaster Recovery Centers (DRC) require support. The Logistics Section will typically offer a courier service when disaster operations in the field are geographically dispersed. The GIUL should coordinate with the Logistics Section to determine timetables for pickup and delivery and plan production schedules accordingly.

Large Formats

Imagery and imagery-derived information (in the form of GIS products) are available in hard copy form, generally in one of the following five sizes:

- “A” size: 8½ inches by 11 inches
- “B” size: 11 inches by 17 inches
- “C” size: 17 inches by 22 inches or 18 inches by 24 inches
- “D” size: 22 inches by 34 inches or 24 inches by 36 inches
- “E” size: 34 inches by 44 inches or 36 inches by 48 inches

Appendix A: List of Acronyms

3D	Three-Dimensional
AOI	Area of Interest
CAP	Civil Air Patrol
CIR	Critical Information Requirement
CORE	Cadre of On-Call Response and Recovery Employees
COTR	Contracting Officer's Technical Representative
CSDGM	Content Standard for Digital Geospatial Metadata
DAMG	Data Analytics Modeling Group
DFC	Disaster Field Counsel
DHS	Department of Homeland Security
DOD	Department of Defense
DPI	Dots per Inch
DRC	Disaster Recovery Center
DSA	Disaster Survivor Assistance
E3	Expeditionary Enterprise Engineering
EC	European Commission
EDW	Enterprise Data Warehouse
EEI	Essential Elements of Information
ELA	Enterprise License Agreement
EMI	Emergency Management Institute
EMR	Electromagnetic Radiation
EMS	Emergency Management Service
ENVAS	Environmental Special Considerations
EO	Electro-Optical
EO/IR	Electro-Optical/Infrared
EPA	Environmental Protection Agency
ESF	Emergency Support Function
ESRI	Environmental Systems Research Institute

EST	Eastern Standard Time
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulations
FCO	Federal Coordinating Officer
FD	FEMA Directive
FEMA	Federal Emergency Management Agency
FEN	FEMA Enterprise Network
FGDC	Federal Geographic Data Committee
FIMA	Food Insurance and Mitigation Administration
FLIR	Forward Looking Infrared Radar
FMV	Full Motion Video
FOUO	For Official Use Only
FQS	FEMA Qualification System
GeoCONOPS	Geospatial Concept of Operations
GeoFramework	Geospatial Framework
GEOINT	Geospatial Intelligence
GeoPDF	Geospatial PDF
GII	Geospatial Information Infrastructure
GIMG	Geospatial Information Unit Manager
GIO	Geospatial Information Officer
GIS	Geospatial Information Service
GISM	Geospatial Information System Manager
GISP	Geographic Information System Specialist
GISU	GIS Unit
GIU	Geospatial Information Unit
GIUL	Geospatial Information Unit Leader
GPS	Global Positioning System
GS	General Schedule
GTG	Geospatial Technical Group
GTGS	Geospatial Technical Group Supervisor

GWG	Geospatial Working Group
HAZUS	Hazards United States
HDDS	Hazards Data Distribution System
HIFLD	Homeland Infrastructure Foundation-level Data
HMGP	Hazard Mitigation Grant Program
HQ	Headquarters
HWM	High Water Mark
IA	Individual Assistance
IAA	Incident Awareness and Assessment
IAL	Infrastructure Asset List
IAP	Incident Action Plan
ICP	Incident Command Post
ICS	Incident Command System
IDP	Individual Development Plan
IMAAC	Interagency Modeling and Atmospheric Assessment Center
IMAT	Incident Management Assistance Team
IND	Improvised Nuclear Device
IOF	Interim Operating Facility
IR	Infrared
IRSCC	Interagency Remote Sensing Coordination Call
ISO	International Organization for Standardization
IT	Information Technology
IWMD	Incident Workforce Management Division
JFO	Joint Field Office
JPEG	Joint Photographic Experts Group
KML	Keyhole Markup Language (File Format)
LES	Law Enforcement Sensitive
LiDAR	Light Detection and Ranging
LNO	Liaison Officer
MA	Mission Assignment

MAC	Mapping Analysis Center
MACS	Multi-Agency Coordination System
MDWG	Modeling and Data Working Group
MH	Multi-Hazard
MoDI	Model and Data Inventory
MODIS	Moderate Resolution Imaging Spectroradiometer
MXD	Map Exchange Document
NA	Not Applicable
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NGA	National Geospatial-Intelligence Agency
NGB	National Guard Bureau
NGDA	National Geospatial Data Asset
N-IMAT	National Incident Management Assistance Team
NOAA	National Oceanic and Atmospheric Administration
NORTHCOM	U.S. Northern Command
NQS	National Qualification System
NRCC	National Response Coordination Center
NRCS	National Response Coordination Staff
NTM	National Technical Means
NWC	National Watch Center
NWS	National Weather Service
OCIO	Office of Chief Information Officer
OMB	Office of Management and Budget
OSG	Operations Support Group
PA	Public Assistance
PDA	Preliminary Damage Assessment
PDF	Portable Document Format
PFT	Permanent Full-Time
PII	Personally Identifiable Information

PLSL	Planning Support Unit Leader
POC	Point of Contact
POTUS	President of the United States
PTB	Position Task Book
PUM	Proper Use Memorandum
QA	Quality Assurance
QC	Quality Control
RA	Regional Administrator
RADAR	Radio Detection and Ranging
REST	Representational State Transfer (Web Service Architectural Style)
RFI	Request for Information
RGC	Regional Geospatial Coordinator
RGRC	Regional GIS Resource Center
RISC	Regional Interagency Steering Committee
RMSP	Remote Sensing Specialist
RRCC	Regional Response Coordination Center
RRCS	Regional Response Coordination Staff
RRF	Resource Request Form
SAR	Synthetic Aperture Radar
SAS	Situational Awareness Section
SITL	Situation Unit Leader
SLTT	State, Local, Tribal, and Territorial
SME	Subject-Matter Expert
SOAP	Simple Object Access Protocol
SOP	Standard Operating Procedure
SOVI	Social Vulnerability Index
SRC	Special Records Collection
sUAS	Small Unmanned Aerial System
TCSP	Technical Specialist
TCUL	Technical Unit Leader

THIRA	Threat Hazard Identification and Risk Assessment
UAS	Unmanned Aerial System
UCG	Unified Coordination Group
UCS	Unified Command System
UNC	Universal Naming Convention
URL	Uniform Resource Locator
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
U.S.C.	U.S. Code
USGS	U.S. Geological Survey
USNG	United States National Grid
US&R	Urban Search and Rescue
WCS	Web Coverage Service Interface Standard (Protocol)
WFS	Web Feature Service Interface Standard (Protocol)
WMS	Web Map Service Interface Standard (Protocol)
WMTS	Web Map Tile Service Implementation Standard (Protocol)
WPS	Web Positioning Service Interface Standard (Protocol)
XML	Extensible Markup Language

Appendix B: Glossary

Critical Information Requirements (CIR). CIRs are specific types of high-priority EEIs. What typically separates a CIR from an EEI is its urgency. FEMA leadership or personnel at the incident level can initiate a CIR for an event that occurred and was not anticipated (e.g., a dam failure or levee breach). CIRs require immediate leadership notification and involvement.

Custodian. The individual or team responsible for maintaining the served content of a resource, ensuring it is always up to date with the best available data that meet policy guidelines, ensuring continued compliance with all policies even as they change over time, and for taking the steps necessary to resolve all issues impacting resource availability and uptime.

Decision-support analysis: Information analysis is a detailed assessment of collected information carried out to synthesize data for informed decision making; it is the link between information collection and dissemination, aimed at addressing the information requirements identified in the collection process.

Decision-support tools. Mathematical formulae, often embedded within a computer program, requiring specific data inputs in order to calculate personnel and resources necessary to support mission-specific activities.

Essential Elements of Information (EEI). A comprehensive list of information requirements, derived from deliberate plans that are also needed to promote informed decision making. EEIs provide context, inform decision making, and contribute to analysis, as well as populate the Incident Command Post (ICP). EEIs are required to plan and execute an operation and to support timely, logical decisions. Situation reports should address EEIs, which are developed throughout the response and recovery to an event.

FEMA Qualification System (FQS). The FQS is a system for qualification and certification for the FEMA incident workforce through experience, training, and demonstrated performance. FQS requires FEMA employees who work in incident management and support positions to be formally certified for these positions.

Forecasting model. A tool to help manage uncertainty about the future and make informed decisions based on data from the past and present and from extrapolations about future trends. Common types of forecasting models include weather models that predict a storm’s direction, timing, and intensity, allowing emergency managers to assess risk and plan response actions.

Geo-enabled data. Data containing a geographic reference (e.g., street address, ZIP Code, highway numbers, state or county codes, or parcel numbers) that can be linked to a representation of the related geography for the purpose of mapping and analysis.

Geospatial analysis. Geospatial analysis is the application of statistical analysis and other analytical techniques to unrefined information that has a geographic or spatial reference.

Geospatial Information System (GIS). A GIS is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.

Hindcasting. Testing of a model, forecast, or prediction by using post-incident historic data to validate accuracy of initial estimates and refine predictive modeling tools for future applications.

Impact estimates. Impact estimates are the output of consequence models or assessments of current/historical data. Impact estimates are designed to answer the question, "Who and what is affected?"

Incident Management (IM). The incident-level operation of the federal role in emergency response, recovery, logistics, and mitigation. Responsibilities in IM include the direct control and employment of resources, management of incident offices, operations, and delivery of federal assistance through all phases of emergency response.

Incident Support (IS). The coordination of all federal resources that support emergency response, recovery, logistics, and mitigation. IS responsibilities include the deployment of national-level assets, support of national objectives and programs affected during the disaster, and support of incident operations with resources, expertise, information, and guidance.

Individual Assistance (IA). IA is provided by FEMA to individuals and families who have sustained losses because of disasters. This type of assistance comes in the form of housing assistance and other needs assistance, such as medical and dental expenses, funeral costs, or clothing.

Information collection. Information collection is the act of gathering and validating information for analysis.

Light Detection and Ranging (LiDAR). LiDAR is an optical remote sensing technique that uses laser light to densely sample the surface of the Earth, producing highly accurate measurements. LiDAR can be used to locate areas of worst impact, identify degraded or impassable routes, enable more efficient routing of search and rescue teams and supply convoys, and support site selection analyses.

Mapping Analysis Center (MAC). The MAC provides response-oriented geospatial analysis during steady-state and operational periods. However, the MAC team may also be tasked to provide support on a one-time, recurring, or ongoing basis. The MAC also provides reach-back mapping and analytic support to various FEMA programs, regions, and incident support operations, which can include the NRCC, RRCC, and/or JFO operations.

Mission Assignment (MA). An MA is a work order issued by FEMA to another federal agency directing the completion of a specific task, citing funding, other managerial controls, and guidance.

Models/modeling. A simplified representation of a system using quantitative and/or qualitative inputs to produce decision-support analysis, especially with the intent of forecasting consequences, impacts, and characteristics.

Moderate Resolution Imaging Spectroradiometer (MODIS). MODIS is a bundle of remote sensing equipment housed on two NASA satellites. These satellites record multiple images of the globe in various wavelengths and resolutions, imaging the Earth's surface.

Owner. The individual, board, leadership committee, or other body responsible for dictating and enforcing a use policy or policies on a resource.

Personally Identifiable Information (PII). PII can be used to distinguish or trace an individual's identity (e.g., name, social security number, or biometric records). PII can refer to standalone data or to data which, when combined with other personal or identifying information, is linked or linkable to a specific individual (e.g., date and place of birth or mother's maiden name).

Public Assistance (PA). PA is a grant program of FEMA that provides federal assistance to government organizations and certain private non-profit organizations following a Presidential disaster declaration.

Raw data. Raw data is quantitative and qualitative descriptions gleaned from instruments, observation, or experience which represent the current state of the world (e.g., real time weather conditions, locations of fault lines, survivor anecdotes, and uncodified knowledge of a state's gaps in recovery capabilities).

Resource. A Web service, including but not limited to REST, SOAP, WCS, WFS, WMS, WMTS, and WPS services; geoprocessing services; geometry services; geocoding services; globe or image services; KML services; or map services published by FEMA or on behalf of FEMA on a server and made available to client applications.

Satellite imagery. An image of the Earth gathered by satellites to help forecasters view the behavior of the atmosphere.

Steady-state operations. The routine organizational activities of FEMA distinct from operations in response to or recovery from an emergency, disaster, or event.

Appendix C: Incident Titles

The geospatial positions within this document are separated by the appropriate “level” at which they operate (incident management vs. incident support; regional vs. national incident support). The *Incident Management and Support Keystone* defines in the following way:

Incident Management is the incident-level operation of the Federal role in emergency response, recovery, logistics, and mitigation. Responsibilities in incident management include the direct control and employment of resources, management of incident offices, operations, and delivery of Federal assistance through all phases of emergency response.

Incident Support is the coordination of all Federal resources that support emergency response, recovery, logistics, and mitigation. Responsibilities include the deployment of national-level assets, support of national objectives and programs affected during the disaster, and support of incident operations with resources, expertise, information, and guidance.

Incident Support – National

Figure 12 shows the position of the Geospatial Technical Group (GTG) in an SAS structure.

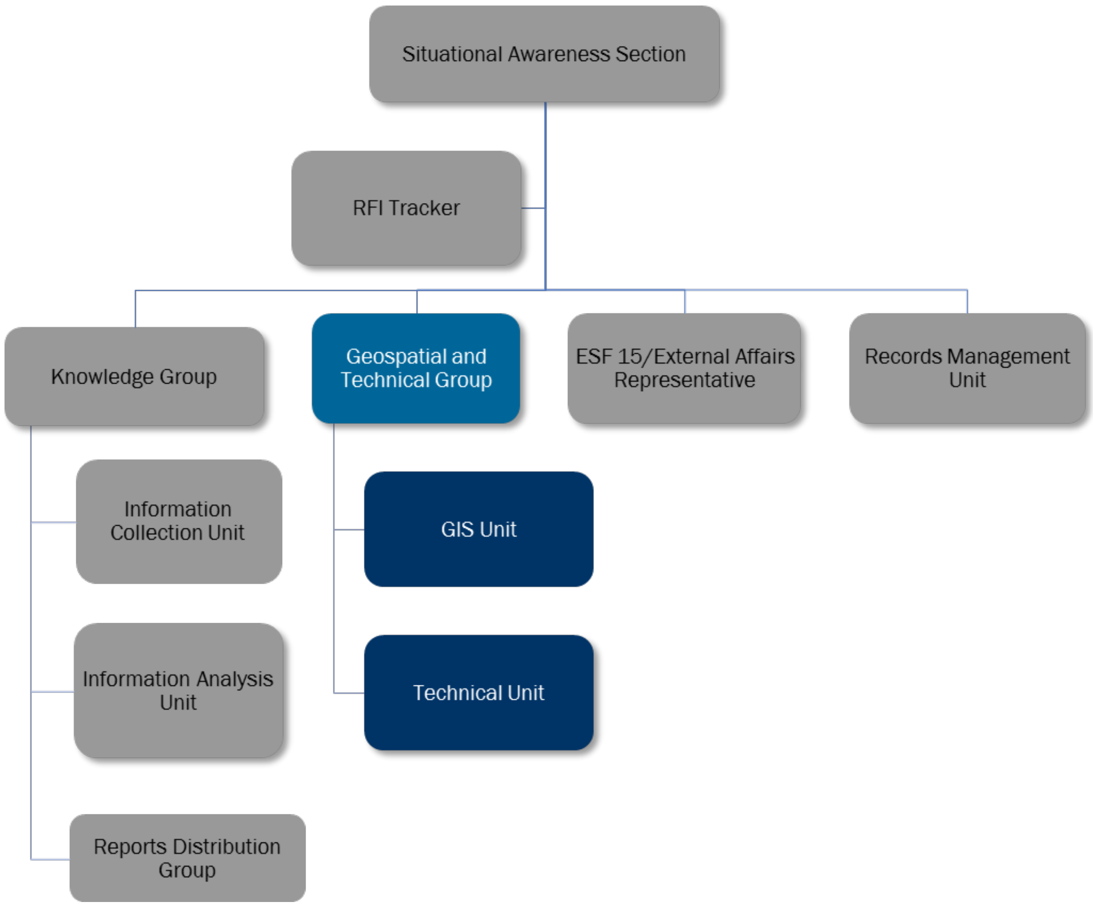


Figure 12: Situational Awareness Section Incident Support Organizational Chart

The Geospatial Technical Group (GTG) provides specialized reports, analyses, and presentations, as needed. The GTG also coordinates with other situational awareness functions to facilitate the development of the common operating picture.

Geospatial Information Unit

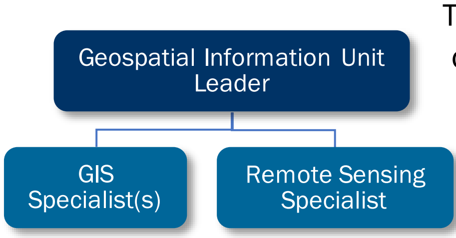


Figure 13: Geospatial Information Unit Organizational Structure

The GIU supports and facilitates NRCS-level planning and decision making through the development of geospatial products and services and through the national-level coordination of remote sensing operations. Figure 13 shows this GIU structure and its respective roles. Table 12 below provides key roles and responsibilities of the Geospatial National Incident Support positions.

Table 12: Geospatial National Incident Support Roles and Responsibilities

National Incident Support Structure	
Geospatial Technical Group (GTG)	• Provides specialized reports, analyses, and presentations to the National Response Coordination Staff (NRCS) and serves as the primary source for Geospatial Information Systems (GIS) products at the incident level. • Exercises the authority of the Geospatial Information Officer (GIO) for interagency geospatial operations. • Integrates, deconflicts, and prioritizes state or regional requirements to create national requirements for geospatial data, remote sensing collection, services, and equipment. • Provides geospatial and remote sensing displays and analyses. • Creates and analyzes geospatial information for decision support. • Integrates geospatial information from external partners to create a complete GIS product for decision making. • Incorporates all relevant data for event-specific situational awareness and geospatial analysis. • Provides technical and mapping expertise required to support NRCS members. • Shares GIS data with activated Regional Response Coordination Staff (RRCS) during an incident. • Aggregates geospatial data, products, and processes into FEMA NRCS's common operating picture at the incident, regional, and national levels. • Identifies operational geospatial information to be integrated with situational awareness viewers. • Provides FEMA senior leadership comprehensive situational awareness from geospatial and technical resources.
GTG Group Supervisor (GTGS)	• Oversees incorporation of all relevant data to produce map products, statistical data for reports, and/or analysis. • Provides technical and mapping expertise required to support NRCS members. • Serves as the link to other technology sources, such as Federal agencies, universities, and information and warning centers.
Geospatial Information Unit Leader (GIUL)	• Oversees Geographical Information System Specialists
Geospatial Information Systems Specialist (GISP)	• Supports National level planning and decision-making through the development of remotely sensed and GIS products and services. • Produces maps and displays combining available data with information on the disaster. • Posts analysis on required knowledge management portals (e.g., HSIN).
Remote Sensing Specialist (RMSP)	• Identifies requirements and Essential Elements of Information (EEI). • Prioritizes areas of interest (AOI). • Identifies local, state, and federal remote sensing assets and capabilities. • Assembles requirements from RRCCs, Incident Management Assistance Teams (IMAT), and affected states to create an integrated picture of remote sensing requirements. • Operates specialized software applications to produce remote sensing products. • Analyzes and compares imagery with operational information. • Requests and coordinates external analysis and support.

National Incident Support Structure	
Technical Unit Leader (TCUL)	• Oversees Technical Specialists
Technical Specialist (TCSP)	• The organization providing these personnel, in consultation with FEMA senior leadership, primarily define the tasks for each of these positions.

Incident Support – Regional

While the RGC coordinates and resolves day-to-day GIS and remote sensing issues within the region, the RGC is also responsible for preliminary incident response support activities prior to the establishment of a UCG. The RGC can assume the responsibilities of the GIUL within the RRCC during activations or delegate that authority to others. Figure 14 shows the regional SAS and where the GIS Unit fits in it.

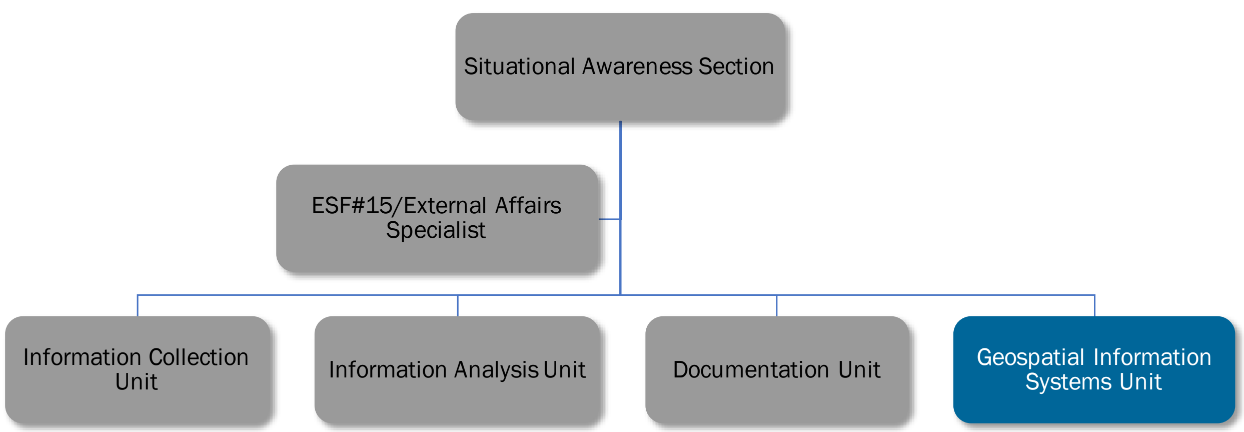


Figure 14: Regional Situational Awareness Section Organizational Chart

Geospatial Information Unit

The GIU addresses requirements to receive, process, and manage disaster-related geospatial requests prior to the establishment of a JFO GIU or the arrival of an IMAT GIUL. Each FEMA region maintains procedures for its RRCS GIU. The GIU at the RRCC determines, in coordination with its chain of command, the appropriate organizational structure and staffing based on the scope of the disaster and evolving requirements. Figure 15 shows the GIS Unit regional incident support structure; Table 13 reviews the main roles and responsibilities that are a part of this regional support structure.

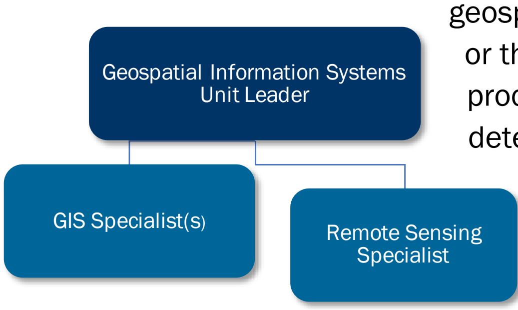


Figure 15: Regional Incident Support Geospatial Information Systems Unit Structure

Table 13: Geospatial Regional Incident Support Roles and Responsibilities

Regional Incident Support Structure	
Geospatial Information Unit Leader (GIUL)	• Provides technical, modeling, and mapping expertise required to support RRCS members by overseeing and ensuring the incorporation of all relevant data to produce map products, statistical data for reports, and/or analysis. • Serves as the link to other technology sources, such as Federal agencies, universities and information and warning centers. • Coordinates with other functions to produce document(s) and input for contribution to the COP. • Ensures the application and coordination of incident-specific geospatial activities—including the production of spatial products, the collection and dissemination of spatial data and analysis, Global Positioning System (GPS) support, and the acquisition, exploitation, and dissemination of remote sensing data. • Coordinates remote sensing activities. • Supervises the GIS Specialists.
Geospatial Information Systems Specialist (GISP)	• Supports incident-, regional-, and national-level planning and decision making by developing geospatial products and services, including products listed in the ICP • Collects and disseminates spatial data and analysis. • Assists with the acquisition, exploitation, and dissemination of remote sensing data. • Conducts basic geo-processing. • Develops geospatial products using specialized geospatial software. • Operates and calibrates GPS units and mobile data collection devices, and supports customers as needed. • Produces maps and displays by combining available demographic data with incident information.

Regional Incident Support Structure	
Remote Sensing Specialist (RMSP)	• Identifies requirements and Essential Elements of Information (EEI). • Prioritizes areas of interest (AOI). • Identifies local, state, and federal remote sensing assets and capabilities. • Assembles requirements from Regional Response Coordination Centers (RRCC), Incident Management Assistance Teams (IMAT), and affected states to create an integrated picture of remote sensing requirements. • Operates specialized software applications to produce remote sensing products. • Analyzes and compares imagery with operational information. • Requests and coordinates external analysis and support.

Incident Management

FEMA's incident level (also known as "the field") refers to the echelon at which operational control of FEMA incident operations, including the federal resources deployed to an incident and the establishment of a UCG, is delegated to a senior federal official (typically, the FCO). The GIU at the incident level is part of the Planning Section, as part of the incident organization's UCS. A qualified GIUL or Geospatial Information Manager (GIMG) for smaller-scale events may lead the GIU. Figure 16 shows where the GIU is positioned within the overall joint state and FEMA structure.

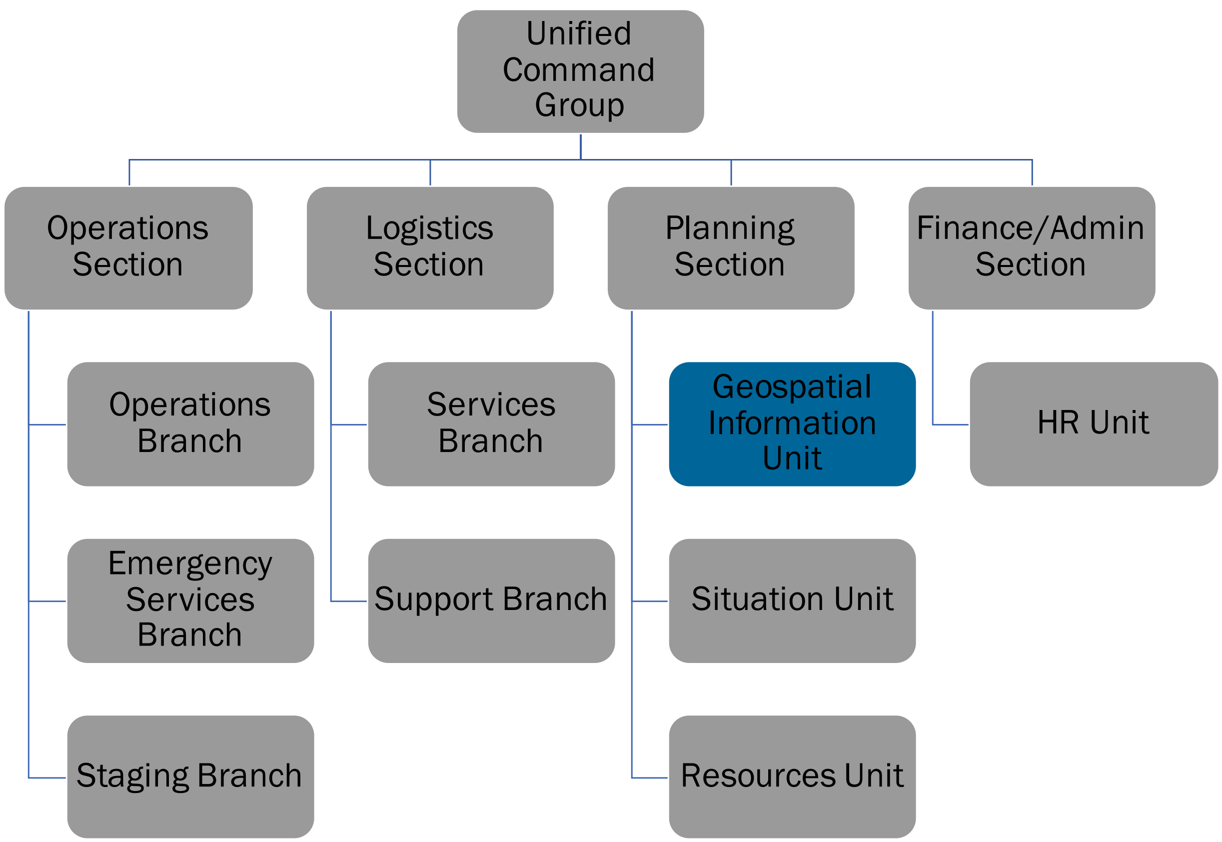


Figure 16: Joint State/FEMA Organization Chart

Geospatial Information Unit

The GIS Unit supports and facilitates incident-level planning and decision making through the development of geospatial products and services in support of the UCS and through the joint coordination of remote sensing operations. Figure 17 shows the GIU organizationial structure at the incident level; Table 14 highlights the common roles and responsibilities found at the regional incident management level.

Table 14: Geospatial Incident Management Roles and Responsibilities

Incident Management Structure	
Geospatial Information Unit Leader (GIUL)	• Sets geospatial priorities based on incident requirements. • Integrates, deconflicts, and prioritizes federal, state, and local requirements to create prioritized regional requirements for geospatial data, remote sensing collection, processing, and exploitation. • Ensures the application and coordination of regional geospatial activities. • Coordinates and distributes requests to state and federal agencies regarding data, modeling, map production, etc. • Integrates geospatial information from external partners. • Provides technical, modeling, and mapping expertise required to support RRCS members. • Supervises the Geographic Information System Specialists (GISP).
Geospatial Information Manager (GIMG)	• Sets geospatial priorities based on incident requirements (e.g., Information Collection Plan, Incident Action Plan [IAP], leadership requests/priorities, etc.). • Identifies potential needs for geospatial and remote sensing support across functional areas. • Coordinates with appropriate stakeholders to prevent duplication of effort and to promote information sharing. • Ensures the application and coordination of incident-specific geospatial activities, including the product of spatial products, the collection and dissemination of spatial data and analysis, Global Positioning System (GPS) support, and the acquisition, exploitation, and dissemination of remote sensing data. • Supervises the GISP.
Geospatial Information Systems Specialist (GISP)	• Performs basic geo-processing, digitization, geo-referencing, and analytical tasks. • Supports incident-, regional-, and national-level planning and decision making by developing geospatial products and services. • Collects data from internal and external stakeholders to develop and update geospatial products. • Creates, maintains, and updates geospatial databases. • Distributes geospatial products via digital and hard copy methods. • Integrates event-specific model output. • Operates specialized applications for disaster support.

Deployed Staffing

FEMA force structure provides a mechanism to ensure that FEMA is properly staffed for multiple simultaneous Level 1 incidents. Should mission requirements exceed the internal personnel capacity of organic resources, FEMA may leverage a variety of staffing solutions to provide geospatial support during disaster operations. The preferred source of GIU staffing from other federal agencies comes from the MA process.

Table 15 identifies geospatial staffing resources and the types of activities performed by each.

Table 15: Staffing Resources for Geospatial Deployments

Source of Staffing	Examples of Staffing
FEMA Staff	• Permanent full-time employees. • Temporary full-time employees. • Cadre of On-Call Response and Recovery Employees (CORE). • Reservists.
Mission Assignments (MA)	• U.S. Army Corps of Engineers (USACE). • U.S. Forest Service. • National Weather Service (NWS). • U.S. Geological Survey (USGS).
State, Local, Tribal, and Territorial (SLTT) Support	• The state geospatial community may be available for short-term surge support. • State employees may be reimbursed for travel expenses and overtime through their own agency or by FEMA. • State emergency management agencies can provide support under a formal FEMA-state agreement or informally. State-FEMA geospatial units are often co-located to support requirements.
Volunteers	• Individuals, non-governmental organizations, or the private sector may volunteer geospatial goods, services, and personnel to support disaster operations. • FEMA is restricted from directly accepting volunteer services but should support the identification and placement of volunteers to support geospatial operations in the affected state or local jurisdiction.
Contract Support	• Government contractors providing geospatial services must support the program areas to which their contract originates while organized within the Geospatial Information Unit (GIU). • All contracts for procurement of services and support must be in accordance with Federal Acquisition Regulations (FAR). The Joint Field Office's (JFO) Logistics Section is responsible for these arrangements. • Plans for contractors are made for as long as justifiable because the contract will need to be reevaluated after its term is complete.

Virtual Deployment for GIS Analysts

Given the dynamic nature of emergency management, it may be necessary to augment or virtually support NRCC, RRCC, or JFO operations using "surge" resources found across the FEMA geospatial community. Virtual deployments, acting under the construct of Unified Geospatial Operations, are vital resources that may be called upon during significant response or recovery operations. Outside of large-scale incidents, virtual deployments may be appropriate when field operations (e.g., JFO) do not necessitate a full-time GIU. To activate virtual support, it is imperative that requestors work with leadership and cadre management (e.g., PlanningCadre@fema.dhs.gov) to request or deploy GIS analysts in support of disaster operations. In most cases, activations will occur through the FEMA Deployment Tracking System under incident management or incident support planning/GIU titles.

Planning Cadre FQS Qualification Matrix

Table 16 and Table 17 highlight the required core competencies, behaviors, and required training for successful performance in specific FQS geospatial positions. Employees are initially designated as trainees and become qualified by completing all training and obtaining the required FQS experience (including deployments) and can demonstrate knowledge and competency in all position requirements. Incident management and incident support staff in the GIU will receive a PTB outlining the specific behaviors and activities they must demonstrate to be qualified in their position.

National Qualification System GIS Positions

The National Qualification System provides a common language and approach for qualifying and certifying FEMA geospatial personnel to assist other federal agency, state, local, tribal, and territorial partners through standardized performance metrics, behaviors, and tasks recognized across entire emergency management community. ***NQS does not replace the existing FQS systems.***

Table 16: Geospatial Information Unit Qualification Matrix (Incident Support)

Incident Support	Required Training	Required FQS Experience	Minimum Required Deployment History	Demonstrate Behavior
Geographic Information System Specialists (GISP)	▪ **E/L/B 190** ArcGIS for Emergency Managers ▪ **IS-103** Geospatial Information Systems Specialist ▪ **IS-922** Applications of Geospatial Information System (GIS) for Emergency Management **E/L/B 313** Basic HAZUS – Multi-Hazards (MH)	None	Not Defined	▪ Operate specialized hardware and software applications ▪ Generate geospatial products ▪ Manage geospatial data ▪ Comply with established policy and protocols ▪ Provide geospatial

Incident Support	Required Training	Required FQS Experience	Minimum Required Deployment History	Demonstrate Behavior
				coordination and customer service
Remote Sensing Specialist (RMSP)	**NFC 015** Introduction to Commercial Imagery*	None	Not Defined	▪ Coordinates remote sensing requirements, resources, and requests for team
Geospatial Information Unit Leader (GIUL)	▪ **E/L/B 827** Geospatial Information System Managers and Unit Leaders (GISM) ▪ **NFC 015** Introduction to Commercial Imagery (Web)* ▪ **E/L/B 179** Application of HAZUS for Disaster Operations ▪ **IS-61** GeoCONOPS In-Depth – Homeland Security Geospatial Concept of Operations (GeoCONOPS) ▪ **IS-63** Introduction and Overview – DHS Geospatial Information Infrastructure (GII) ▪ **E/L/B 317** Comprehensive Data Management for HAZUS – MH ▪ **E/L/B 172** HAZUS for Flood • **See https://www.agile.mil/* • *Register under the "Intelligence" section (DHS Link does not work)* • *Make an NGA student account and sign up for the course on its Website* *Search for course: NGA – SET1105*	IS GISP Qualification	Not Defined	▪ Oversee management and analysis of geospatial data ▪ Manage completion and distribution of geospatial products ▪ Determine requirements and acquire resources to establish the unit ▪ Provide geospatial coordination and customer service ▪ Demonstrate effective supervisory and leadership principles
Geospatial Technical Group Supervisor (GTGS) National Response Coordination Center (NRCC)	**E/L/B 827** Geospatial Information System Managers and Unit Leaders	Not Defined	Not Defined	▪ Provides FEMA senior leadership comprehensive situational awareness from geospatial and technical resources

Table 17: Geospatial Information Unit Qualification Matrix (Incident Management)

IM Title	Required Training	Required FQS Experience	Minimum Required Deployment History	Demonstrate Behavior
Geographic Information System Specialist (GISP)	▪ **E/L/B 190** ArcGIS for Emergency Managers ▪ **E/L/B 598** FEMA Incident Workforce Academy – Specialist Series ▪ **IS-103** Geospatial Information Systems Specialist ▪ **E/L/B 313** Basic HAZUS – MH ▪ **IS-822** Fundamentals of Management and Support Coordination of Federal Disaster Operations ▪ **IS-922** Applications of GIS for Emergency Management	▪ None	▪ Two separate deployments in the position title for at least 14 days each	▪ Operate specialized hardware and software applications ▪ Generate geospatial products ▪ Manage geospatial data ▪ Comply with established policy and protocols ▪ Provide geospatial coordination and customer service
Geospatial Information Unit Manager (GIMG)	▪ **E/L/B 172** HAZUS for Flood ▪ **E/L/B 300** Intermediate Incident Command System (ICS) (ICS 300) for Expanding Incidents ▪ **E/L/B 563** Basic Management in Disaster Operations ▪ **E/L/B 827** Geospatial Information System Managers and Unit Leaders ▪ **NFC 015** Introduction to Commercial Imagery (Web)* ▪ **E/L/B 179** Application of HAZUS for Disaster Operations ▪ **IS-61** GeoCONOPS In-Depth – Homeland Security Geospatial Concept of Operations (GeoCONOPS) ▪ **IS-63** Introduction and Overview – DHS Geospatial Information Infrastructure (GII) **See https://www.agile.mil. Register under the*	▪ GISP Qualification	▪ Two separate deployments in the position title for at least 14 days each	▪ Provide geospatial coordination and customer service ▪ Determine requirements and acquire resources ▪ Set geospatial priorities in order to manage the completion and distribution of geospatial products ▪ Practice effective and appropriate interpersonal communication and team behavior ▪ Implement data management process and ensure staff adheres to established procedures, standards, and doctrine

IM Title	Required Training	Required FQS Experience	Minimum Required Deployment History	Demonstrate Behavior
	"Intelligence" section. Search for (COURSE NGA-001-SET105e)			
Geographic Information Unit Leader (GIUL)	▪ **E/L/B 317** Comprehensive Data Management for HAZUS – MH ▪ **E/L/B 564** Managing in Disaster Operations – Preparing the Middle Manager ▪ **E/L/B 825** FEMA Incident Action Planning (IAP)	▪ GIMG Qualification	▪ Three separate deployments in the position title for at least 14 days each; at startup and when fully activated; supervise	▪ Oversee management and analysis of geospatial data ▪ Manage completion and distribution of geospatial products ▪ Determine requirements and acquire resources to establish the unit ▪ Provide geospatial coordination and customer service ▪ Demonstrate effective supervisory and leadership principles

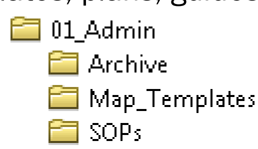
APPENDIX D: FOLDER STRUCTURE AND FILE SHARING

Guidelines for folder structures in the steady-state environment, cloud environment, and disaster situations provide a common baseline for users throughout the event to access. Having a common format allows users to access events through the full event life cycle and allows users to transition from one location to another seamlessly.

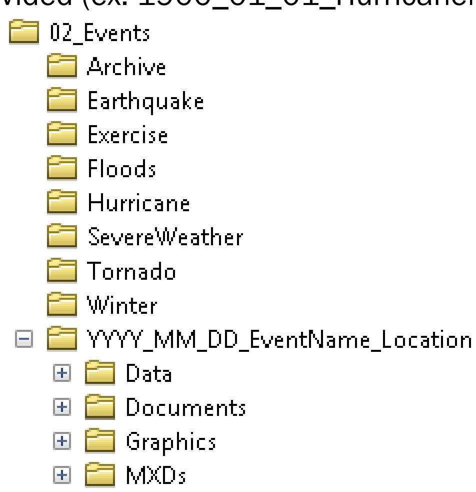
Steady-State

Steady-state, in the context of the *Geospatial Support for Disaster Operations Guide*, refers to the time and space in which everyday non-disaster activities happen. The following folder structure is intended to be the baseline for all activities related to geospatial work:

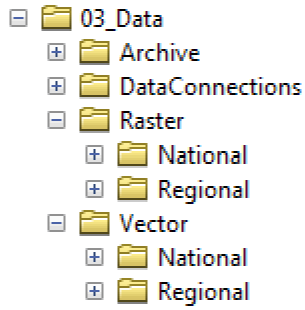
- **Section 01_Admin:** This section is meant to contain administrative documentation and guides. Examples of information stored in this folder would be SOP guides, blank copies of the official map templates, plans, guides, etc.



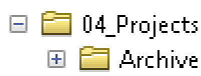
- **Section 02_Event:** This section is meant to contain all information created for an incident. The blank folder structure at the bottom of this section's heirarchy should be copied into the event type of the current event and given a name based on the naming convention provided (ex. 1900_01_01_HurricaneName_SouthEast).



- **Section 03_Data:** This section is meant to contain data sources used for mapping production. The Raster and Vector folders are further seperated by National and Regional folders. The Regional folder is then seperated further by region number and then by state. Data is placed in the root of the folder it most closely aligns with (e.g., a nationwide dataset of schools would go into the National folder, whereas a dataset of New York schools would go into the Regional -> Region II -> New York folder).

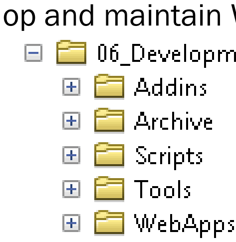


- Section 04_Projects: This section is meant to contain long-term and/or larger projects. Projects that have undefined final deliverables or projects that could involve multiple iterations or variations could reside in this folder (e.g., the project of developing templates for standard products would be considered a "Project" for this section).



- Section 05_Product_Requests: This section is meant to contain ad hoc and standard products. The Product Requests subfolder will contain all ad hoc products and one off type of product. The Standard Products subfolder will contain all repeated, daily, or standard products (e.g., standard products include declaration maps, logistics maps, etc.).

- Section 06_Development: This section is meant to contain all files used in the development and maintence of applications, scripts, and other development activites. The Addins subfolder will contain all files involved in maintaining ArcMap addins. The Scripts folder will contain scripts written to automate activites. The Tools folder will contain the files required for the maintence of tools. The WebApps folder will contain files used to develop and maintain Web applications.



- Section 07_Users: This section is meant to be used as a folder for users' personal work and testing that do not actively reference a project or event.

Events

The Event folder contains all activities related to a specific event. When a new event is expected, declared, or work has otherwise begun, the default folder structure listed next should be created with the appropriate naming convention based on the event. The naming convention is YYYY (Year), MM (Month), DD (Day), EventName (descriptive name for the event, no spaces, should align with WebEOC name), and Location (geographic location). Data, maps, and documents should contain a date in the naming convention to assist with version controls. (GeoFrameworkMapNumber_GeoFrameworkMapName_20160101[YYYYMMDD]_1400 [Time]). The folder structure is as follows:

- **Section Data:** This folder contains data related to the event not contained in a prior data connection or other data store. Data already stored in your steady-state data folder or in a data connection should not be copied to this folder unless there have been edits made to it that will need to be represented in future products related to this event.
- **Section Documents:** This folder contains documents related to the event. Only documents related to the specific event important for continuity of event support and for record keeping shall be placed in this folder. Do not copy emails, documents, information, etc., that are not related to this specific event into this folder. All generic documentation, such as SOPs and other doctrine, should be in the steady-state folder.
- **Section Graphics:** This folder contains all soft copy map products created during support for an event or activity. Documents should be placed in the folder of their respective map type according to the FEMA GeoFramework. Documents that reside outside of the FEMA GeoFramework should receive a new folder with the map purpose as its name. A copy of each new product shall be placed in the "Current" folder in the graphics folder structure. An update to an already existing product should replace the prior product in this same folder. This allows one repository for the latest available information.

- **Section MXDs:** This folder contains all Map Exchange Documents (MXD) for products being created. This is not the folder that contains MXD black templates. Documents should be placed in the folder of their respective map type according to the FEMA GeoFramework. Documents that reside outside of the FEMA GeoFramework should receive a new folder with the map purpose as its name.

Appendix E: Geospatial Framework

The FEMA Geospatial Framework (GeoFramework) was developed as a guideline for creating standard map products throughout the entire event life cycle. Because of variability between incidents, data availability, mission requirements, event magnitude, and resources, the map products, and accompanying data layers and supplemental text provide a framework for the actual products that may be needed during an emergency response.

Purpose

The GeoFramework provides the FEMA GWG with a set of 21 standard map products to use as a baseline for addressing decision makers' questions during an emergency response. The 21 standard products represent a starting point to support incident operations and are intended to be refined, when applicable, as additional data and resources become available. In particular, the GeoFramework will likely be refined at the regional, state, and local level so that products are tailored to meet the needs of the decision maker and incorporate local-level data layers into the map products. Figure 18 reflects GeoFramework applicability across these levels.

Figure 18: GeoFramework Applicability

Product Categories

The 21 standard map products are organized under six main product categories, with each addressing an overarching question related to understanding the incident and assessing the impact.

1. **Hazard Map:** Size of the area exposed
2. **Federal Support:** Description of who is involved and the financial impact
3. **Population:** Number of people exposed or impacted
4. **Buildings:** Number of buildings exposed or damaged/destroyed
5. **Transportation:** Overview of damage to the transportation network
6. **Lifelines:** Status of community lifelines (e.g., infrastructure and essential facilities)

The six product categories are further divided into Tier 1- and Tier 2-level products, with Tier 1 representing a high-level overview and Tier 2 providing more granular information with community-level and site-specific details.

Hazard Map

The Hazard Map is used by operational personnel in completion of their mission and answers questions related to *where* the event is occurring and *what* is the extent and type of incident. There are many variations of the hazard map, each dependent on the type of incident. In the event of a chemical, biological, radiological, or nuclear emergency, the hazard map includes the atmospheric dispersion plume produced from the IMAAC. The plume impact map includes the geographic coverage of the agent, as well as information related to occupational exposure. The hazard maps for natural disasters include impact maps for earthquakes, hurricanes, floods, wildfires, and winter storms. They are often refined over time as new information becomes available, such as the track of a hurricane or changes in the status of flood gauges. Figure 19 emphasizes the HAZUS and the Multi-hazard Risk Assessment Software Tool.

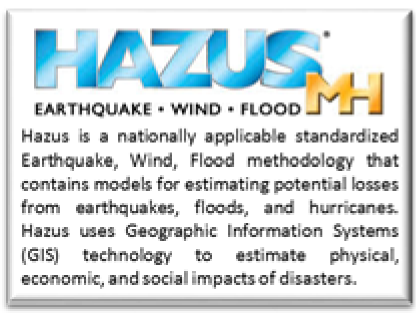


Figure 19: Hazards U.S. Multi-hazard Risk Assessment Software Tool

Federal Support

Map products that fall under the Federal Support product category address the questions of what geographic areas are affected and will likely or have already, requested federal support (e.g., counties and tribal nations), and the type of support (e.g., PA, IA, and hazard mitigation). Federal Support maps also include several Tier 2-level map products, including the following:

- Information related to the Incident Action Plan (IAP) and force laydown, which helps decision makers understand the operational structure and assess the physical location of field assets, distribution centers, and staging areas;
- National Flood Insurance Program policies by ZIP Code, including whether these properties overlap with the flood inundation area and if they have filed repetitive loss claims; and
- DRC locations, along with IA registrants.

Population Impacts

The Population Impact maps are primarily used to provide an estimate of the number of individuals who may have been affected by the event and to what degree they have been affected. Tier 1 products may include information related to the exposed population, such as the number of individuals (based on LandScan population data) exposed, injured, displaced, or evacuated. Additional map products that help decision makers understand the impacts on the population include those related to US&R (i.e., search areas for rescue operations), as well as those related to the Social Vulnerability Index (SOVI).

The SOVI was developed by the University of South Carolina and is a measurement that indicates the potential impact from disasters on populations based on a variety of social characteristics that might make the population in a particular area more vulnerable to a disaster. Population and housing characteristics are considered, such as age, low income, disability, home value, and other factors. A higher SOVI score indicates an area is more vulnerable, and, therefore, individuals in that area may require additional support (e.g., assistance with evacuations and increased supplies/resources). By mapping the SOVI score for affected communities, emergency responders can appropriately target rescue and response operations to aid in supporting the most vulnerable populations.

Building Impact

The Building Impact maps help leadership understand what areas have experienced building damage, the degree of damage, and the financial impact of the damage. Because limited building damage information is available immediately following an incident, initial map products are based on modeled building damage from a HAZUS analysis. Modeled building damage maps can include the estimated amount of debris generated, percent of parcels in each census block exposed to the hazard, and/or the estimated financial cost of the building damage.

As building damage information becomes available, products displaying modeled damage are transitioned to display actual or observed building damage based on field assessments and remote sensing data. In addition to maps showing the observed data, supplemental maps that display the following are produced to help decision makers understand the extent of the observed damage and how far along the damage assessment process is:

- Progress, displayed as percent completed, of damage assessments in the affected area;
- Estimated debris, based on an analysis of the PDA; and
- Debris removal per county, displayed as the percent of the total estimated debris.

Transportation Impact

Map products within the Transportation Impact category help decision makers understand what areas are difficult to access or are isolated and what areas are most important to regain access. This helps prioritize response and recovery efforts, including US&R, so that isolated communities are reached and critical infrastructure and essential facilities are accessible. The Transportation Impact map provides an overview of the transportation network within the affected area, including the operational status (e.g., open, closed, and limited access) of roads, airports, railroads, ferries, and ports. Additional variations of the Transportation Impact map include live traffic updates, the location of isolated communities, and an inaccessibility analysis to capture areas inaccessible because of damage from the event.

Lifeline: Infrastructure and Essential Facilities

The lifeline map products provide an overview of the availability and status of community lifelines, including critical infrastructure, essential facilities, and large retail chains. There are four variations of the Tier 1 product, listed next. Because of the sensitivity of some critical infrastructure, these maps may be labeled FOUO.

- Essential facilities, including but not limited to fire stations, police, hospitals, emergency operation centers, and shelters, in the affected area;
- Fatality management, which displays the location and facilities necessary to ensure the proper recovery, handling, identification, transportation, tracking, storage, and disposal of human remains and personal effects;
- Mass care, showing the available resources to support the affected population, such as traditional sheltering assistance locations, open shelters, American Red Cross facilities, and mass care assistance; and
- Estimated impact on mass care, which shows the operational status of hospitals and mass care facilities, based on modeled damage.

As required and applicable, Tier 2 maps may be produced to answer questions related to specific critical infrastructure in the affected hazard area, including the location and status of the following:

- Utilities (e.g., cellular towers, water treatment plants, and transmission lines);
- Facilities for vulnerable populations (e.g., nursing homes, day care centers, and dialysis centers);
- Energy, showing power outages as reported by DHS' Environment for Analysis of Geo-Located Energy Information (Eagle-I) and/or DHS' Infrastructure Asset List (IAL);
- Chemical hazards (e.g., hazardous waste storage); and
- Private sector impacts showing the status of large retail chains.

Table 18 summarizes the Product Categories and Tier 1 and Tier 2 Associated Geospatial Products.

Table 18: Summary of GeoFramework Product Categories and Associated Geospatial Products

Product Category	Product Type	Tier 1 and Tier 2 Map Products
1	1	Hazard Map
	1a.	Community Level Details
2	2.	Federal Support Declarations
	2a.	Incident Action Plan (IAP)/Force Laydown
	2b.	Commodities
	2c.	NFIP Policies/Claims Exposed to Hazards
	2d.	DRC/IA Registration Maps
3	3.	Population Impacts
	3a.	Social Vulnerability
	3b.	Urban Search and Rescue
4	4.1	General Building Stock Impacts (#) HASZUS/Modeled
	4.2	Building Values Impact ($) HAZUS/Modeled
	4a.	Building Damage (observed)
5	5.	Transportation Impacts
	5a.	Site-Specific Detail
6	6.	Lifeline: Infrastructure & Essential Facilities
	6a.	Status of Utilities
	6b.	Essential Facilities for Vulnerable Populations
	6c.	Energy
	6d.	Chemical Hazards
	6e.	Private Sector Impacts

Summary

The GeoFramework is routinely reviewed, particularly after an incident, to ensure that it is supporting critical information requirements for emergency operations. The GeoFramework is intended to provide a baseline set of products, aligning with the essential elements, needed to support key leadership decisions. Table 18 summarizes the six product categories and 21 standard products.

The GeoFramework is intended to be a starting point to answer broad questions that are inherent of all incidents. Additionally, it is expected to remain flexible enough so that map products can be adapted throughout the response and recovery process. As each incident unfolds, the GeoFramework will evolve based on incoming information and scenario- and site-specific data.

Symbology

Cartographic Elements

Table 19 identifies the elements that must be included in all maps generated by GIS personnel in FEMA incident management and support environments.

Table 19: Required Cartographic Elements

Element	Description
Legend	Identifies the meaning of symbols used to represent features on the map. Symbols not easily understood by the reader should be listed in the legend.
Scale	The ratio of a distance on the map to the corresponding real-world distance. If the scale of the overview map is global, a scale indicator (e.g., graticule, representative fraction, or scale bar) is not needed. Only include fractional scales if the map is not intended to be shared in any way other than as original printouts.
Title	All geospatial products should include a title bar that indicates the title of the event and area of interest. In disaster field environments, ink is a precious commodity, so use ink sparingly. For example, omit a background color in the title bar.
Author	The author of the map or at least his/her initials should be included on all incident management and support map products. The FEMA incident map templates also contain a space for the map author's position title.
North Arrow	Orientation provides the reader with the relationship between the directions on the map and corresponding compass directions. All maps should have a north arrow. If the orientation of an inset is different from the data frame, then the inset should include its own north arrow.
Date	The currency of the data, as well as the map itself, needs to be included somewhere in every map product, especially because of the dynamic event data typically included in incident management and support geospatial products.
Inset Map	Inset maps can be a small map set within a larger map showing a detailed part of the map at a larger scale or the extent of the existing map drawn at a smaller scale within the context of a larger area.
Locator Map	A locator map (or overview map) is a type of inset map that is a smaller-scale map and highlights the limits of another map's extent and surrounding area. Inset maps designed to provide an overview must consider the map readers and determine what location information they need in order to properly establish the extent of the study area. Closeup inset maps can be used to provide further detail for the areas that are rather congested on the main map.

Standard Symbology

The standard symbology that should be used for all ICS-compliant documents and reporting structures is the standard HIFLD symbology library. This applies to all incident maps included within IAPs and other Incident Command System (ICS) 200 series forms. This will ensure consistency and interoperability with other ICS-based organizations, such as state and local emergency management agencies, the U.S. Environmental Protection Agency, U.S. Coast Guard, and the National Wildland Fire Coordinating Group.

Cartographic Standards

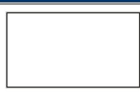
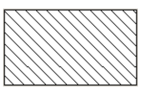
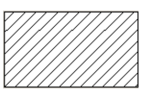
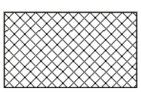
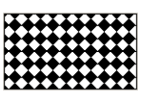
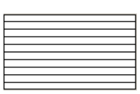
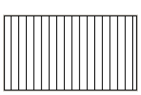
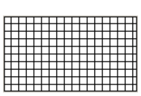
The incident facilities map should be produced in a black-and-white-compatible format (color is acceptable as long as patterns are used) in order to facilitate hard copy production. These maps shall also use the correct naming and identification map symbols, including the following referenced symbology standards. If the UCG or command and general staff require that additional location types be included on the incident map, the Planning Section should ensure that symbol variations are appropriately represented in the legend.

Cartographic Standards

The declaration map should be produced in grayscale or black and white and should use patterns instead of colors to represent the county's or jurisdiction's designation.

Table 20 provides examples of declaration map polygon symbology.

Table 20: Declaration Map Polygon Symbology

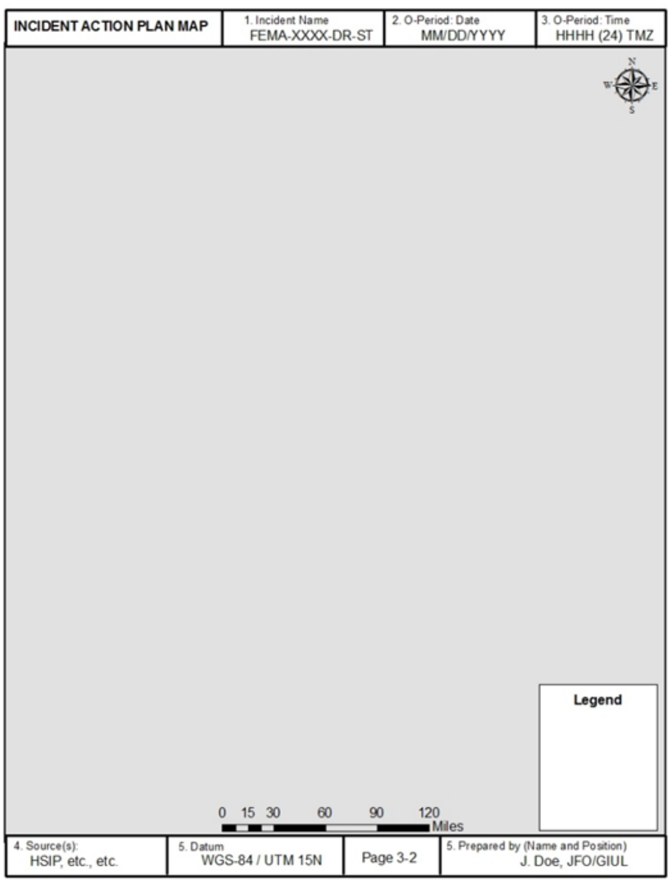
Symbol	Feature Represented	Standard
	Non-Designated County/Hazard Mitigation Grant Program (HMGP)	Polygon *Simple Fill Symbol* R:255; G:255; B:255
	Designated County (PA)	Polygon R:0; G:0; B:0 *Line Fill Symbol (1 pt)* (Angle: 45, Offset: 0, Separation: 6)
	Designated County (IA)	Polygon R:0; G:0; B:0 *Line Fill Symbol (1 pt)* (Angle: -45, Offset: 0, Separation: 6)
	Designated County (IA/PA)	Polygon R:0; G:0; B:0 *Line Fill Symbol (1 pt)* (Angle: -45/45, Offset: 0, Separation: 6)
	President of the United States (POTUS) Emergency Declaration (EM)	Polygon R:0; G:0; B:0 *Marker Fill Symbol (16 pts)* (Separation: X=10, Y=10)
	County Emergency Declaration	Polygon R:0; G:0; B:0 *Line Fill Symbol (1 pt)* (Angle: 0, Offset: 0, Separation: 6)
	State Emergency Declaration	Polygon R:0; G:0; B:0 *Line Fill Symbol (1 pt)* (Angle: 90, Offset: 0, Separation: 6)
	Governor's Request	Polygon R:0; G:0; B:0 *Line Fill Symbol (1 pt)* (Angle: 0/90, Offset: 0, Separation: 6)

Symbol	Feature Represented	Standard
	Preliminary Disaster Assessments Ongoing (PDAs)	Polygon R:0; G:0; B:0 *Marker Fill Symbol (4 pts)* (Separation: X=10, Y=10)

The symbols in Table 21 are optional and can be included at the discretion of the SITL/Operations Section Chief.

Table 21: Optional Symbols

Symbol	Feature Represented	Standard
	Area of Interest (Second Order – e.g., Bordering States)	Polygon *Simple Fill Symbol* **R:**178; **G:**178; **B:**178
	Area of Interest (Third Order – e.g., Canada/Mexico)	Polygon *Simple Fill Symbol* **R:**51; **G:**51; **B:**51



Map Templates

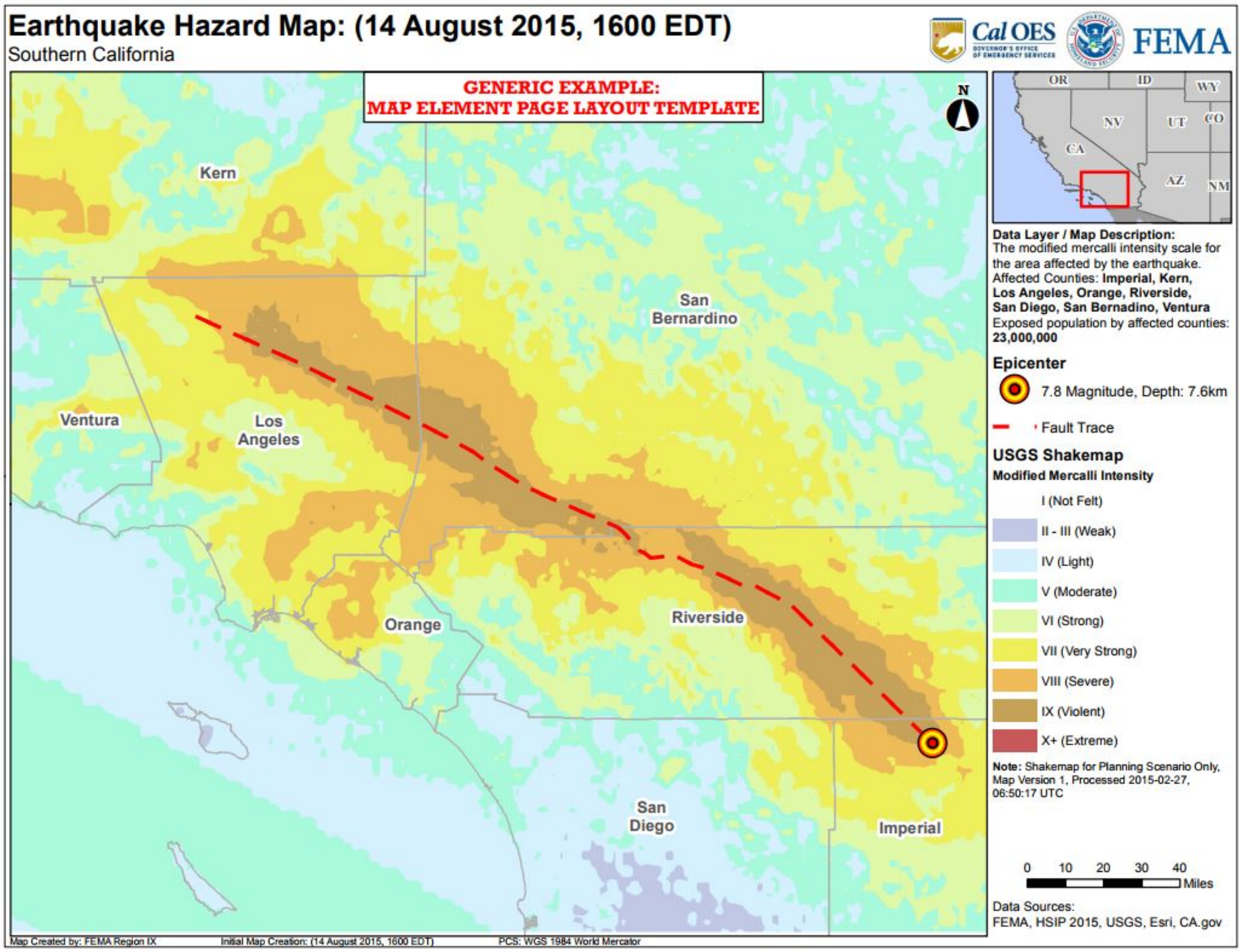
Portrait Template

Portrait maps within the IAP should contain form elements surrounding them that provide a seamless look with the rest of the document. The template (Figure 20) can be used and modified within the constraints of the ICS symbology standards already adopted by FEMA. The map template can also be shifted to landscape as long as it maintains the surrounding map form elements.

The general cartographic elements included in a map are title, date of map, a locator map, a legend, a north arrow, text describing the source, and author(s). Additional cartographic elements might include text describing spatial reference, a reference scale, and a scale bar.

The page number in the center cell on the bottom of the map frame should be changed to reflect the map's respective page within the IAP.

Figure 21 shows a generic landscape map template.



Appendix F: Training Resources

FEMA maintains a variety of required and optional training resources for GIU employees. More detailed staff development plans to further employee readiness is available with the GIO.

Required Training

FQS applies to all employees, including disaster reservists and full-time employees, regardless of employment status. Training requirements for the GIU are being reviewed and may include updated or revised requirements one year after implementation. This fact should not delay or deter individuals from completing the requirements currently identified.

Mandatory Training for All Employees

As a baseline, all GIU employees should complete the current mandatory FEMA training. Individuals should consult their supervisor, cadre manager, or training unit leader for the most up-to-date list of mandatory courses for their organization.

Most of these courses are found on the FEMA Intranet within the FEMA Employee Knowledge Center at http://on.fema.net/employee_tools/occhco_tools/cdo/Pages/training.aspx.

GIU-Specific Training

Under FQS, the GWG identified several training requirements. If a requirement is identified for a specialist position, it is also required to progress to the next higher position within the qualifications progression chart. Table 22 shows the suggested training classes for new, intermediate, and advanced GIS users.

Optional Training Supporting Knowledge or Skill Development

In addition to the required training previously referenced, there are many additional GIS training courses recommended for FEMA GIS staff to incorporate into their Individual Development Plan (IDP). The optional and recommended trainings referenced in the *Geospatial Support for Disaster Operations Guide* are based on documented requirements within FEMA at the time of publication regarding the production and management of data, maps, and applications commonly used within FEMA. A more comprehensive list of current optional and recommended training courses associated to professional development is outlined in the FEMA GIS Workforce Development Plan. The plan is updated at least once per calendar year to synchronize with the FEMA IDP schedule. The courses listed in Table 22 provide a progressive path of training.

Table 22: Suggested Training Classes for New, Intermediate, and Advanced GIS Users

Suggested Training Resources for New GIS Users at FEMA		
Build an understanding of foundational GIS concepts and components.		
Course	**Provider**	**Commitment**
Geospatial Analysis (Chapters 1 and 2)	Book	2 hours
Basics of Geographic Coordinate Systems	ESRI	3 hours
Basics of Map Projections	ESRI	2 hours
Creating and Editing Metadata in ArcGIS	ESRI	3 hours
Get Started with the ArcGIS Online	ESRI	3 hours
Google Earth Beginner Tutorials	Google	30 minutes
IS-922: Applications of GIS for Emergency Mgmt	EMI	3 hours
IS-103: Geospatial Information Systems Specialist	EMI	3 hours
Build on foundational GIS concepts and start to learn basic analytical skills. Select a classroom, instructor-led option or an online, self-paced option.		
Course	**Provider**	**Commitment**
Classroom, instructor-led option: EMI-190: Intro to ArcGIS for Emergency Managers	EMI	4 days
Online, self-paced option: Learning ArcGIS Desktop for ArcGIS 10	ESRI	24 hours
Getting Started with the Geodatabase	ESRI	3 hours
Geocoding in ArcGIS Desktop 10	ESRI	1 hour

Suggested Training Resources for Intermediate GIS Users at FEMA		
Review foundational concepts and build on analytical skills.		
Course	**Provider**	**Commitment**
Geospatial Analysis (Chapters 3, 4, and 5)	Book	2 hours
Distance Analysis Using ArcGIS	ESRI	3 hours
Building Models for GIS Analysis Using ArcGIS	ESRI	3 hours
Basics of Raster Data	ESRI	3 hours
Layout Design Essentials	ESRI	1 hour
Basics of Python (for ArcGIS 10)	ESRI	3 hours
Learn about and apply knowledge to FEMA workflows.		
Course	**Provider**	**Commitment**
IS-61 GeoCONOPS In-Depth	EMI	30 minutes
IS-63 DHS Geospatial Information Infrastructure (GII)	EMI	1 hour
Capturing Data with Collector for ArcGIS	ESRI	1 hour
E/L/B 827 Geospatial Information System Manager and Unit Leaders	IWMD	4 days
Apply GIS knowledge to HAZUS-Multi Hazard (HAZUS-MH).* *(Coordinate HAZUS installation with supervisor to ensure current delivery method is followed.)*		
Course	**Provider**	**Commitment**
Classroom, instructor-led option: E-313: Basic Hazus for Multi-Hazards (MH)	EMI	4 days
Online, self-paced option: Getting Started with Hazus-MH 2.0	ESRI	3 hours
Introduction to the Hazus-MH 2.0 Inventory	ESRI	3 hours
Introduction to the Hazus Earthquake Model	ESRI	3 hours

Suggested Training Resources for Intermediate GIS Users at FEMA		
Loss Estimation Using the Hazus Earthquake Model	ESRI	3 hours
Understanding Hazus Earthquake Model Results	ESRI	3 hours
Introduction to the Hazus Flood Model	ESRI	3 hours
Loss Estimation Using the Hazus Flood Model Results	ESRI	3 hours
Understanding Hazus Flood Model Results	ESRI	3 hours
Introduction to the Hazus Hurricane Model	ESRI	3 hours
Loss Estimation Using the Hazus Hurricane Model	ESRI	3 hours
Understanding Hazus Hurricane Model Results	ESRI	3 hours
Introduction to the Hazus Storm Surge Model	ESRI	3 hours
** FEMA Qualification System (FQS) requires GIS Managers (GIMG) to take E-313: Basic HAZUS for Multi-Hazards. A series of 12 online courses offered by ESRI may be used as a substitute for E-313. They should be taken in the order listed, and certificates of completion should be submitted to a cadre manager.*		

Suggested Training Resources for Advanced GIS Users at FEMA		
Continue to develop analytical skills.		
Course	**Provider**	**Commitment**
Processing Raster Data Using ArcGIS	ESRI	3 hours
Regression Analysis Using ArcGIS	ESRI	3 hours
Introduction to Surface Modeling Using ArcGIS	ESRI	3 hours
Performing Spatial Interpolation Using ArcGIS	ESRI	3 hours
Build on knowledge of GIS workflows and data structures.		
Course	**Provider**	**Commitment**
Creating Desktop Add-ins Using Python	ESRI	1 hour
Working with Geodatabase Domains and Subtypes	ESRI	3 hours
Versioned Editing Workflows for the Multiuser Geodatabase	ESRI	1 hour
Apply knowledge to FEMA-specific situations and workflows.		
Course	**Provider**	**Commitment**
E-317 Comprehensive Data Management for Hazus	EMI	4 days

Additional Information – ESRI Virtual Campus

- **Create your ESRI Global Account:**
  1. https://webaccounts.esri.com/cas/index.cfm
- **How to register for self-paced training:**
  1. Search the ESRI Training Catalog.
  2. Premium Courses[b] are available through the ESRI Enterprise License Agreement (ELA).
     - To take a premium course, send an email to FEMA-GISELA@fema.dhs.gov with a subject line of "Training Request."
       - Include your contact information (name, email, and telephone number).
       - If a contractor, include your company, Contracting Officer's Technical Representative (COTR)/federal point of contact.
       - Include the full course name.
       - The ELA account manager will reply with a course access code.

[b] All FEMA employees (government and contractor) are permitted to take premium courses.

APPENDIX G: GEOSPATIAL COORDINATION CALLS

Within the first operaitonal period of an incident, the NRCC GTGS will initiate a conference call with the impacted Regional GIU. A sample agenda for this call is as follows:

The National Geospatial Coordination Call should last no more than 30 minutes. Despite some variance because of different types of events, some of the primary priorities and objectives for the impacted jurisdiction may be as follows:

- Mass search and rescue operations
- Health and medical data points
- Mass care services
- Provide essential public and private services and resources to the impacted population
- Essential Infrastructure
- Mortuary support
- Address potential hazards, such as hazardous materials, fires, and contaminated water

Further clarification of priorities and objectives may be found in existing deliberate plans or from specific regional requirements.

National Geospatial Coordination Conference Call Agenda Template

Geospatial Coordination Call – (Insert Event Name)

All,

The National Geospatial Coordination Call will be scheduled (insert meeting time and recurrence schedule) e.g., … "to take place daily at 2 p.m. eastern standard time (EST) beginning Monday, June 1st to Wednesday, June 10th."

Conference Call Number: 1-800-320-4330

Conference Call Pin: XXXXXX

The purpose of this call is to discuss the following geospatial activities and requirements related to the current (insert disaster name and or type).

Participants

Action Item Review (5 minutes)

Modeling Activities (10 minutes)

Remote Sensing Activities (10 minutes)

GIS Activities (20 minutes)

State/Local Report

JFO/Field Report

Regional Report

Federal Partner Agencies (USACE, NOAA, USGS, etc.)

NRCC GIS Coordinator Report (MAC)

Final Comments/New Action Items (5 minutes)

*Please note each reporting agency or group involved in the immediate response/recovery activities should appoint a primary person to brief on their geospatial activities. Reports should be brief and concentrate on current support GIS products, data availability or data requirements, product distribution, or gaps.

FEMA