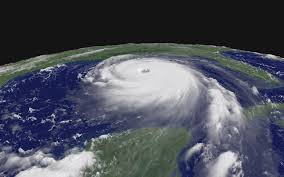
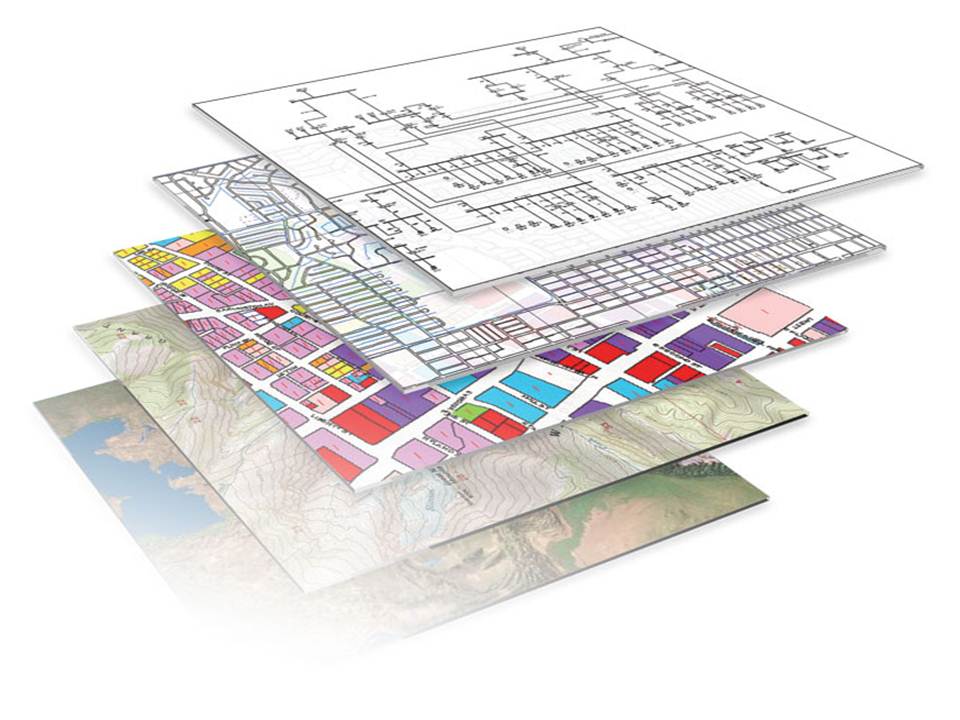
 **National Alliance for Public Safety GIS Foundation**

**Geospatial Standard Operating Guidance for Multi-Agency Coordination Centers**

***SUPPLEMENT FOR COASTAL STORMS***

****

**Version 3.0**

**Revision Register**

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date** | **Summary of Changes** | **Name** |
| 1.0 | 03/14/2013 | Initial Draft | National Alliance for Public Safety GIS Foundation – Coastal Storm Working Group |
| 2.2 | 04/14 | Second Draft | National Alliance for Public Safety GIS Foundation – Coastal Storm Working Group |
| 3.0 | 06/14 | Third Draft | National Alliance for Public Safety GIS Foundation – Coastal Storm Working Group |
| 4.1 | 7/14 | Fourth Draft | National Alliance for Public Safety GIS Foundation – Coastal Storm Working Group |
|  |  |  |  |

Produced by the -   
National Alliance for Public Safety GIS Foundation  
 Standards Working Group

DISCLAIMER –

This document was prepared by the National Alliance for Public Safety GIS (NAPSG) Foundation for informational purposes only. This is not an official document.  While every reasonable precaution has been taken in the preparation of this document, NAPSG assumes no responsibility for errors or omissions, or for damages resulting from the use of the information contained herein.

The information contained in this document is believed to be accurate. However, no guarantee is provided. Use this information at your own risk.  Do not use this document as a legal citation to authority.

This document was prepared with support from the, U.S. Department of Homeland Security. Points of view or opinions expressed in this document are those of the authors and do not necessarily represent the official position or policies of the U.S. Department of Homeland Security.

This document may be obtained in electronic format at <http://www.napsgfoundation.org>

# TABLE OF CONTENTS

TABLE OF CONTENTS 2

List of Figures 5

CREDITS 7

DOCUMENT BACKGROUND 9

Tips on How to Use this Guidance Document 10

INTRODUCTION 11

How GIS Can Assist Emergency Managers and First Responders? 15

What is GIS? 15

What Types of Questions GIS Can Answer? 16

What Resources are Needed/Where Can I Get Them? 17

FEMA Emergency management Institute 18

NAPSG Quick Guide 18

keys to the successful use of gis that emergency managers and first responders should know 19

What Do GIS Professionals Need to Know About Emergency Management? 21

Emergency Management Systems 21

Emergency Operations Center 24

Emergency Management Assistance Compact 25

International Charter 25

Crisis Information Management Systems 25

Critical Actions and Activities 26

Glossary of Emergency Management Terms and Definitions 28

keys to the successful use of gis that gis professionals should know 29

GIS team preparation Checklist 32

GIS Team Standing Orders for a Coastal Storm 32

Example - GIS Team Standing Orders Coastal Storm – Pre-Impact 33

Example - GIS Team Standing Orders Coastal Storm – Post-Impact 35

GIS Resource & Staffing Requirements 36

Resource Requirements 37

Staffing Requirements 39

Geospatial Roles and Responsibilities 40

GIS Responder Expectations 40

Shifts and Team Transition 41

ICP/DOC/MOC GIS Staffing 41

Team Transition 41

File Naming and Directory Structure 43

GIS File Directory Structure 43

GIS File Naming Convention 45

Communication 46

Mapping Protocols 48

Common Operating Platform 49

Consumable Services 49

Map Templates 49

Map Elements 50

Product Format Conventions 50

Map Symbology Guidelines 50

Map Distribution Regulations 51

QA/QC 51

Archiving 52

Standard Map Product Definitions 52

Optional Map Product Definitions 52

Data Protocols 53

Data Format Conventions 54

Data Backup Policy 54

Briefing Cycles 55

Information Availability 55

Data Acquisition and Dissemination 56

Data Management Plan 56

Essential Elements of Information 57

Storm Models 62

Compiled Imagery 65

Crowd Sourced Data 65

Obtaining Event Data 65

Damage Assessment 66

US National Grid 67

International, National & Federal Geospatial Products and Programs 67

State/Local Geospatial Products and Programs 69

Data Dissemination 70

Data Dissemination Protocols 71

Information Dissemination Protocols 71

Data Connections 72

Enterprise Geodatabase 72

GIS Emergency DVD or Hard Drive 72

Public Data Sharing/Exchange Policy 72

Documentation and Metadata 74

Dissemination of Metadata 74

Indexing Metadata to Facilitate Discoverability 74

Training/Exercises 75

Training 75

Exercises 76

Appendix 1: GIS Preparation Checklist 77

Appendix 2: List of Acronyms 81

Appendix 3: Glossary of Emergency Management Terms and Definitions 84

Appendix 4: Geospatial Products and Programs 86

Appendix 5: NOAA WEATHER DEFINITIONS 87

Appendix 6: EXAMPLE OF GEOSPATIAL ROLES AND RESPONSIBILITIES 89

Appendix 7: Imagery Types 91

# List of Figures

Figure 1-USGS Depiction of Atlantic Basin Tropical Storms from 1851-2000 11

Figure 2- Damage from Hurricane Andrew in Florida in 1992 12

Figure 3-USGS Depiction of Flooding Caused by a Storm Surge in Southern California in 2010 16

Figure 4-Examples of GIS Displayed in an EOC 17

Figure 5-Example of an ICS Organizational Structure 22

Figure 6-FEMA Multi-Agency Coordination System Diagram 22

Figure 7-Example of the Physical Layout of an Emergency Operations Center 24

Figure 8-GIS Team Standing Orders for a Coastal Storm – Pre-Event 34

Figure 9-GIS Team Standing Orders for a Coastal Storm – Post-Event 35

Figure 10-Example of a GIS Supply List 39

Figure 11-Example of a Directory Structure 44

Figure 12-Example of File Naming Conventions 45

Figure 10-Example of Data Format Conventions 54

Figure 14-Example of Data Format Conventions 54

Figure 15-Example of a Data Backup Policy 55

Figure 16-Example Recommended Datasets 62

Figure 17-Examples of Storm Models 64

Figure 18-Example of a FEMA Damage Classification per the DHS GeoCONOPS 66

# CREDITS

Many dedicated leaders in the public safety and GIS communities supported the development of this Geospatial Standard Operating Guidance (SOG) for coastal storms response. In smaller storms, this may just involve local and State governments. On larger events, this may involve the Federal Emergency Management Agency, the United States Coast Guard, and several other Federal agencies that will participate in response program coordination with the state and local emergency responders following the National Response System protocols.

Foremost, the National Alliance for Public Safety GIS Foundation and its partners in the project are grateful for the time and expertise that so many practitioners contributed in developing this:

Gerard Aiken, Geospatial Coordinator, Response Division, Region 3, Federal Emergency Management Agency (FEMA)

David Alexander, Director, DHS Geospatial Management Office (GMO)

Bob Bewley, Chief, Office of Cartographic Data Services, United States Geological Survey (USGS), National Geospatial Program

Bill Burgess, Washington Liaison, National States Geographic Information Council

Richard Butgereit, Information Management, GISP, Florida Division of Emergency Management

Brian Crumpler, ISP Coordinator for Northern Virginia, Virginia Information Technologies Agency

Bob Davis, Cartographer, USGS, Core Science Systems, National Geospatial Program

Tony Foisy, Project Manager, GISP, CSX

Heather Gilbert, Project Manager, National Oceanic Atmospheric Administration (NOAA)

Sandy Gruber, GIS Coordinator, City of Lincoln City, OR

Rezwan Karim, Flood Map Specialist, FEMA

Tyler Kleykamp, Chief Data Officer, Office of Policy & Management, State of Connecticut

Jim McConnell, Assistant Commissioner for Strategic Data, Director, Geographic Information Systems, New York City Office of Emergency Management

Mary Meade, GIS Manager, FEMA

Chris Meyer, GIS Systems Analyst, City of Virginia Beach, CGIS

James E. Mitchell, PhD, IT GIS Manager, Louisiana Dept. of Transportation & Development

Robert Moore, GISP, Catastrophe Risk Analyst II, American Modern Insurance

Dale Morris, GISP, Director, Erie Co. Office of Geographic Information Services

Peter Noy, United States Coast Guard

Bruce Oswald, Project Manager/Principal Author, National Alliance for Public Safety GIS Foundation (NAPSG)

Chris Rogers, Lieutenant, Kirkland Fire Department, NW Chair, NAPSG

Farouk Rohoman, Information Assets & 9-1-1 Data Manager (Acting), IT Solutions, Corporate Services, Niagara Region, Canada

Sandi Stroud, NG911 Project Manager, Michael Baker Jr., Inc.

# DOCUMENT BACKGROUND

This Standard Operating Guidance document was developed by a team of Geographic Information Systems (GIS) specialists and professionals, leaders in public safety operations & management and incident support subject matter experts. This document strives to serve as a template to support national GIS standards for coastal storms using GIS and technical professionals, embedded within an Incident Command System (ICS) structure.

This document proposes a set of guidelines for coordinating geospatial emergency response efforts. These guidelines are intended to serve as a shared foundation, encouraging improved communication and collaboration amongst GIS and other emergency management staff preparing for and responding to coastal storms. How these guidelines are implemented will depend on the local geography and type of storm. This living document provides a starting point to produce guidelines for the collection, organization, and management of geospatial data; map creation; and output within Multiagency Coordination Centers (MACC’s) for coastal storms. It is anticipated that this document will be updated as more local agencies adopt GIS operating procedures for emergency management and provide best practices back to the NAPSG Foundation via [admin@publicsafetygis.org](mailto:admin@publicsafetygis.org).

Intended as a template, agencies are encouraged to modify document content to accommodate local and regional specific details. Modifications may range from referencing local datasets and file locations to adjusting standard map products to better account for local hazards or values at risk. It is recommended that the GIS Team Leader and the emergency management staff work together to create a Standard Operating Procedure (SOP) or Standard Operating Guidance (SOG) that meets the unique needs of their State or local agency (and/or jurisdiction) for coastal storms.

The Department of Homeland Security’s (DHS) Homeland Security Geospatial Concept of Operations (GeoCONOPS) provides additional information on federal geospatial activities undertaken in support of emergency management. The Homeland Security GeoCONOPS is a strategic roadmap to understand, and improve, the coordination of geospatial activities across the entire spectrum of the Nation: from federal, to state, and local governments, to private sector and community organizations, academia, the research and development industry and citizens in support of Homeland Security and Homeland Defense (HD). The Homeland Security GeoCONOPS is structured to address key mission areas of prevention, protection, mitigation, recovery and response. To obtain a copy of the Homeland Security GeoCONOPS visit: <http://www.geoplatform.gov/sites/default/files/geoconops/DHS_Geospatial_CONOPS_v6_SCREEN_140529.pdf> or visit the Homeland Security GeoCONOPS Website at: <https://www.geoplatform.gov/geoconops-home>. In addition, the DHS GMO has developed several self-paced, on-line training courses that are valuable to both emergency management personnel and GIS professionals. These courses are available on the FEMA Emergency Management Institute (<http://www.fema.gov/contact-us/fema-training-emergency-management-institute>).

## Tips on How to Use this Guidance Document

Within this document, *background information* on each section is offered in blue text boxes at the beginning of each chapter*.* The background information is intended to guide the user on how to utilize the associated guidance. Text which is bold, italicized, and in carrots delineates where **<<*local jurisdictional input is needed>>***. Examples are given in motion quotes and are intended to provide the reader with tips on how to use and interpret the examples provided. Diagrams are also marked as examples to indicate where local inputs are required. Please note that all examples and diagrams are offered up only for reference purposes and are not intended to set a standard. Not all MACC’s are alike. Be sure to modify the examples given to fit the needs of your facility. While there has been a significant effort to identify the acronyms used in the text, a comprehensive list has been compiled in Appendix 2.

It is recommended that, once your agency has created a GIS operations document for coastal storms, it be exercised when emergency management agencies or first responders conduct scenario-based exercises. During these exercises, GIS products should be required to be delivered by the GIS team and used by the emergency management staff to specifically test different elements within the document. Subsequent to the exercises, after action reports should identify areas of the document and GIS response that worked as well as those that need improvement. The document should be updated after each exercise to improve its effectiveness.

For more information on how to integrate geospatial technologies within your public safety organization, please visit <http://carat.napsgfoundation.org/> for best practices and a prototype version of the interactive Capability and Readiness Assessment Tool (CARAT). The CARAT is intended for public safety practitioners interested in learning about and/or building a GIS to support their agencies' work. It is designed to serve as an assessment tool to develop a roadmap for anyone interested in learning about, doing, or directing a GIS in support of public safety.

# INTRODUCTION

***Purpose*:** This Standard Operating Guidance document (SOG) was prepared to provide guidance and key components of a template SOG that will help to facilitate State and local agencies with the creation, preparation, coordination, and dissemination of GIS services and products for coastal storms. This document is aimed at serving both State and local government needs. It recognizes that the role of the GIS manager at the State level and local level may differ from almost exclusively “coordination” to “hands on” GIS output. Each organization must determine how to best allocate staff resources to serve their unique mission.

Coastal storms are unique among natural events in that technology can identify and track them days in advance of their arrival. This provides emergency managers with GIS capabilities in their Emergency Operations Centers with a significant advantage in preparing for such storms, predicting their impacts, and responding to their community’s needs.

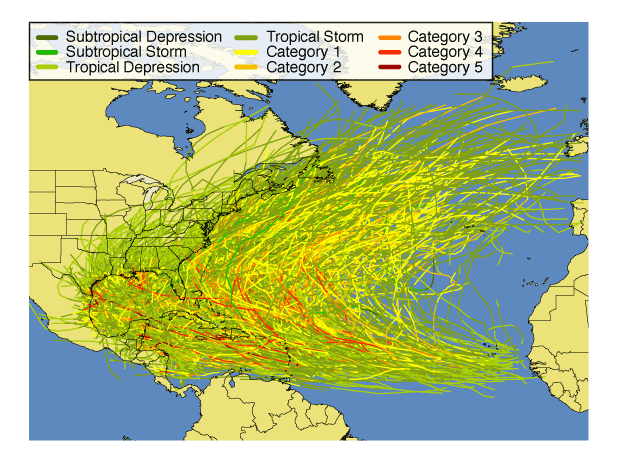


Figure 1-USGS Depiction of Atlantic Basin Tropical Storms from 1851-2000

This living document provides a starting point to produce guidelines for the organization and management of GIS data, map creation and output within Multi-Agency Coordination Centers (MACC’s) specifically. Additionally, proper internal and external communication channels for sharing these products are addressed.

This SOG will cover storms impacting the East, Gulf and West coasts as well as the Great Lakes. It will also cover winter as well as summer storms. While coastal storms can occur at any time, they are most widely known for their impacts on the West Coast (flooding and landslides) in the fall and winter. On the Gulf and East Coasts, they are most devastating in the latter part of the summer into the fall when the sea-surface waters have heated up providing significant energy for coastal storms in these areas. The Great Lakes Region is best known for their “lake effect” storms that dump inordinate amounts of snow in the region throughout the winter months. However, coastal storms can also provide significant damage or disruption throughout the year.

In its “Storm Surge Overview” (<http://www.nhc.noaa.gov/surge/>), NOAA provides the following facts on coastal storm vulnerability:

* From 1990-2008, population density increased by 32% in Gulf coastal counties, 17% in Atlantic coastal counties, and 16% in Hawaii (U.S. Census Bureau 2010)
* Much of the United States' densely populated Atlantic and Gulf Coast coastlines lie less than 10 feet above mean sea level
* Over half of the Nation's economic productivity is located within coastal zones
* 72% of ports, 27% of major roads, and 9% of rail lines within the Gulf Coast region are at or below 4 ft. elevation (CCSP, SAP 4-7)
* A storm surge of 23 ft. has the ability to inundate 67% of interstates, 57% of arterials, almost half of rail miles, 29 airports, and virtually all ports in the Gulf Coast area (CCSP SAP 4-7)

Thus, while coastal storms may not directly impact every state, the impact that they impose on the citizens of this country as a whole is significant!



Figure 2- Damage from Hurricane Andrew in Florida in 1992

It is essential that the major planning, organizational needs, data gathering, template development and training be completed long before the coastal storm season approaches. This document attempts to apply many of the lessons learned during previous storms to better prepare for future events. It is intended to provide emergency managers, first responders and GIS professionals another tool that they can use during a coastal storm to improve their ability to respond to future storms.

***Audience:*** The intended audience for this document includes all local and state staff assigned GIS support roles for coastal storm events in a coordination center, including Emergency Operation Center (EOC), Department Operation Center (DOC) and Emergency Medical Services Medical Operations Center (MOC). This document is meant for use within Operations Centers and the Multi-Agency Coordination System, and, therefore, follows the National Incident Management Structure (NIMS). NIMS states that EOCs do not have to be organized around the Incident Command System (ICS). This document is not intended for use by the Incident Command, and, therefore, does not follow direct guidance procedures mandated in ICS. For more information about GIS use within ICS, please see the National Wildfire Coordinating Group GIS Standard Operating Procedures (GSTOP, June 2006) (<http://www.nwcg.gov/pms/pubs/GSTOP7.pdf>). However, components of this guidance document can be adopted and applied to the development of SOP’s or SOG’s for ICS specifically.

For additional information on federal geospatial activities in support of emergency management, please see the Homeland Security Geospatial Concept of Operations (GeoCONOPS) coordinated by the Department of Homeland Security Geospatial Management Office (GMO). To obtain a copy of the Homeland Security GeoCONOPS visit: <http://www.geoplatform.gov/sites/default/files/geoconops/DHS_Geospatial_CONOPS_v6_SCREEN_140529.pdf> or visit the Homeland Security GeoCONOPS Website at: <https://www.geoplatform.gov/geoconops-home>.

***Objectives:***

Seven objectives were set to adequately address GIS needs and practices in an emergency event:

1. Develop standard operating guideline templates for coastal storms with a focus on State and Local Government needs.
2. Ensure the document and standards are consistent with the Homeland Security GeoCONOPS and the current NAPSG SOG.
3. Provide guidance for State and local GIS professionals without a background in coastal storms to be able to quickly understand what is required of them and how they can become more effective and productive members of the emergency management/first responder team.
4. Determine key GIS resources and tools for MACC’s (Incident Command Post (ICP), DOC or MOC).
5. Determine data and mapping protocols.
6. Determine and document protocols for data/map dissemination/sharing via web applications.
7. Determine data and map sharing practices with external contacts.

In order to meet these seven objectives, this document is broken down into the following chapters:

How GIS Can Assist Emergency Managers and First Responders – This section aids emergency responders who may be unfamiliar with the usefulness of GIS by providing an overview of the capabilities that GIS can offer for coastal storm events.

Keys to the Successful Use of GIS that Emergency Managers and First Responders Should Know – Provides general information about the use of GIS to emergency managers and first responders to help them optimize the utilization of geospatial technology and data to its full potential.

What GIS Professionals Need to Know About Emergency Management – Outlines the various emergency management organizational structures and physical layout of the MACC’s to aid GIS Staff when providing support within an EOC.

Keys to the Successful Use of GIS that GIS Professionals Should Know – Provides general information to GIS professionals to help them understand the best ways in which GIS, the technology and the data can be used during an event:

Standard Operating Procedure for Coastal Storm Response – Discusses the main components involved in a coastal storm response, including:

* GIS preparation checklist
* GIS team standing orders
* GIS staffing and resource requirements
* Mapping and data protocols
* Damage assessment
* Product tracking, documentation & metadata guidelines
* Communication
* Training & exercises

While it is suggested that this document be read in its entirety, the authors also realize that individuals may choose to read only certain chapters directly relating to their emergency management roles. For that reason, each chapter is written to “stand alone” and may repeat some material from prior chapters. It is hoped that this will be understood by the reader and serve to reinforce that information. However, because roles provide expectations, it is important for every member of the response team to develop a familiarity with the roles of their colleagues and how they will interact.

# How GIS Can Assist Emergency Managers and First Responders?

Coastal storms are unique among natural events in that technology can identify and track them days in advance of their arrival. This provides emergency managers with GIS capabilities in their Emergency Operations Centers with a significant advantage in preparing for such storms, predicting their impacts, and responding to their community’s needs.

Disasters and emergency operations affect a location and its surrounding communities whether big or small. All phases of emergency management involve the collection, analysis, and dissemination of geospatial data/information in an organized and logical manner. Geographic Information Systems (GIS) can provide a mechanism to organize, analyze and visually display information relevant to a coastal storm. These functions assist emergency managers or first responders in performing their duties whether they are in the preparedness, mitigation, response or recovery phase. This includes showing a storm’s predicted path and intensity, the maximum and most likely storm surges, river and urban flooding, areas potentially requiring evacuation, and, for winter storms, snow and ice predictions. In addition, it can show the number of people, businesses and infrastructure potentially impacted so that emergency managers can better understand the inherent risk and formulate a response, and forecast recovery needs. Once these analyses are performed, this information can be displayed in maps, charts, graphs, reports or web sites to effectively disseminate the appropriate information to government officials, responders and the general public.

## What is GIS?

A GIS is an information system that understands location. While it requires hardware and software, timely and relevant geospatial information is the key for it to provide accurate solutions. Much more than a map, a true GIS adds analytical capability that informs decision making while providing the ability to model, predict and assess a storm’s impact on a community and its critical infrastructure.

GIS products are built with layers of data. Each of these layers can be stored in an individual file or database and displayed together to depict relational location perspective. For example data can include static or real-time information, such as:

* Weather information
* Anticipated flood zones
* Daytime and nighttime population data
* Businesses
* Roads/Infrastructure (including marinas, boat launches and mooring locations)
* Land use/land cover
* First responder vehicle locations and movement
* Place names and boundaries

This data can be ‘layered’ together on a map to show which populations, businesses, or critical infrastructure will be most likely impacted by a storm. GIS analysis can be used before a storm to determine the best evacuation routes as well as the best way for contra-flow lane reversal (if required). During operations, GIS can provide situational awareness on those evacuation routes also.

GIS has a distinctive analytic ability that brings together otherwise disparate datasets. Because information can be organized by its location on the earth, a user can see relationships that are not evident in text reports. GIS provides the type of situational awareness that enhances incident-level decision-making to save lives and protect property as well as critical facilities.

## 

Figure 3-USGS Depiction of Flooding Caused by a Storm Surge in Southern California in 2010

## What Types of Questions GIS Can Answer?

With accurate geospatial information, GIS analysts can answer many questions. Of particular interest when responding in an EOC to a coastal storm event, one may be interested in the following:

* Where and when is the storm expected to hit and what are the predicted winds?
  + What are the predicted winds, when and where will they arrive?
  + How far inland will the storm surge come?
  + Will citizens need to be evacuated? What are the evacuation zones? How many will need to be evacuated? Where are the citizens with special needs?
  + What schools, hospitals, nursing facilities and day care centers will need to be shut down?
  + Where are the shelters? Are they out of the flood zones?
  + What businesses will be impacted and possibly need to be closed? What kind of businesses are they? Are there likely hazardous materials present on their sites?
  + What will be the economic impacts?
  + Where are potential staging areas located?
  + What are the best evacuation routes?
* What is the extent (location and severity) of the storm damage?
  + Where are roads open/closed?
  + For a wintertime storm, what is the extent of the snow and/or ice requiring removal? What roads have been most recently treated?
* Where is the available versus unavailable?
  + Who will need to be evacuated prior to the storm hitting?
  + Who needs to be rescued after SAR begins?
  + What is the predicted level of precipitation? What is the expected impact on river and stream flooding?
  + From what locations are the pictures of the event and the post event available?



Figure 4-Examples of GIS Displayed in an EOC

## What Resources are Needed/Where Can I Get Them?

In order to operate a successful GIS-based response, trained resources are required. The GIS Resources and Staffing section of this SOG aids in identifying the resources and staffing recommended for a successful response. Content provided in that section should be considered optimum. Specific roles will depend on the size of staffing and the manner and extent to which GIS is implemented across State and local government. MACCs should develop their own GIS capabilities and rely on participating agencies for data and subject matter expertise related to their specific mission where appropriate. For most situations, GIS Team members will fill multiple roles. It is recommended that MACCs work with their State and local government agencies to identify these resources and develop relationships to have GIS responders report to the MACC if/when needed. It is also recommended that MACC officials and GIS responders train together prior to incidents to better understand each other’s roles and the role they each play in a successful response.

If you don’t have adequate GIS resources, it is suggested that you contact your State GIS Coordinator. Your state’s coordinator would be able to guide you to available resources. A listing of State Coordinators is available at: <http://www.nsgic.org/state-representatives>. If there are not adequate GIS resources within your state, states have the option of obtaining additional resources from other states through the Emergency Management Assistance Cooperative. Contact your State EOC to determine if and how that is an appropriate resource to meet your needs.

## FEMA Emergency management Institute

The DHS Geospatial Management Office (GMO) has developed a series of courses on the Homeland Security Geospatial Concept-of-Operations (GeoCONOPS) that identifies points of collaboration, best practices, technical capabilities and authoritative data sources. While it is geared for technical personnel supporting operations centers at State and local government, it also provides useful information for emergency managers looking to better use GIS in their operations. These courses can be found on the FEMA’s Emergency Management Institute website at:

<https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-60>, <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-61>, and <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-62>.

## NAPSG Quick Guide

For more information, please reference the NAPSG publication: A Quick Guide to Building a GIS for Your Public Safety Agency at the NAPSG website:

<http://napsgfoundation.org/wp-content/uploads/2013/10/NAPSG-SOG-Quick-Guide-V3.pdf>

# keys to the successful use of gis that emergency managers and first responders should know

The most important keys to a successful GIS-aided response are the integration of GIS generated information into the emergency management workflow, training, communication, cooperation, and understanding. This section discusses the key elements emergency managers and first responders need to understand in order most effectively take advantage of GIS during an event.

1. Have a GIS team selected and trained (minimum ICS/IS-100 and 200 and IS-700) prior to a coastal storm event as well as familiarity with meteorological terminology and data products.
2. If additional GIS staffing is required, discuss your needs with your State GIS Coordinator/GIO (<http://www.nsgic.org/state-representatives>).
3. Meet with your GIS team before your region’s major coastal storm season to explain the issues that you encounter during a coastal storm. Learn what assistance GIS can provide you to meet your emergency management needs. Be sure to relay your timing needs for the delivery of GIS products.
4. Integrate the use of GIS products into your standard operating procedures/emergency management workflow.
5. Provide regular communication with the GIS team on emergency management and first responder needs, expectations and product delivery timetables.
6. Ensure appropriate bandwidth, Internet connectivity, servers, printers/plotters, supplies and IT staff support.
7. Provide the GIS professionals a clearly defined organizational chart so that they can understand the structure of the organization and who to go to get things done.
8. Ensure that your GIS team has access to regular training on GIS software/tools as well as incident scenarios; integrate the use of GIS into emergency management drills/scenarios (It is essential for team members to clearly understand their roles and establish realistic expectations).
9. Provide a space/room in the EOC or ICP for the GIS team to work together/collaborate. This will help to streamline workflow and foster for better communication.
10. If possible, designate a GIS liaison (refer to Geospatial Roles and Responsibilities) to work informally with the emergency management staff (before, during, and after an event) to better understand their needs and suggest GIS support that can assist them in resolving their issues.
11. Understand that GIS can be used for more than planning. GIS data collection and analysis is a valuable tool to provide situational awareness and focused response throughout all phases of an event. (Refer to “What types of questions GIS can answer?” in the previous section.)
12. Enable proper coordination with GIS professionals at State and Federal Governments when appropriate.

# What Do GIS Professionals Need to Know About Emergency Management?

In order to effectively respond to an emergency as a GIS professional, it is important to understand the various emergency management and incident command protocols that are in place. Not all Multi-Agency Coordination Centers (MACC’s) are alike. In many cases, the GIS responders to MACC’s may be unfamiliar with the layout, hierarchy, and processes taking place. Research how your agency’s Incident Command System (ICS) is structured. The organization’s organizational chart can be very useful. GIS responders may also want to refer to and become familiar with the Homeland Security Geospatial Concept of Operations (GeoCONOPS) (http://www.geoplatform.gov/sites/default/files/geoconops/DHS\_Geospatial\_CONOPS\_v6\_SCREEN\_140529.pdf) if Federal Government agencies are to become involved. In addition, the DHS Geospatial Management Office (GMO) has developed a series of courses on the Homeland Security Geospatial Concept-of-Operations that identifies points of collaboration, best practices, technical capabilities and authoritative data sources. These courses are geared toward technical personnel supporting operations centers at State and local government. They can be found on the FEMA Emergency Management Institute website: <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-60>, <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-61>, and <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-62>.

## Emergency Management Systems

Emergency management systems are policy documents with the purpose of guiding agencies on their internal organizational structure when responding to an event. They offer an operational foundation for emergency management organizations. They also provide the flexibility for expansion and integration with other levels of government should the need arise.

NIMS

The **Department of Homeland Security (DHS) released the National Incident Management System (NIMS) in March 2004 with subsequent updates in 2008**. It describes NIMS as follows: “The National Incident Management System (NIMS) provides a systematic, proactive approach to guide departments and agencies at all levels of government, nongovernmental organizations, and the private sector to work seamlessly to prevent, protect against, respond to, recover from, and mitigate the effects of incidents, regardless of cause, size, location, or complexity, in order to reduce the loss of life and property and harm to the environment. NIMS works hand in hand with the National Response Framework (NRF). NIMS provides the template for the management of incidents, while the NRF provides the structure and mechanisms for national-level policy for incident management.”

For more information about NIMS, see: <https://www.fema.gov/pdf/emergency/nims/NIMS_core.pdf>.

ICS



Figure 5-Example of an ICS Organizational Structure

The **Incident Command System (ICS)** is a command structure set up in the field for first responders. Some of these command systems have GIS staff. ICS provides a flexible mechanism for coordinated and collaborative incident management for first responders. The physical location where the ICS is set up is called the Incident Command Post (ICP). If you are requested to respond to or drop off information to the ICP, the following organizational structure will provide assistance in identifying the right people. For more information about ICS see: <http://www.nrt.org/production/NRT/NRTWeb.nsf/AllAttachmentsByTitle/SA-52ICSUCTA/$File/ICSUCTA.pdf?OpenElement>

Homeland Security GeoCONOPS

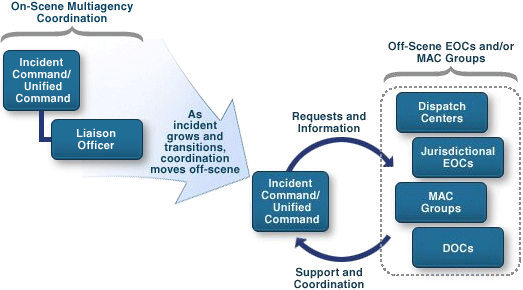


Figure 6-FEMA Multi-Agency Coordination System Diagram

The **Homeland Security (HLS) Geospatial Concept of Operations (GeoCONOPS**) is a strategic roadmap to understand, and improve, the coordination of geospatial activities across the entire spectrum of the Nation: from federal, to state, and local governments, to private sector and community organizations, academia, the research and development industry and citizens in support of Homeland Security and Homeland Defense (HD). The intended audience for this document is the entire geospatial community within the Homeland Security Enterprise that supports the missions of the federal government under The Stafford Act, the National Response Framework (NRF), Presidential Policy Directive-8 (PPD-8) and Presidential Policy Directive-21 (PPD-21). This includes stakeholders and actors representing the Emergency Support Functions (ESFs), the Joint Field Offices (JFO), Federal Operations Centers, the disaster preparedness exercise and evaluation community, and those involved in other NRF missions. To obtain a copy of the Homeland Security GeoCONOPS visit: <http://www.geoplatform.gov/sites/default/files/geoconops/DHS_Geospatial_CONOPS_v6_SCREEN_140529.pdf> or visit the Homeland Security GeoCONOPS Website at: <https://www.geoplatform.gov/geoconops-home>.

Multi-Agency Coordination System  
FEMA characterizes multi-agency coordination as a process that allows all levels of government and all disciplines to work together more efficiently and effectively. Often, cooperating agencies develop a **Multiagency Coordination System (MACS)** to better define how they will work together and to work together more efficiently; however, multiagency coordination can take place without established protocols. MACS may be put in motion regardless of the location, personnel titles, or organizational structure. MACC’s such as Emergency Operations Centers (EOC’s) and Department Operations Centers (DOC’s), etc. are part of several system elements included within the MACS.  EOC’s and DOC’s are intended to facilitate MACS functions, and may provide support to Area Command, Incident Command, or Unified Command when resource needs exceed local capabilities.

**GIS**

Fire Services Coordinator

EAS Room

Radio Room

**R.A.C.E.S.**

Audio/ Visual Hardware - Plotters

**Joint Information Center (JIC)**

**211 – Public Inquiry**

**Policy**

**Video Wall Display (3)**

**Law**

**Fire/Health**

**Const. & Engineer.**

**Care & Shelter**

**Ops Chief/ EOC Director/ Recovery**

**Logistics**

**Plans**

**Liaisons**

Operations

**Information and Intelligence**

Figure 7-Example of the Physical Layout of an Emergency Operations Center

## Emergency Operations Center

NIMS defines **Emergency Operations Centers (EOC’s)** as a component of a MACS. EOC’s do not have to be organized around ICS. NIMS states, "EOC’s may be organized by major discipline (e.g., fire, law enforcement, or emergency medical services); by emergency support function (e.g., transportation (ESF-1), communications (ESF-2), public works and engineering (ESF-3), or resource support (ESF-7)); by jurisdiction (e.g., city, county, or region); or, more likely, by some combination thereof. Incident Command Posts need reliable communication links to EOC’s to ensure effective and efficient incident management.” Some EOC’s can be mission-oriented and reside within the organization responsible for an Emergency Support Function (ESF). Personnel representing multiple jurisdictions and functional disciplines and a wide variety of resources may staff EOC’s.

An EOC is activated to support the on-scene response during an escalating incident by relieving the burden of external coordination and securing additional resources. It is the physical location where organizations and agencies come together during an emergency to coordinate response and recovery actions and resources. An EOC is often an established, physical location that is set up as an operations center. During an event, smaller incident command posts (ICPs) are often established. ICPs can be set up anywhere-a high school gymnasium or a mobile command facility in a parking lot.

***<<State/Regional/Local System Name>>***

***<<Include a description or reference to state, regional, or local systems or documents that impact emergency operations in the area>>***

## Emergency Management Assistance Compact

The **Emergency Management Assistance Compact (EMAC)** was established in 1996 and was the first national disaster relief compact since 1950 to be ratified by Congress. During a governor-declared state of emergency, EMAC offers assistance through the sending of personnel, equipment and commodities to aid disaster relief. All 50 States, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands are EMAC members. EMAC allows affected states to join together and help one another during a disaster and provides a methodology for those states receiving assistance to pay those states providing assistance. For more information on EMAC see: <http://www.emacweb.org>. (State EOC’s are responsible for requests for assistance through the EMAC process.)

## International Charter

The **International Charter** provides a unified system of space data acquisition. It delivers that data from various space-based platforms that are related to the areas impacted by disasters. This includes both man-made and natural events. The services are provided to authorized users, using a secure system. The International Charter is comprised of over 20 agencies, which have committed to provide various resources, at no cost, to support the International Charter for major events. For more information about the International Charter see: <http://www.disasterscharter.org> and your State GIS Coordinator/GIO at: <http://www.nsgic.org/state-representatives>.

## Crisis Information Management Systems

Crisis information management systems are systems and viewers designed to manage information flow during an incident. Typically, these are web-based crisis information management systems that provide a secure, log-on platform for emergency managers and first responders to share real-time critical information, and can perform basic mapping and analysis during an incident. Examples of these systems include: WebEOC, e-Team, Disaster LAN, and Knowledge Center. (These are commercial products designed to provide a **Common Operating Picture**.)

Many emergency managers and first responders have utilized a Common Operating Picture(COP) during an incident. A COP is a single viewer that contains relevant GIS data (such as predicted storm surge and flood inundation, path of a coastal storm, populations and businesses most likely to be impacted, evacuation zones, evacuation routes, etc.) and tools that several different command centers or groups can utilize during an incident. Your individual agency may have an established COP in use. It is important for GIS personnel to be aware of its existence and become familiar with its functionality well before an event.

With the advent of cloud computing and the need to integrate various sensors and mobile devices into a COP, GIS technology is moving towards the use of a **Common Operating Platform**. A Common Operating Platform is the underlying infrastructure that data, tools and various applications are built upon. Examples include Esri’s ArcGIS Server or ArcGIS Online, Google Earth or the equivalent built to Open Geospatial Consortium (OGC) standards. It has the capability to manage content and operations, display situational awareness, engage the public, gather data and share content. The most powerful capability provided by a Common Operating Platform is the ability to push the content to many different target applications and technologies. The information can be used on a computer, through a mobile (tablet or smartphone) application, or a web-based viewer. This allows emergency managers and first responders to be completely mobile and take their response efforts out of the command center, and creates an environment that all responders involved can utilize.

## Critical Actions and Activities

There are several critical actions and activities that GIS professionals must consider when working with Unified Command and ICS staff during an event.

1. Needs assessment – This assessment addresses several things. First, it establishes the importance of data during an incident. As a general rule, all “basemap” data (refer to the subsection entitled, “Essential Elements of Information” for additional information) should be up to date and available within the EOC. Events can change rapidly, and it is essential to have all data (local data in particular) on hand to address any issues or requests as they arise. If the EOC loses connectivity to any web services or other external data sources, the GIS team will still be able to function. (Loss of connectivity can result from problems on-site, and the source, or anywhere in-between.)

Second, it influences the products you can produce, such as data layers, web services, maps (electronic or paper), and analyses. In order to do determine the needed products, GIS professionals should work with the emergency managers and first responders to fully understand their needs and discuss GIS products that can be delivered in a timely manner.

Third, GIS professionals should create templates and familiarize themselves with the data (including creating bookmarks and shortcuts for easy access) and models needed to support common emergency management workflows for a coastal storm response. Then, they should familiarize the emergency managers and first responders on the various ways GIS can be used during a coastal storm. (This is important in managing expectations on both sides and learning how to request as well as produce specific GIS products.)

1. Examples of common GIS products include: path of the storm and its anticipated locations during various time frames, areas anticipated to be inundated, population, businesses, and critical infrastructure to be impacted by the storm path, evacuation zones, evacuation routes, locations of shelters, snow and ice coverage (for winter storms), imagery of post-storm impacts, and locations of emergency responders and equipment in the field. Many of these are available as real-time data feeds. Finally, the needs assessment will indicate what analysis is needed to be performed or obtained from experts. Examples of analysis available on line include: HURREVAC (recommended for wind speed probabilities and arrival times <http://www.hurrevac.com/index.html>), HAZUS [recommended for planning and exercise development] <http://www.fema.gov/hazus>), and the National Weather Service River Forecast Center (recommended for information on river and urban flooding) <http://water.weather.gov/ahps/rfc/rfc.php>). After the storm subsides, the GIS team may be called upon to assist with urban search and rescue operations and as well as analyze the economic impact of the storm on businesses in affected area(s). It can be used to track the progress of post-storm cleanup and restoration (such as damage assessments or debris removal).
2. GIS is more than a map – GIS is a powerful tool, and can be used for so much more than static mapping. It is important to ensure that the products produced are useful to the incident command staff prior to, during and after the storm has left. GIS can contribute important information throughout the emergency management response cycle. It is also important to demonstrate to them the multiple ways that GIS can be used to assist them during an incident.

The ability of GIS to combine data from disparate sources will provide answers to questions that emergency responders don’t know to ask. Work with them to determine what questions emergency responders are trying to answer about the event, and suggest products beyond basic maps that will help. In addition, GIS analysis can be used beyond its basic function in other ways such as: predictive modeling, remote sensing mashups, equipment tracking, temporal displays (fly-throughs and animation), spatial dataset reporting, form generation, rapid field reporting using mobile devices which allow data to be uploaded to the server in real-time and pushed back to the field crews, spatial division of labor, GeoPDF® production, geo-referencing photographs. Finally, GIS can be used to harvest pictures and reports from individuals provided through social media to provide a more comprehensive perspective of the overall picture during and after a coastal storm.

1. Timing is essential – The importance of producing products in a timely manner cannot be overstated! During an incident it is crucial to deliver information as quickly as possible. As a result, it is not necessarily efficient to focus on cartographic elements, such as colors, titles, *etc*. Keeping the message clear and simple is critical. Creation of templates developed through numerous training exercises will provide GIS professionals the information necessary to provide the basic map elements needed by emergency managers and first responders. This will result in quicker production at the time of the incident. For standardized products, provide the emergency managers with a delivery schedule that will meet their operational requirement.
2. Make the message easy to understand – Keep map products, presentations, situational reports and briefings straightforward. Bold graphics are often preferred when meeting with first responders. GIS professionals may not be working with individuals who are familiar with the technical terminology of GIS. It is most productive to focus on the subject matter being depicted instead of the technical aspects of the work. Avoid GIS/technology acronyms! (Side-by-side exercises with emergency managers will help to address this issue.)
3. Archive products produced – Archive each product produced as a PDF indicating the date and time it was distributed. Maps can be stored in document and PDF formats and shared and used as documentation. Data should be time-stamped at the record or database level. These will be invaluable tools, later, to determine what was happening and when.
4. Product tracking mechanism – Develop a mechanism (spreadsheet or database) to track the status of scheduled products and specialized requests. Use this to review GIS product status during shift transitions. (It can also serve as a “product catalog” that decision-makers, emergency managers, and first responders can use to select products to meet their needs.)

## Glossary of Emergency Management Terms and Definitions

In order to successfully communicate in and emergency management environment, GIS professionals need to understand the emergency management terms. Appendix 3 provides a listing of terms and definitions.

# keys to the successful use of gis that gis professionals should know

The most important keys to a successful GIS aided response are integration of GIS into the emergency management workflow, training, communication, cooperation, and understanding. GIS professionals also need to understand what data, software and hardware are keys to a successful incident response. This section discusses the key elements that a GIS professional needs to understand during an event.

1. Know what products are can assist emergency managers and first responders for a coastal storm. Meet with emergency managers (and first responders, if possible) and learn about their workflow and needs. Suggest GIS products that will meet their needs, test them out in scenario training, and modify them as required. In addition:
   1. Know where the data and/or models for those products are located.
   2. Data quality is important. Know how current and accurate the data are and if that is sufficient to support operation needs.
   3. Historical data has its place, but, during live operations, inaccurate data destroys the credibility of GIS technology.
   4. Know the time frame that each must be produced. Identify how much time is required to produce those products.
   5. Place as much as possible in a centralized file location so that it can be quickly accessed and moved if staff is deployed. In addition, having data backed up in a location remote from the EOC is highly recommended. This cloud based storage for data back up should be strongly considered.
   6. In addition to the standard “basemap” data (refer to the subsection entitled, “Essential Elements of Information” for additional information), it will include: critical facility locations (hospitals, police and fire stations), businesses along the coast, and demographic data. (A checklist of data typically required for a coastal storm is provided in the Data Acquisition and Dissemination section.)
   7. Imagery will be a crucial component during a coastal storm. GIS staff at local governments should communicate with State and Federal GIS teams to learn what imagery is available or planned for their areas. State GIS staff should coordinate with the Federal government to determine what imagery may be available or planned for their state.
   8. Prior to the event, data sharing and information sharing agreements, or general outlines (for quick modification) should be in place. If possible, become familiar with what agreements are in place in your area.
2. Determine the proper bandwidth necessary to support GIS operations and establish what is available. Work with the IT staff to ensure appropriate Internet connectivity, servers, printers/plotters, security, and any other equipment are made available. Inadequate or unstable bandwidth or missing key equipment will severely degrade operations. Communicate these requirements to management **before an event**, so that steps can be taken to mitigate these needs. It is important to note that even with the best planning sometimes what is needed is not available. Establish a risk avoidance plan for what to do without the items/services discussed with management and/or other key items with high probabilities of failure. Some of these requirements can be determined through drills and scenario-based exercises.
3. Standardize the products to be available during an event. Develop a “Product Catalog” of datasets, maps (electronic, web, and paper), reports and analyses that will be available. Each standard product should include a schedule for delivery. Work with emergency managers and first responders to determine an appropriate schedule for standardized products based on their operational requirements. Standardized products might include maps showing the storm path and surge, evacuation zones, evacuation routes, etc. as well as situational reports, standard analysis, etc.
4. Develop a system to track and memorialize all geospatial product requests and deliveries. It is recommended that a PDF with a date and time designation be archived for all products developed for later reference. Create basemaps, templates, animation templates and standard forms whenever possible. Work with emergency management staff to integrate these elements into the daily briefings and emergency management workflow.
5. Timeliness is critical! GIS products need to be delivered on time in order for emergency managers and responders to make informed decisions. While it is imperative that products be accurate, GIS professionals must remember that their work is time-sensitive for decision makers. **If geospatial products are not delivered in a timely manner in an emergency, important decisions will be made without them.**
6. Develop training on software/tools, scenarios, and emergency management drills, and conduct this training on a regular basis. During emergency management drills, ensure that geospatial products are incorporated into the emergency manager’s workflow so they know what to expect and how it can aid them. Technology is constantly changing, and it is beneficial to be current in all elements. This includes not only software versions, but also emergency management protocols and regulations. Performing training on a regular schedule allows for you to be current when an emergency occurs. This is critical to establish roles and expectations regarding the role of GIS, across the entire organization.
7. Communication is critical during a response. It is important to:
   1. Communicate on all levels with management and requestors about expectations, needs, and products available as well as ingestion and distribution capabilities versus needs;
   2. Establish and implement standard symbology for map presentations (this will reduce confusion and avoid problems created by incorrect interpretation of data);
   3. Establish a procedure for processing (and tracking) standard products as well as new product requests and communicate that with management and likely requestors;
   4. Conduct regular GIS team communication, coordinate on partner tools and their integration; and
   5. Coordinate GIS efforts with local, State and Federal government GIS professionals where appropriate. When possible, share work products to eliminate duplication of effort.
8. It is important to understand the importance of metadata. During an event you will most likely not have the time to create extensive metadata. To provide metadata is as complete as feasible, it is recommended that metadata templates be established. It will help others to understand the data, use it in the best way possible and help reduce the chances for duplication. Although it does not eliminate the requirements for full metadata (i.e., ISO/TC 211 compliant) for data intended to be released beyond the ICS. Minimal metadata should include basic information such as the incident name, description, source of the data, a contact person, the date and time it was created/collected and any limitations the data may have.
9. Understand the organization chart in place during the event. This allows the GIS professional to know who to go to for information, permission, and questions, and ensures that the information is coming from and going to the correct people. It also helps with the command staff needs and workflow. Create a staff list with contact information and shift preference pre-event that can be used during the response.

Standard Operating Procedures for Coastal Storms

This chapter discusses the main components involved in preparing for and responding to a coastal storm. It includes examples of standing orders for a GIS team, a pre-event checklist, GIS staffing and resource requirements, mapping and data protocols and metadata guidelines among other elements. In addition, NOAA has developed a tutorial for coastal storm mapping which may be of some assistance (<ftp://ftp.csc.noaa.gov/pub/stormtutorial/Storm_Mapping_Tutorial.zip>).

These examples should provide a GIS team with a head start in the preparations needed to insure that they meet the needs of the EOC. Modifications to each should be made to reflect the specific needs of the emergency management staff at your EOC.

## GIS team preparation Checklist

This document provides a general checklist (located in Appendix 1) which sums up what steps should be taken to fully prepare a GIS for a coastal storm. This checklist should be used as a guideline, and customized by individual organizations to best suit their mission during to emergency events.

## GIS Team Standing Orders for a Coastal Storm

**Example – GIS Team Standing Orders for a tropical coastal storm:**

The following standing orders provide the reader with an idea of the kinds of products/models that are available and should be considered when providing support to an EOC. These should be adjusted to reflect the needs of your State or community as well as the predicted severity of the coastal storm. The example provided assumes that the team will have access to a website and web services.

The GIS Team Standing Orders for a Coastal Storm provided herein draws heavily from the standing orders for the Florida Division of Emergency Management’s GIS Unit. While the need for long-term preparation and practice for a coastal storm cannot be overstressed, modern technology has provided the emergency management community with the ability to track tropical coastal storms from a number of days prior to it making landfall. As a result, there are a number of tasks that a GIS team can undertake to assist the EOC in their efforts to be fully prepared for the onslaught of the storm.

## Example - GIS Team Standing Orders Coastal Storm – Pre-Impact

|  |  |
| --- | --- |
| **T-120 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Prepare website to show advisories and paths | GIS Chief |
| Get with IT to insure EOC floor is operationally ready | ISS/ GIS Chief |
| Notify GIS staff to monitor storm and be ready for potential activation | GIS Chief |
| Check Supplies- Paper, Ink, Office Supplies | GIS |
| Check Critical Facility Inventory data, perform last minute QC | GIS |
| Check Status Map Web tool and/or mobile apps | GIS Chief/Programmer |
| Map/distribute SLOSH, MOM’s or MEOW’s as appropriate with data from the National Hurricane Center (NHC) | GIS |
| Map evacuation zones based on MOM’s or MEOW’s. | GIS |
| Determine critical facilities (including health-related) within evacuation zones. | GIS |
| Determine number and characteristics of affected population by zone. | GIS |
| Determine shelters to be activated. | GIS |
| Determine evacuation routes. | GIS |
| Confer with local National Weather Service (NWS) office on track, intensity, and timing of storm. | GIS |
| **T-96 hrs. Crosscheck** |  |
| ***Tasks: (all analysis done at this time are for internal use only)*** | ***Responsible/Complete*** |
| Notify EMAC/mutual aid for skill specific GIS personnel | GIS Chief |
| Prepare Status Maps | GIS |
| Begin Search & Rescue (S&R) USNG Mapbooks | GIS |
| Begin County Specific Critical Facility Inventory and Storm Surge Zone Maps | GIS |
| Check Recon Reporting Tool | GIS Chief/Programmer |
| Run demographic analysis of vulnerable populations | GIS |
| Confer with local NWS office on track, intensity, and timing of storm | GIS |
| Map health facilities to be evacuated with this time period (i.e. for New York City 96 hour is period for health facility evacuation, 48 hour for generalevacuation) | GIS |

|  |  |
| --- | --- |
| **T-72 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Website check, how is it holding up under load | GIS Chief |
| Begin disaster direct feeds/activation template | Webmaster |
| Current Situation Map for web | GIS Chief |
| Prepare map for evacuation information | GIS Chief |
| Begin communications with branch chief for GIS assistance | GIS Chief |
| Run HAZUS on Statewide Region | GIS |
| Confer with local NWS office on track, intensity, and timing of storm | GIS |
| **T-48 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Begin coordination with logistics for Logistics Staging Area/Point of Distribution (LSA/POD) information | GIS Chief |
| Begin Coordination with ESF4/9 for USAR needs | GIS Chief |
| Edit the Operational Assets as the area of interest becomes more specific | GIS Analyst |
| Begin demographics for counties in the area of interest | GIS Analyst |
| If Recon teams are called in coordinate with team leader for needs | GIS Analyst/ Chief |
| Confer with local NWS office on track, intensity, and timing of storm | GIS |
| Map zone(s) to be evacuated by general public within this time period | GIS |
| Map evacuation routes | GIS |
| Map hurricane shelters | GIS |
| **T-24 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Continued coordination with logistics and begin LSA/POD maps | GIS Analyst |
| Begin creating S&R or reconnaissance requested maps | GIS Analyst |
| ESF 1 and 3 coordination for transportation constraints | GIS Analyst |
| Prepare Status Maps | GIS Chief |
| Run HAZUS on Region | GIS Analyst |
| Prepare website for accepting field reports | GIS Chief/Programmer |
| Submit pre-scripted missions for S&R support and Aerial Imagery | GIS Chief |
| Confer with local NWS office on track, intensity, and timing of storm | GIS |
| Map any additional zone(s) to be evacuated if forecast worsens | GIS |

Figure 8-GIS Team Standing Orders for a Coastal Storm – Pre-Event

## Example - GIS Team Standing Orders Coastal Storm – Post-Impact

|  |  |
| --- | --- |
| **0 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Confer with local NWS office on track, intensity, and timing of storm | GIS |
| **T+12 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Confirm with ESF 1 and 3 transportation impacts | GIS Analyst |
| Confirm with ESF 5 Intel/Recon CF impacts | GIS Chief |
| Confirm with logistics staging areas/points of distribution and store closures/damaged | GIS Chief |
| Update Status Maps | GIS Chief |
| Get confirmed impacts in to event layers | GIS |
| HAZUS build region for post-impact run | GIS |
| Confirm with ESF 1 and 3 transportation impacts | GIS Analyst |
| Map coastal inundation areas from field reports, Civil Air Patrol, etc. (and similarly for other areas of damage from wind and rain) | GIS |
| **T+24 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Support Recon | GIS |
| Support S&R | GIS |
| Run HAZUS on Impacted Region | GIS |
| Start producing maps for PDA teams | GIS |
| Support Recon | GIS |
| Support S&R | GIS |
| Run HAZUS on Impacted Region | GIS |
| Update and map coastal inundation areas from field reports, Civil Air Patrol, etc. (and similarly for other areas of damage from wind and rain) | GIS |
| Map preliminary damage assessments in inundation area | GIS |
| Map staging areas near inundation area (for debris, supply distribution, etc.) | GIS |
| **T+48 hrs. Crosscheck** |  |
| ***Tasks:*** | ***Responsible/Complete*** |
| Update and map coastal inundation areas from field reports, Civil Air Patrol, etc. (and similarly for other areas of damage from wind and rain) | GIS |
| Update maps of damage assessments in inundation area | GIS |
| Update maps of staging areas near inundation area (for debris, supply distribution, etc.) | GIS |

Figure 9-GIS Team Standing Orders for a Coastal Storm – Post-Event

## GIS Resource & Staffing Requirements

**Background:**  This chapter details the physical resources and personnel skill sets required for GIS responders to fulfill GIS needs & expectations in an emergency event. Potential GIS responders should be identified and trained prior to an incident.

Not all Multi-Agency Coordination Centers (MACC’s) are alike. Please be sure to modify the sections and examples below to fit your MACC needs. For example if the local MACC does not have computers loaded with GIS software or data, the document will need to provide instructions on where the equipment is located. In addition, some MACC’s may have a GIS Unit within the Planning Section, while some may have a GIS Branch within the Intel/Info Section of the National Incident Management System (NIMS) structure. The GIS Staffing Requirements section is also solely provided as an example and should be modified based on your jurisdictional needs are scalable based on the size of the jurisdiction as well as the size of the incident.

GIS staff expectations & team structures should be clearly identified prior to an incident. Potential GIS responders should be made aware of these expectations before agreeing to become a GIS responder. In a MACC, the environment during an incident can be very frantic with requests for information and maps coming from a variety of people and disciplines. Responders are also expected to work long hours while keeping a high performance level and intensity. Some outstanding GIS professionals may not function well in this type of environment, and, therefore, may not be ideal candidates as GIS responders. It is recommended that GIS staff conduct internal scenario-based exercises prior to an incident to educate the GIS team on the expected pace and demands of incident response and to determine the roles that team members are best suited for.

It is also very important that emergency management and first responder’s personnel are educated on the value and use of geospatial information and how it can and should be integrated into their workflows. Conducting exercises and cross training for GIS personnel is an important part of implementing your agency’s SOPs.

**Example GIS Supply List**

The table that follows serves as an example for the “GIS Supply List”. The needs and availability of resources for each agency or jurisdiction will vary. Use this list as a guiding example and not as a fixed set of requirements.

***Purpose:*** This chapter details the resources and skill sets required for GIS Responders to fulfill GIS needs & expectations in an emergency event.

### Resource Requirements

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **REQUIRED** | | **Location** | | |
| **Office** | **Field** | **Primary** | **Secondary** | **Tertiary** |
| CREDENTIALS | | | | | |
| Official agency photo identification | √ | √ |  |  |  |
| Letters for transit/travel | √ | √ |  |  |  |
| Documentation (if required) | √ | √ |  |  |  |
| HARDWARE (Where possible, field hardware should be ruggedized) | | | | | |
| Laptop and/or Desktop | √ | √ |  |  |  |
| License keys, dongles and codes written down | √ | √ |  |  |  |
| Plotter &/or printer & software driver | √ |  |  |  |  |
| Projector(s) | √ |  |  |  |  |
| GPS Hardware |  | √ |  |  |  |
| Projection Screen |  |  |  |  |  |
| Multi-Gb Flash Drive (32 Gb or more) | √ | √ |  |  |  |
| Portable, External Hard Drive (1 Terabyte or more), cloud storage | √ | √ |  |  |  |
| Backup Laptop Battery |  | √ |  |  |  |
| Broadband Access Card Activated | √ | √ |  |  |  |
| Cell phone with published number and TXT or SMS activated | √ | √ |  |  |  |
| SOFTWARE | | | | | |
| GIS Software license to machine | √ | √ |  |  |  |
| MS Office | √ | √ |  |  |  |
| Adobe Reader with GeoPDF extension | √ | √ |  |  |  |
| Adobe Acrobat Full Version with GeoPDF extension |  |  |  |  |  |
| GPS device and GIS software support GPS analyst (e.g. ArcGIS GPS Analyst extension) |  | √ |  |  |  |
| Metric Converter | √ |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | REQUIRED | | LOCATION | | |
| Office | Field | Primary | Secondary | Tertiary |
| SOFTWARE (Cont.) | | | | | |
| TerraGo GeoPDF | √ |  |  |  |  |
| Publisher for ArcGIS (with license) | √ |  |  |  |  |
| GeoPDF extension for Adobe | √ |  |  |  |  |
| DATA RESOURCES | | | | | |
| Commercial and Government Imagery | √ |  |  |  |  |
| Locally Available Downloaded Data | √ |  |  |  |  |
| HSIP Data | √ |  |  |  |  |
| Spare Copies of the above | √ |  |  |  |  |
| MAP RESOURCES | | | | | |
| Department Specific Maps | √ |  |  |  |  |
| Wall Maps | √ |  |  |  |  |
| Locally Used Road Maps | √ | √ |  |  |  |
| Campus Maps | √ | √ |  |  |  |
| Transit Maps |  |  |  |  |  |
| POI Maps/Boater’s Guides |  |  |  |  |  |
| GENERAL RESOURCES | | | | | |
| GIS Desk Book\* | √ |  |  |  |  |
| Markers (Dry Erase)/Pens/Pencils | √ |  |  |  |  |
| Compass (Magnetic not scribing type) |  |  |  |  |  |
| Ruler or map scale | √ | √ |  |  |  |
| CDs/DVDs - Writeable | √ |  |  |  |  |
| Push Pins | √ |  |  |  |  |
| Plotter Ink Cartridges | √ |  |  |  |  |
| Plotter Paper (to include Mylar) | √ |  |  |  |  |
| SAFETY | | | | | |
| Personal Phone with Texting ability or SMS (to communicate with relatives) | √ | √ |  |  |  |
| Personal hot drink cup | √ | √ |  |  |  |
| A supply of your business cards (Current business cell phone on card) | √ | √ |  |  |  |
| Snack Food, e.g., energy bar | √ | √ |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | REQUIRED | | LOCATION | | |
| Office | Field | Primary | Secondary | Tertiary |
| Your emergency contact list printed up and current – The emergency GIS group members, the State GIS Coordinator/GIO, personal contacts. | √ | √ |  |  |  |
| TRAVEL | | | | | |
| Change of clothing | √ | √ |  |  |  |
| Personal items | √ | √ |  |  |  |

Figure 10-Example of a GIS Supply List

\*NOTE – GIS Desk book should include – SOP, GIS & IT Staff Contact List, Data/Map Matrix, Symbology Quick Guide, GIS EOC Staff Checklist, Map/Schematic of the Room (where are resources located), GIS Software Tips/Tricks, How to Access/Use your EOC Software.

### Staffing Requirements

To ensure access to critical geospatial information and products, personnel must be readily available to support the many entities engaged in incident operations. This level of specific operational support provides situational awareness and geospatial tools to the managers of MACC’s and field facilities.

During an event, the number of GIS staff members can vary greatly. Many EOC’s will have from 1-5 GIS staff per shift. Your particular organization will need to assign roles based on team size and staff availability. At the State level, the team lead’s role may be almost entirely focused on coordination between State agencies, county/local governments and Federal agencies. At the county/local government level, the team lead’s time will more likely be split between coordination and hands-on GIS work. At either level, it would be ideal to include: manager/team lead, deputy manager/team lead, analyst(s), database administrator and web/mobile application developer. However, some of these roles may be filled by the same person (for example: one of your analysts may also be able to develop mobile apps), but having a team large enough so that an individual can be dedicated to a specific task is ideal.

It is important that GIS staff are identified (and approved by their respective chains of command), teams and team member roles identified and back-up staff arranged in the planning process. Finally, it is important that team members participate in scenario training within their respective roles and learn to work together as a team to meet their goals.

In some cases, agencies such as health or transportation will have their own mission-driven EOC’s with GIS staff manning them as well. In those cases, it is important to coordinate GIS activities across the enterprise to avoid duplication of efforts and to insure that the emergency management EOC has the latest data and analysis feeds developed by experts in those agencies.

The skills required for a GIS support staff are varied by the size and duration of the storm, and phase of disaster, i.e. response, damage assessment, recovery. The <<EOC/DOC/MOC Unit/Branch/ etc>> is responsible for collecting, analyzing, and disseminating information across all emergency support functions. The unit should include emergency managers, first responders and, at least, part of the GIS team to be most effective. One focus of the team will be to develop an integrated common operational picture of an emergency event. It will also review information coming from the field, DOC and EOC personnel and work with each entity to develop appropriate quality control procedures, identify gaps, and develop intelligence products for staff. Most of the <<branch/unit/etc>> products will be built around geospatial information. The structure of the GIS team is modular. In a smaller incident, one person could fill multiple roles and in a large-scale incident several people could staff the same role.

**Example Geospatial Roles and Responsibilities:**

Appendix 6 provides an example of key geospatial position titles and associated responsibilities similar to the Homeland Security GeoCONOPS, Section 2.1, Table 2-1. This list illustrates the types of roles you may want to have identified for your facility; however, the roles and position titles will need to be modified to fit your facility. These roles are scalable, and one person may fill multiple roles during smaller incidents, while multiple people may need to fill one role during larger scale disasters.

### Geospatial Roles and Responsibilities

**Example GIS Responder Expectations:**

GIS is considered an essential emergency function and GIS Staff are consequently considered essential personnel during an emergency event. Staff that is directly affected by the event are not expected to report to work. It is the responsibility of GIS staff to communicate their availability status to the GIS Team Leader. The GIS Team Leader will keep track of which staff is available to report and which staff has been affected by the event and unable to report.

### GIS Responder Expectations

## Shifts and Team Transition

**Background:** When shift changes occur, the risk that product delivery commitments will go unfulfilled, data production slowed or institutional knowledge lost is heightened. Having proper protocols in place to insure a smooth transition is essential.

* **Purpose:** In order to facilitate a smooth transition between shifts, it is important that GIS staff accurately maintain a record of all requests, their status and their priority level as well as what has been delivered and what is pending. (A simple spreadsheet may do or a more sophisticated system may be developed.) The purpose of this chapter is to identify GIS staffing periods and team transition requirements.

### ICP/DOC/MOC GIS Staffing

ICP’s, DOC’s and MOC’s employ ***<< enter shift length, ex: 12 hour>>*** shifts. During most emergency events the EOC, DOC and MOC are staffed 24 hours/day.

***<< Outline how EOC, DOC, and MOC are staffed. Detail the process for obtaining additional GIS support and identify reserve staff resources>>***

### Team Transition

**Example Beginning of Shift Tasks:**

* Sign in on your operations center’s Staffing Log.
* Communicate your role and availability via <<Identify appropriate communication systems and channels>>
* Assess GIS needs of Incident Command and your operations center and the needs of fellow GIS staff at other operations centers.
* Review the status of products produced, under production as well as those anticipated for the shift. Identify any critical delivery times for unfinished products.
* Debrief the outgoing GIS team to determine products completed, in progress or due in the coming shift as well as other important details
* Provide data, map products and progress reports through relevant communication channels
* As necessary or requested, provide data, map products and progress reports through relevant communication channels

#### Start of Shift

At the beginning of a shift, GIS staff should complete the following tasks: ***<<Enter local protocols>>.***

#### End of Shift

At the end of a work shift, GIS staff will debrief their replacement with the following information: ***<<Enter local protocols>>.***

**Example End of Shift Tasks:**

* Wrap up the project/map/data that you are working on to the best of your ability.
* Provide a report on the products produced during the last shift as well as those under production and those anticipated for the shift.
* Communicate the end of your shift via ***<<Identify appropriate communication systems and channels>>***. Include the name of your replacement.
* Brief your replacement in the following:
  + Provide them with the latest report on deliverables as well as the schedule for standard product delivery. Review:
    - What deliverables have been requested?
    - What has been created? What is left to be created?
    - Where are the archived PDF’s of the products produced during the last shift?
  + What base data have been modified?
  + Where are your notes?
  + Provide the last Media Report.
  + What next steps have been identified?
  + Provide your replacement with your contact information.
  + Provide your replacement with contact information for other GIS professionals that are currently staffing the event or due to report.
  + What are the standard products and which is coming due in the next shift.

## File Naming and Directory Structure

**Background:** This chapter is intended to provide GIS staff with a common, standardized file naming convention and directory structure. The examples provided are for reference purposes only and are not intended to set a standard.

The example directory structure was borrowed from the GIS Standard Operating Procedures (GSTOP) used by GIS Specialists to fulfill the GIS needs of the Planning Section of the Incident Management Teams. Standard naming conventions and directory structures foster easier collaboration between varying shifts of GIS Responders. The directory structure is set up with the date and time at the beginning of each folder and file to facilitate easy chronologic sorting ensuring that the most recent map information is at the top or bottom of a file list depending on sort order. For more information on GSTOP, please visit <http://gis.nwcg.gov/gstop_sop.html>

Per section 2.3, Information Sharing and Data Dissemination, of the GeoCONOPS, DHS recommends federal agencies share data in compliance with the National Information Exchange Model (NIEM). NIEM is a program supported by DHS and other Federal agencies to facilitate data sharing by providing a common vocabulary to ensure consistency and understanding amongst disparate agencies. NIEM utilizes Open Geospatial Consortium (OGC) standards for geospatial data. The emergency management domain data elements and attributes were derived from current standards set forth by the Emergency Data Exchange Language (EDLX). For more information on NIEM, please visit [https://www.niem.gov](https://www.niem.gov/).

* **Purpose:**  This chapter provides GIS staff with a common, standardized file naming convention and directory structure. The structure and naming conventions set herein are intended to support an efficient workflow process by providing self-evident naming protocols that are specific not only to each individual incident but also to each incident’s time(s) and date(s).

**Example Directory Structure:**

The example directory structure convention provided here was borrowed from the GSTOP. This structure will be accessible on the*<<* Folder location *>>* however; it is also suggested to maintain a copy on your desktop/laptop C:\ drive in the event that a network connection is not possible. The directory structure is set up with the data and time at the beginning of each folder and file to facilitate easy chronologic sorting.

### GIS File Directory Structure

During an emergency event, incident related data and maps are to be retrieved from: 1. <<Folder location>> and/or 2. <<Web application>> (per the file structure guidelines defined below).

**Example Directory Structure**

* <<Folder (for example, P:\ICPGIS)>>\BaseData - This folder contains basemap data; data specific or derived from the event are NOT stored here.
  + DEMs – Digital Elevation Models
  + Logos – logos and data disclaimers
  + Raster – Hillshade, Eagle Aerial Imagery, Air Photo Imagery
  + Vector – Transportation, Admin Boundaries, Points of Interest, etc.
* <<Folder>>\Tools – This folder contains extensions, scripts, models, DMS-DD conversion macro/script, other software used during the incident
* <<Folder>>\Incidents\ - This is the top tier GIS Emergency Response directory:
  + YYYY\_IncidentName – This is the top tier Folder for a unique event. 4-digit year and the name of the Unique Incident (e.g. 2003\_CedarFire)
    - Date (YYYYMMDD) date/time stamped incident spatial data layers; one folder for each day of the incident
      * Incident Data – All data stored in this folder are data that are specific to the incident and include a date/time stamp – DATA SHOULD NOT BE PUBLISHED TO THE WEB UNTIL THE PRODUCT IS READY FOR USE/DISSEMINATION AND APPROVED BY THE INCIDENT COMMANDER. Consideration should be given to breaking ‘incident data’ into sub-groups 1) DEM, 2) Raster, and 3) Vector – as incident data could be collected in these forms.
      * Products – GIS analysis and map products produced for the event on that day
      * Workspace – Workspace for that day
      * External Maps – Daily maps produced outside the organization

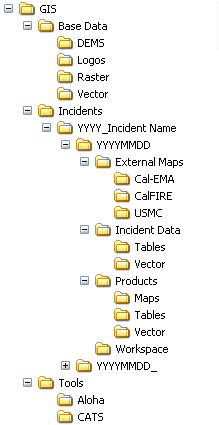


Figure 11-Example of a Directory Structure

*NOTE – In addition to incident related maps and data, resources such as basemap data, GIS Map templates, layer files, scripts and other tools will be accessible on* **<<Folder location>>.**

### GIS File Naming Convention

**Example GIS File Naming Convention:**

Provided below is a recommended GIS file naming convention that can be applied. Be sure to consider your local regulations when defining this component of your SOP or SOG.

All data files (\*.shp, \*.xlsx, \*.dbf, \*.kml, etc.) must contain <<enter local regulations>>. Similarly, map document names (\*.pdf, \*.jpg, etc.) must contain <<enter local regulations>>.

**Example GIS File Naming Convention**

All data files (\*.shp, \*.xlsx, \*.dbf, etc.) must contain date/time, incident agency responsible for creating a map and subject matter qualifiers. Similarly, map document names (\*.pdf, \*.jpg, etc.) must contain date/time, incident name, subject matter information as well as size (e.g. 11X17, ANSI B, Custom32X66, etc.) and orientation (i.e. portrait vs. landscape) of the map.

* + Data file – yyyymmdd\_hhmm\_IncidentName\_Subjectmatter\_Agency.
  + Map document - yyyymmdd\_hhmm\_IncidentName\_Subjectmatter\_Agency\_Size\_Orientation.\*\*\*
  + Example
    - MISS\_CanyonIncident2010\_06\_04\_2330\_ColorIndexMap\_FWRL.pdf – MODIS Color Index of Ocean Features and Circulation Patterns along with trajectories for June 4, 2010

For field collected data, also include a Source Code tag when naming the data file:

* GPS\_Name = Global Positioning System\_Collector’s Name
* FOBS = Field Observer
* SITL = Situation Unit Leader

For data/maps that were provided by Local, State or Federal Agency tag with Agency’s Acronym:

* CalFire (or relevant state agency)
* CDC
* Etc.

NOTE – When adding non-standard tags ALWAYS notify GIS staff of their presence and meaning. Also, it is the responsibility of each GIS responder to ALWAYS communicate the file naming convention that they are using to those with whom they are sharing the data.

Figure 12-Example of File Naming Conventions

## Communication

Communication is a key component during any type of emergency response. Depending on the size of the coastal storm, any number of agencies/organizations at the local, State and Federal government may be involved. Efficiency is a very important part of a response. Good communication is critical in achieving the emergency management goals for the event. There are several other communication opportunities that GIS professionals should be aware of. In all cases, the GIS professional should go through the EOC public information officer for communication to the public.

1. Within the EOC – The GIS Team Leader should communicate regularly with emergency management staff hierarchy to determine their needs/priorities and insure that they understand how GIS can assist them. In addition, where appropriate, the GIS Liaison should sit down informally with emergency management staff, work groups and task forces to learn about their issues, suggest to them how GIS can assist and relay that information to the GIS team.
2. Local or State GIS Emergency Responders – If additional GIS resources are needed, the GIS team should go through the ICS resource request structure. Also, there is the potential that the lead federal agency or responsible party would be providing additional resources and support. You can also contact your State GIS Coordinator/GIO if you would like to identify potential additional resources either within the state or via the Emergency Management Assistance Compact. A listing of State Coordinators/GIO’s is available at: <http://www.nsgic.org/state-representatives.>
3. GIS coordination calls and distribution lists – GIS coordination calls either through the State or Federal Governments are common on major coastal storms. Being on such calls or getting feedback from them via a designated representative can be essential to coordinating GIS activities as well as meeting various needs. Contact your State Coordinator/GIO to determine how to get on appropriate local, State or Federal Government GIS coordination calls and/or distribution lists.

Also, during an event, there are typically emergency management coordination calls that occur between groups that are working on the incident. It is important for a representative from the GIS group be involved in these calls. To learn about these groups/calls, if you are working with local government, it is suggested that you contact your State GIS Team Leader in the EOC or the State Coordinator/GIO. If you are working at the State government level, you should be communicating with your county/local government level as well as the Federal government (typically, through your regional FEMA geospatial coordinators).

1. The Public – During a coastal storm, the public will be looking for information. Press releases and news-based information will be handled through the Public Information Officer (PIO) that the Unified Command establishes. However, the GIS team should coordinate with the PIO to explore opportunities to communicate geographically relevant information to the public through the use of mobile-based applications and web-based portals. These products and resources should be coordinated and approved through the incident’s Joint Information Center (JIC) and/or Public Information Officer, especially on things like evacuation zones, evacuation routes, power outages, gas stations open with power, etc. It is important to remember that the majority of the population now interacts with the Internet through their mobile device more often than through a computer. During and after a storm, that may be the most effective means to provide them with appropriate information. Some communities such as New York City and San Diego have already developed applications (“Ready NYC” and “Ready San Diego”) designed for mobile devices that provide tips, encourage citizens to make a plan, put together an emergency kit, and sign up for alerts on evacuations, locations of shelters, etc. This provides a quick and efficient way to keep the public informed through a device that they typically will carry with them throughout the day. Other organizations such as the Red Cross have mobile applications (<http://www.redcross.org/prepare/mobile-apps>) that should be considered for information delivery as well.

## Mapping Protocols

**Background*:*** It is recommended that map templates designed with local base data and standard symbology similar to nationally recognized products (refer to Map Symbology Guidelines) be compiled prior to an incident. Templates streamline the process of delivering maps out to the Emergency Management Team especially during the initial response period. It is common for map templates and elements need to be changed as the incident evolves, expands and contracts.

The use of the US National Grid (USNG) should also be incorporated into your agency’s SOG’s and policies where appropriate. Resources to support the implementation of USNG are available from the USNG Implementation Center (<http://mississippi.deltastate.edu/>), the Federal Geographic Data Committee (FGDC) (<http://www.fgdc.gov/usng>) and from NAPSG (<http://www.napsgfoundation.org/blog/napsg-blog/128-usng-pre-incident>).

It is important to establish QA/QC procedures. Before a map is released from the GIS Unit/Branch, all map elements must be updated including author/contact person, date/time, scale bar, file location information, title, legend, and symbology. Special attention should be paid to time and date information. This information is critical when asked to reproduce a map or for after-action reporting or for litigation purposes. All products should be archived as PDF’s to preserve their integrity.

There is not a nationally adopted incident-level standard symbology set. This is an evolving topic that DHS, FEMA, and NAPSG are currently working to address. However, there are standard symbol sets proposed by the Homeland Security Working Group (<http://www.fgdc.gov/HSWG/index.html>). NAPSG is working toward a standardized symbology set. More information on symbology is available at: <http://www.napsgfoundation.org/blog/napsg-blog/131-the-incident-map-symbology-story>.

Agencies should establish standard and optional map products for coastal storms. GIS professionals should meet with emergency managers to determine their needs, what standard products will be produced and what data layers, tools and models that will be required. It is recommended that mapping products be discussed pre-event. This allows the GIS professionals to create templates, familiarize themselves with the data commonly used, and have input on various ways GIS can be used to assist emergency managers and first responders during a coastal storm.

It is important to recognize the potential that a mobile application may need to be made available to the public. When possible, determine what kind of information will be included in it be determined pre-incident.

Elevation is an important factor in coastal flooding. An appropriate Vertical Datum (NAVD 88) should be selected and clearly noted on all map products, as necessary.

* **Purpose:** In order to promote clear communication to facilitate interpretability and ease of use, all GIS Staff should follow the guidelines listed below when creating map products in support of a coastal storm.

### Common Operating Platform

Many emergency managers and first responders utilize a Common Operating Picture (COP) before, during and after a coastal storm. A COP provides a single viewer that contains relevant GIS data and tools that multiple command centers or groups can utilize during an incident.

The information presented in the COP can be used on a computer, through a tablet or Smartphone application, or a web-based viewer. This allows emergency managers and first responders to be completely mobile and take their response efforts outside of the physical confines of the command center and creates an environment that all responders involved can utilize.

Most recently, GIS technology is moving towards the use of a Common Operating Platform. A Common Operating Platform is the underlying infrastructure that data, tools and various applications are built on. It is built on a geospatially-enabled database web server (such as ArcServer, ArcGIS Online or an open source equivalent). It has the capability to manage content and operations, display situational awareness, engage the public, gather data and deliver content. The most powerful feature of a Common Operating Platform is the ability to make content available to many different target applications/technologies.

### Consumable Services

Consumable GIS services reside on a web server and are accessed over a network, allowing data, maps, tools and other GIS resources to be shared. This is known as a Service Oriented Architecture (SOA). One benefit of using consumable services is that updated data and maps are immediately available to everyone using the service as soon as the updates are made. Another benefit of using SOA is that one dataset can be consumed by many different users or web applications. This allows for data to be created once and utilized in multiple maps or applications. It is important to note that when implementing an SOA, the data archive still needs to be maintained. This must be designed into the system before an incident so processes are in place to perform data replication and archiving during the event.

* + GIS Services are available at: <<Fully-Qualified Server name/ArcGIS/Rest>>

### Map Templates

* Map Templates are available at: <<Folder location or hyperlink>>
  + Use the Templates available at this location to create all map products, whenever possible

### Map Elements

**Example Required Map Elements:**

* Title – Includes Incident Name, Map theme, Geographic Extent, date/time of the data or product
* Legend
* Scale Bar
* Logos and Data Disclaimers
  + Logo and data disclaimer to recognize data sources
  + Logo and data disclaimer to recognize County Group/Dept/Division
* File Location– provide the full path name for the network location of the map document; ex: C:\GIS\Incidents\yyyy\_IncidentName\YYYYMMDD\Products\yyyymmdd\_hhmm\_IncidentName\_Subjectmatter\_Agency\_Size\_Orientation.mxd
* North Arrow
* Projection – Name of the projection, datum (including vertical datum), and units
* Data Sources – who, what, where, when, why and how (source codes - refer to page 21 of <http://www.nwcg.gov/pms/pubs/GSTOP7.pdf> NWCG SOP)
* “Time Sensitive Data” Disclaimer Stamp – for all maps that are time sensitive
* “DRAFT” stamp – if map is a draft

### Product Format Conventions

* + Share completed map products with ***<< Enter agency/section>>*** in ***<<Enter format>>*** format.
  + Export maps with 100 dpi resolution to keep file size down, unless higher resolution is necessary to see detail (300 dpi is recommended for hard-copy print maps). This eases data sharing and load on networks.

### Map Symbology Guidelines

* + Symbology should be clear and understandable within the context of the visual presentation.
  + Symbols that are clear and understandable on an image background may not be appropriate on lighter cartographic backgrounds.
  + Symbology designed for static, paper maps may not be appropriate for electronic or interactive formats.
  + Reference the most widely used symbol set by your jurisdiction.
  + Working with DHS and FEMA, NAPSG has developed a symbol set specifically for MACC’s, which is available through the NAPSG website at: <http://www.napsgfoundation.org/>.
  + The FGDC offers some suggested symbology that may or may not support the needs of your agency. For these resources visit - <http://www.fgdc.gov/HSWG/index.html>.
  + If you are an ArcGIS user, additional resources on how to use the FGDC symbology are available at - <http://resources.arcgis.com/content/kbase?fa=articleShow&d=29213>

### Map Distribution Regulations

**Example Map Distribution Guidelines:**

* GIS Staff are not at liberty to distribute maps or GIS incident data to media or public. Incident Command has the sole authority for approving the release of GIS products.
* Incident maps may be distributed to the Public if requested/instructed by ***<<Enter position>>*.**
* Any GIS products released to the public are considered public information and can be posted for distribution via the Internet. (Always check to insure that data released with these products are not restricted for distribution in any way.)

### QA/QC

* + Strive for excellence on the initial version. If a bad map or bad data are discovered, notify and update the <<enter GIS position>> immediately. The GIS group (and all individuals referring to the map/data) will be notified via <<Identify channels for communicating QC related issues>>, identify what exactly the flaw is, work to correct the map and redistribute immediately.
  + Remove incorrect data or maps from locations such as published web applications as soon as possible, but do not permanently delete the bad information 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 any bad data that was released may need to be accessed at some point during or after the event.
  + Perfect is a goal. Complete is more realistic. It is most important to get “the message” across to the viewer as clearly and efficiently as possible.

### Archiving

* + Knowing what occurred and when during an event can be invaluable both during and after that event. It is strongly recommended that a PDF of all map products with a date and time noted be created and archived after each product is distributed.

### Standard Map Product Definitions

The standard map product definitions 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.

<< Enter standard map product definitions>>

### Optional Map Product Definitions

The optional map product definitions section outlines the product objectives, the target audience, data content and cartographic requirements for those map products that are *optional* for all State or Regional Multi-Agency Incidents. These map products provide supplementary and specialized information for use during the response and recovery phases of the incident. Other ad hoc map products may also be requested to meet incident specific needs.

<< Enter optional map product definitions>>

## Data Protocols

**Background:** It is recommended that data formats, data and map transfer protocols, and back-up policies be standardized prior to an incident. Things to consider are native data and file formats that emergency responders and other GIS responders will be accessing. For example, if a .dbf table is distributed out to emergency management officials and they use Microsoft Excel to open the file they will receive a warning message, most responders will not go beyond the warning message to access the file. Another example is, if a .pdf or .kml file is distributed to field personnel and they do not have Adobe Acrobat Reader or Google Earth on their mobile device, the field personnel will not be able to open the file. Other options include ArcGIS Online or an open source equivalent.

It is recommended that consideration be given to sorting all data and information in a cloud service as well as having it backed-up on local drives (and/or thumb drives within the EOC). This will prevent any data loss due to network connectivity issues and ensure that it is being backed-up and stored properly. Local storage should be on a scheduled backup to ensure data/information integrity regardless of network/ Internet connectivity issues.

The briefing cycles section is intended to give GIS responders direction for responsibilities and a timeframe for which products may need to be ready.

The damage assessment section is intended to give direction on how damage assessment data can be collected.

***Purpose*:**  This chapter discusses data format conventions, data backup and data sharing policies. The key to a successful GIS response is data preparation that promotes data and application interoperability.

**Example Data Format Conventions:**

GIS staff should adhere to the following Data Format Conventions. Examples provided here serve only as examples and do not set standards for the use of any particular software.

### Data Format Conventions

**Example – Data Format Conventions**

* Acceptable Data Formats include - <<Example: .xlsx, .dbf, .shp, File Geodatabase, KML
* Post tables for GIS staff as .dbf for quick import into GIS software
* When working with Excel spreadsheets remember that cell values linked to calculations will not be translated between .xlsx and .dbf. If there are values of consequence that are linked to a calculation, create a new field for the data values and perform a paste special (Values only) before converting to .dbf. Make sure that there are no spaces in the header row and worksheet tabs.
* Tables posted for consumption or use outside of GIS should be in an MS Excel (.xlsx) format to avoid software compatibility issues/warnings when opening the file.
* Acceptable Map [Output] Formats include - <<Example: .jpg, .pdf, .mxd
* When exporting to .jpg or .pdf use a resolution of 100 dpi (for printing hard copies 300 dpi is the recommended resolution) unless higher resolution is necessary to see detail. This reduces file sizes to accommodate file sharing and network limitations.

Also, keep your audience in mind. When creating products shared to mobile devices (i.e. through PIO), reducing the file size (and reducing the bandwidth required to download the information) is often more critical than increased resolution

* + Use Relative Paths Option when sharing .mxd’s with others - Select the Document Properties option from the File Menu, followed by the Data Sources button in the “Map Title” Properties dialog. Then select “Store relative path names to data sources” and “Make relative paths the default for new map documents I create.”

NOTE – When posting zip files, use same naming convention as associated data file (refer to above naming conventions).

Figure 13-Example of Data Format Conventions

Figure 14-Example of Data Format Conventions

### 

### Data Backup Policy

To avoid duplication of effort and loss of work products GIS staff are to adhere to the following practices <<Enter data backup policy>>

**Example Data Backup Policy**

* Perform and save all work in the Workspace directory under the incident (or on your C: Drive if the network is unavailable or sluggish)
* Create backup copies of the files you are working on, on a regular basis
  + At a specific time interval, it is recommended this be done every 2-4 hours
* Save/Backup work to USB memory stick or to portable, external hard drive or in the cloud, etc.
  + Tip: Purchase a portable, external hard drive with backup software.
  + IMPORTANT – *Legal action* is often associated with post disaster mitigation, relief, and funding. Saving all your work and keeping a time log or journal of events, people, and requests made is highly suggested.
* When a product is complete, create a PDF of it with the date and time noted and save the file to an area designated as an archive.

Figure 15-Example of a Data Backup Policy

### Briefing Cycles

During an emergency event, the <<Emergency Operation Center (or IC/DOC/MOC/etc)>> operates on a <<enter briefing cycle times, ex: 12 hour>> briefing cycle. Often <Enter briefing times>>, EOC Officials and/or Elected Officials and/or staff brief the media/public. These briefings provide information as to the extent of the area and population affected as well as actions enlisted by the <<jurisdiction or entity>> and other agencies to show the incident progression (if applicable) and reconcile the damage.

### Information Availability

It is recommended that the GIS team work with the emergency managers and first responders to establish a timeline for how long the data will be available during and after an event, what the process will be for requesting/obtaining the data and what data will be available versus what data will need to be kept confidential. Communication about the post-event data will ensure that data distribution is done properly. It is important to note that local, state, and federal open records/freedom of information/right-to-know laws may have a bearing on the availability of information developed during or subsequent to an event.

## Data Acquisition and Dissemination

**Background:**  This section is intended to familiarize GIS Responders with the types of data that may be requested of them, data they may need to acquire, data they may need to create, and how that data is transferred. This section also provides GIS responders with federal geospatial products and programs available to them. GIS Responders may want to refer to and become familiar with the Homeland Security GeoCONOPS. The Homeland Security GeoCONOPS lists various datasets and essential elements of information required to support federal geospatial activities.

The Public Data Sharing/Exchange Policy section establishes the rules for the sharing of data and policy for release to the news media and for public release. It is important to note that GIS responders are not allowed to release incident information to anyone outside the incident without following the policies identified within the jurisdiction.

The Recommended Datasets section provides an example of datasets that GIS responders may want to have at their disposal prior to a coastal storm. GIS responders may also want to refer to and become familiar with the Homeland Security GeoCONOPS and its Appendices. Section 2.2.2 of the Homeland Security GeoCONOPS lists essential elements of information and relevant datasets used to support federal geospatial activities. It may not be necessary to include the list in the local document, but it is recommended that a list is available in case individuals or entities that are not familiar with the local data provide GIS assistance. It is also a good idea to have this data available on an Emergency DVD/CD, memory stick, hard drive or in the cloud that can be shared with other responding agencies (such as the US Search and Rescue Team) or to easily reload data in case of hardware failure.

Data connection information is important to include in case automatic data connections fail. Data connection protocols are not easily remembered when hurried or tired.

* **Purpose:** This chapter provides GIS staff with an understanding of the media briefing cycles, incident data, and damage assessment protocols.

### Data Management Plan

A Data Management Plan should address the following:

* Determination of what data is available for use versus what data needs to be acquired/produced;
* Sharing protocols (including standards), data delivery schedules, data expectations, data formats, information flow, roles of staff, methods (including how and who performs edits on data and version control methodologies) and systems used, documentation/archiving; and
* Need for a database manager and database administrator for the GIS data

A Data Management Plan, whether for a simple or complex incident, should be drafted and reviewed by all data providers to ensure standards are followed. This includes items such as expected data formats, data collection formats, data delivery schedule, and data repositories. Having this kind of plan in place prior to or in the early stages of an incident is essential so that initial data management is done properly and the GIS staff are operating effectively and not having to expand efforts correcting QA/QC problems or data flow issues from the start of the response.

### Essential Elements of Information

The recommended datasets list details GIS datasets that are optional in support of the GIS functions outlined in these standards. Section 2.2.2 of the Homeland Security GeoCONOPS provides additional detail on Essential Elements of Information (EEI) supporting federal emergency management operations. The relevant datasets are listed in Appendix B of the Homeland Security GeoCONOPS. These EEI’s may vary by specific incident type, but generally include information such as disaster boundaries, socioeconomic impacts, critical infrastructure, etc.

There are many ways for local jurisdictions to obtain base and incident specific geospatial data. It is recommended that MACC’s leverage existing data warehouses from local jurisdictions and state agencies to locate needed data. Contact your states’ geographic information council to find out what state or regional data warehouses or portals are available or contact your State GIS Coordinator. For a listing of State GIS Coordinators visit: <http://www.nsgic.org/state-representatives>.

Because coastal storms differ in their impacts across the country, other datasets may be required to assist in incidents. For instance, landslides are more common during West Coast storms or massive snow accumulations are more common to winter storms in the Great Lakes region. Some examples of datasets for those events have been provided in the following charts. It is suggested that the GIS team work with the emergency managers to determine any unique data required for their region beyond what is suggested in this document.



**Example Recommended Datasets:** The recommended datasets list details GIS datasets that are recommended in support of the mapping functions outlined in these standards. The Homeland Security GeoCONOPS provides additional detail on EEI’s supporting federal emergency management operations. Trusted datasets are listed in Appendix B of the Homeland Security GeoCONOPS.

**Example Recommended Datasets (Gathered prior to the Event)**

**Imagery**

* Purpose: Identify current conditions
* Aerial imagery with date
* Oblique aerial imagery (i.e. similar to Pictometry) (optional)

**Elevation**

* Purpose: Identify current conditions and areas prone to flooding
* Digital Elevation Model
* Topography
* LiDAR (optional)
* Bathymetry (optional)

**Land Ownership/Administrative**

* Purpose: Identify ownership and appropriate jurisdictions
* Address points/ranges
* Parcel boundaries w/CAMA data
* Municipal and administrative boundaries
* Businesses located on property
* Landmarks

**Hydrography**

* Purpose: Identify pre-storm conditions
* Hydrography
* FEMA flood zones/DFRIM data/National flood hazard layer
* SLOSH boundaries
* Historic flood boundaries
* Levee locations
* Tide charts

**Utilities**

* Purpose: Identify infrastructure that could be damaged. Identify infrastructure that could be hazardous. Provide guidance for access by first responders.
* Utility pipelines
* Power lines (optional)
* Power plants (including nuclear power plants)

## 

**Recommended Datasets Continued:**

**Transportation**

* Purpose: Identify access routes to the incident, evacuation routes, and other related transportation reference points. Support routing of public vehicles (evacuation/ avoidance).
* Roads
* Evacuation routes (including contra-flow routing)
* Bridges and tunnels
* Railway lines and stations
* Subway lines and stations
* Ferry lines and terminals
* Navigable waterways (including NOAA nautical charts & electronic navigation charts)
* Boat ramps
* Maritime infrastructure (vessel mooring areas, marinas, boat ramps, ports, docks)
* Airports
* Helicopter landing zones
* Transportation resources - buses, school buses (with wheelchair access), ambulances

**Population**

* Purpose: Identify impacted and at-risk populations.
* Population data/U.S. Census
* Nighttime population vs. daytime population
* Seasonal population
* Businesses
* At-need population (schools, day care, nursing homes, assisted care facilities, universities, hospitals/clinics, urgent care, mental health and correctional facilities, etc.)

**Public Safety Data**

* Purpose: Identify public safety and incident command facilities
* Fire stations
* Police stations
* EMS
* EOC’s (local, State, Federal)
* Public Safety Answering Points (PSAPs)/911 Call Centers
* Shelters (shelters, shelters allowing pets, animal shelters)
* Staging areas
* Incident command post
* Evacuation zones

**Search and Rescue**

* Purpose: Define and train with a grid that can scale for local, regional, State and Federal search and rescue teams.
* United States National Grid (USNG)
* Data packaged on hard drive or other portable device to provide to Search and Rescue Teams from out of the area.

**Recommended Datasets Continued:**

**Critical Infrastructure**

* Purpose: Identify critical infrastructure not otherwise covered in other categories
* Local/State identified critical infrastructure
* Critical infrastructure data within DHS Homeland Security Infrastructure Program (HSIP) data

**HSIP**

* Purpose: Identify a broad spectrum of data available for use
* DHS Homeland Security Infrastructure Program (HSIP) data is available for use as HSIP Freedom and HSIP Gold and provides data in many of the categories listed above. For more information on HSIP, go to: <https://www.hifldwg.org/hsip-guest>

**Chemical and Other Environmentally Related Facilities**

* Purpose: Identify environmentally related facilities
* Chemical facilities & extremely hazardous and hazardous sites (SARAH Title 3 sites)
* Sewage treatment plants
* Public wells
* Public reservoirs
* Pumping stations
* Oil and gas farms
* Sanitary Sewers
* Water Treatment Plants
* Potable water mains
* Storm water facilities (catch basins, storm sewers, outfalls)

**Recreation**

* Purpose: Identify recreational facilities as well as places with potential users
* Public beaches
* Parks & campsites
* Ball fields
* Stadiums and other large recreational facilities

**Communications (optional)**

* Purpose: Identify potential communication outages due to the incident.
* Cell towers
* Radio communication
* Main Internet hubs/lines
* Telephone (land line) facilities & lines

**Landslides**

* Purpose: Identify additional data that can be used specifically to plan for and ameliorate the impacts of landslides caused by coastal storms.
  + Historic landslide data
  + Slope data
  + Soils data
  + Identification of clear-cut or fire impacted areas

**Recommended Dynamic Datasets (Just prior, during and after a storm)**

**Weather**

* Purpose: Identify event related conditions that may influence response
* NOAA NWS forecasts, NowCOAST, CO-OPS
* NOAA NWS National Data Buoy Center
* USGS river/stream gauges
* Atmospheric conditions (wind direction, etc.)
* For Winter coastal storms:
  + Snow accumulations
  + Ice accumulations
  + Roads cleared (AVL in snow plows)

**Imagery\*** (Refer to section on Compiled Imagery in proceeding text)

* Purpose: Identify event related conditions that may influence response
* Post storm aerial imagery
* Civil Air Patrol photographs
* Satellite imagery
* Oblique aerial imagery (i.e. Pictometry or similar)

**Hydrography**

* Purpose: Identify current conditions
* River levels (current & forecasted)
* Flooding extents
* US Army Corps of Engineers (USACE) high flow estimates
* Levee breaches

**Incident Specific Data**

* Purpose: Identify response requests and efforts made
* Requests for assistance
* Rescues
* Evacuations
* Fires
* Deaths
* Activated evacuation zones
* Activated staging areas
* Debris sites
* Communications trailers
* Vessel locations (AIS)
* Volunteer reception centers
* Temporary morgue(s)
* Supplies (i.e. sandbags, emergency generators, medical supplies, food, water, etc.)
  + Shelter supply needs (food, water, fuel, clothing)
* Closures of (schools, day care, nursing homes, assisted care facilities, universities, hospitals/clinics, urgent care, mental health and correctional facilities, etc.)

**Recommended Datasets Continued:**

**Utilities**

* Purpose: Identify damaged electrical and phone infrastructure.
* Power outages
* Phone (land line) outages
* Cell phone outages

**Transportation**

* Purpose: Identify access routes to the incident, evacuation routes, and other related transportation reference points. Support routing of public vehicles (evacuation/ avoidance).
* Road closures
* Airport closures
* Rail & subway stoppages
* Bridge closures (including moveable bridges)
* Ferry stoppages
* Port closures
* Active evacuation routes (including contra-flow routing)

Figure 16-Example Recommended Datasets

### Storm Models

Coastal storms can cause damage through wind damage, storm surge, erosion (landslides), flooding, etc. There are various models that can be used to predict what to expect from a storm depending on its path, the tide level, the wind velocity/direction and the amount of precipitation the storm is anticipated to bring. NOAA and a number of other Federal agencies provide data generated by these models that can be used by GIS professionals to estimate the magnitude and probable extent of flooding impacts in communities across the region. Examples of commonly used models are provided below. This information can then be used by emergency managers to formulate strategies for potential evacuations should the need arise. The National Hurricane Center (NHC) provides a three-tiered approach to determine which storm surge product should be at what point in the event timeline. This includes a discussion of the following products:

* Maximum Envelope of Water (MEOW)
* Maximum of the Maximum Envelope of High Water (MOM)
* Tropical Cyclone Storm Surge Probabilities (P-Surge)

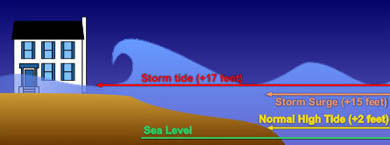


Figure 18-NOAA’s depiction of storm surge

A graphical presentation of these can be found at: <http://www.nhc.noaa.gov/surge/products.php>. In addition, training is available at: <http://www.fema.gov/pdf/plan/prevent/nhp/slosh_display_training.pdf>.

**Example of Storm Models**

**Hurrevac**

* Best Use: Storm Path, Wind Speed & Storm Surge Probabilities – Provides current forecast (most likely), wind speed probabilities, and storm surge probabilities using data from the National Hurricane Center. It allows you to step through the storm and see where it will be in 12 hours, 48 hours. Florida uses scripts to pull down past tracks, the current forecast (most likely), wind speed probabilities, and storm surge probabilities from it.
* Link: <http://www.hurrevac.com/index.html>
* For related GIS data, please visit the National Hurricane Center <http://www.nhc.noaa.gov/gis>

**Potential Storm Surge Flood Map**

* Best Use: Early warning – Within 60 minutes of the issuance of a hurricane warning, will display just where flooding from the hurricane could occur and how deep the water could be in various locations.
* Link: [www.hurricanes.gov](http://www.hurricanes.gov/)

**NOAA Storm Surge Models**

* Best Use: Early warning – Understanding storm surge maximum risks as well as the most probable storm surge.
* Maximum Envelope of Water (MEOW) provides a worst case basin snapshot for a particular storm category, forward speed, trajectory, and initial tide level, incorporating uncertainty in forecast landfall location: <http://www.nhc.noaa.gov/surge/meowOverview.php>
* Maximum of the [Maximum Envelope of High Water (MEOW)](http://www.nhc.noaa.gov/surge/meowOverview.php), or MOM, provides a worst cast snapshot for a particular storm category under "perfect" storm conditions: <http://www.nhc.noaa.gov/surge/momOverview.php>
* The Tropical Cyclone Storm Surge Probabilities graphics show the overall chances that the specified storm surge height will occur at each individual location on the map during the forecast period indicated: <http://www.nhc.noaa.gov/aboutpsurge2.shtml>?

**River Flooding**

* Best Use: Can be used to obtain information/forecasts on river and urban flooding.
* <http://water.weather.gov/ahps/rfc/rfc.php>

**RMS Risklink**

* Best Use: Models for wind and storm surge damage done to property and infrastructure. Can replicate approaching storm from dataset of several 10,000 historical or potential storms.
* <http://www.rms.com/models/models-cat/storm-surge> - \**NOTE – Risklink requires prior licensing*

**HAZUS**

* Best Use: Wind model – The State of Florida uses this for the wind model, but not for the storm surge.
* Link: <http://www.fema.gov/hazus>

Figure 17-Examples of Storm Models

*NOTE – NOAA states that storm surge is a leading cause of coastal floods.*

### Compiled Imagery

During disasters, the number of imagery sources is sometimes overwhelming. In addition to your State website, the FEMA GeoPlatform (<http://fema.maps.arcgis.com/home/>) and the USGS Hazards Data Distribution System (HDDS) (<http://hdds.usgs.gov/hdds2/>) are good sources to consider accessing as well. (It is suggested that you contact your FEMA Geospatial Regional Coordinator to find out about other opportunities that may arise.)

### Crowd Sourced Data

During major disasters, many citizens provide unique information on its impacts at their locations. Whether it’s a 140-character description on Twitter or a photograph on Facebook or other social media site, this information can provide insight into events unfolding throughout the area of responsibility that the EOC may have. Leveraging crowd-sourced data can provide valuable insight for the EOC.

Additionally, many agencies are utilizing tools such as ArcGIS Online and Google’s Crisis Mapper to enable crowd sourcing of geographic reports. As different organizations responding to the event, carryout their mission-driven responsibilities, many are sharing information using platforms such as ArcGIS Online. This provides the opportunity to access, “authoritative crowd sourcing.” Authoritative crowd souring is data collected by an authoritative source and provided over the Internet through web services. By exposing their operational data, organizations participating in a response can augment the overall common operational picture with their authoritative data.

### Obtaining Event Data

Whenever possible, it is recommended that protocols be established for importing and displaying damage assessment data from mobile devices in the field. However, it is also recommended that agencies establish protocols for collecting data and creating maps when technology is not available (i.e., no internet connection, no electricity, etc.). If field collection devices are not available, having a large-scale plotter to print paper maps is invaluable for staff going out in the field. Ideally, a mobile system will be available. This allows data updates to be pushed directly to the systems for immediate consumption. If a designed technology is not available, then consider other options that allow field collection. Examples include: taking geo-referenced photographs with a smart phone that can be uploaded later, phone calls where data are called into the ICP, or paper-based forms that can be used in the field when no technology is available.

Also, it is important to establish protocols for verifying data (i.e. damage assessment, debris, etc.) that is collected in the field. This is particularly important when those data are collected using paper forms or other non-technology-based methods, such as pre-printed, grid based Mapbooks and a data collection instruction page. Establish these protocols early in the process to ensure consistent data is being collected for the duration of the incident. This especially important as contractors may collect much of these data and they are often less well trained than regular field staff. At a minimum, a standardized data collection form should be used and should include a minimal amount of metadata.

***FEMA Damage Classification***

|  |  |  |
| --- | --- | --- |
| **Damage Level** | | **Observed Damages** |
| **General Damage Classifications** | | |
| LD | Limited Damage | Generally superficial damage to solid structures (e.g.,  loss of tiles or roof shingles); some mobile homes and  light structures are damaged or displaced. |
| MD | Moderate Damage | Solid structures sustain exterior damage (e.g., missing  roofs or roof segments); some mobile homes and light  structures are destroyed, many are damaged or  displaced. |
| ED | Extensive Damage | Some solid structures are destroyed; most sustain  exterior and interior damage (roofs missing, interior  walls exposed); most mobile homes and light  structures are destroyed. |
| CD | Catastrophic Damage | Most solid and all light or mobile home structures are  destroyed. |

*NOTE – This Damage Classification is for wind damage. A damage assessment which considers water is:* [*http://www.vaemergency.gov/sites/default/files/IA\_Training\_Aid\_Table\_color021507.pdf*](http://www.vaemergency.gov/sites/default/files/IA_Training_Aid_Table_color021507.pdf)*. It can help to communicate how hard areas are hit without having to physically visit each location. More information on damage assessment is available at:* <http://www.vaemergency.gov/em-community/recovery/damage-assessment> and <http://www.vaemergency.gov/sites/default/files/PA_guide_template_color021507.pdf>.

Figure 18-Example of a FEMA Damage Classification per the DHS GeoCONOPS

### Damage Assessment

As outlined in Section 5.2.3 of the Homeland Security GeoCONOPS, *“*Damage assessments provide a vital flow of information to the response community. ………. The data collected and compiled through Damage Assessment activities defines the locations and levels of magnitude of event-related impacts. The combination of imagery resources, models, and ground truth data provide rapid estimates and quantitative field observations to assist in making critical decisions in the early phases of the disaster operation.”

The previous table includes an example of the FEMA damage classifications listed in the Homeland Security GeoCONOPS. These classifications are recommended for use by all agencies. Use of these classifications as well as the use of a common grid (such as the US National Grid) will streamline the collection and consolidation of local damage assessment efforts. It will also facilitate the transfer of data to state and federal agencies.

### US National Grid

The use of a standardized grid, such as the USNG should also be incorporated into your agency’s SOG’s and policies. The USNG is a point reference system of grid references commonly used in the United States. It provides a nationally consistent language of location in a user-friendly format. Utilization of the USNG will aid in interoperability between local, state, and federal agencies should the need arise. Resources to support the implementation of USNG are available from the USNG Implementation Center (<http://www.deltastate.edu/college-of-arts-and-sciences/center-for-interdisciplinary-geospatial-information-technologies/>) and from the FGDC (<http://www.fgdc.gov/usng>). For more information on USNG see: <http://napsgfoundation.org/wp-content/uploads/2014/01/Implementation-Guide-to-The-USNG.pdf>.

### International, National & Federal Geospatial Products and Programs

There are many Federal geospatial data and tools resources available to State and local agencies. The following list is not inclusive of all programs, but will provide a broad overview of products available to local agencies.

#### The International Charter

The International Charter is an international collaboration among space agencies to provide a mechanism for rapid tasking of satellites for immediate response to emergencies. Free satellite-based information is provided to national disaster management authorities and humanitarian organizations to support immediate response to major natural or man-made disasters.

The Charter has been activated for more than 325 disasters (as of the end of 2011) in over 120 countries since its inception in 2000. The Charter gives access to a constellation of satellites equipped with radar and optical sensors. Information on the Charter can be obtained from going to: <http://www.disasterscharter.org/web/charter/home>. For more information regarding the Charter, including requesting an activation of the Charter in response to a disaster, please contact Brenda Jones: [bkjones@usgs.gov](mailto:bkjones@usgs.gov) or Ryan Lamb: [lamb@usgs.gov](mailto:lamb@usgs.gov). Please note that local governments should coordinate their needs through their State GIS Coordinator/GIO.

#### HIFLD

The Homeland Infrastructure Foundation-Level Data (HIFLD) working group was established to address desired improvements in collection, processing, sharing, and protection of homeland infrastructure geospatial information across multiple levels of government and to develop a common foundation of homeland infrastructure data to be used for visualization and analysis on all classification domains. For more information on federal geospatial products and programs visit: <http://www.hifldwg.org/>.

#### NSGIC GIS Inventory

The GIS Inventory is managed by the National States Geographic Information Council (NSGIC) as a tool for states and their partners. Its primary purpose is to track data availability and the status of GIS implementation in state and local governments to aid the planning and building of Spatial Data Infrastructures. It can be used by public safety agencies, mutual aid groups, EOC’s, and MACC Facility’s as a “yellow pages” directory for GIS information and also as a tool to share links to data & web mapping services to support public safety at the local and state levels. Refer to: <http://gisinventory.net/>.

#### NSGIC Emergency Contacts Listing

#### NSGIC provides a listing of emergency GIS contacts for every State as well as the Puerto Rico, the District of Columbia and the US Virgin Islands. The listing also provides contacts at FEMA, the USGS, and other Federal agencies along with State Adjutant General. Its primary purpose is to provide 7x24x365 contact information for GIS professionals who could be involved in an incident. This information is not for public distribution, but is available for government use and can be obtained through the State Geographic Information Officer or GIS Coordinator at: <http://www.nsgic.org/state-representatives>.

#### Geospatial Platform

Much Federal data is available openly the GeoPlatform (<http://www.geoplatform.gov/>). The Geospatial Platform is envisioned as a managed portfolio of common geospatial data, services and applications contributed and administered by authoritative sources and hosted on a shared infrastructure. More information can be found at <http://www.geoplatform.gov>.

#### DHS Geospatial Information Infrastructure (GII)/HSIN

Other data and data classified as “For Official Use Only” and “Sensitive But Unclassified” is available through the DHS Geospatial Information Infrastructure tools (GII). Using the Homeland Security Information Network (HSIN) for identification management, the GII is able to provide a national secure and trusted web-based portal for geospatial information sharing and collaboration between federal, states, local, tribal, territorial, private sector, and international partners engaged in the homeland security mission. Access to those sources is to individuals who have been “credentialed” by DHS. Those wishing to go through that process can find out more by going to: <http://www.dhs.gov/homeland-security-information-network>.

More information on the DHS OneView and other GII resources can be found in Appendix E of the Homeland Security GeoCONOPS.

#### Digital Coast

Digital Coast is a resource provided by NOAA that provides access to data, tools, case studies, and training for professionals working with coastal areas. It was established with the concept that good data is not always enough, and can be most effective when communities have access to information that can be used to fully understand how to address coastal issues. For more information see: <http://www.csc.noaa.gov/digitalcoast/>.

#### Virtual USA

Virtual USA was a collaborative effort developed by DHS. It aims to connect various disparate state emergency management geospatial data into one common operational picture by utilizing current information-sharing platforms to permit new and existing technologies to seamlessly exchange information with one another. For more information see: <https://vusa.us/Login.aspx>.

#### HSIP Freedom and Gold

The Homeland Security Infrastructure Protection (HSIP) dataset is a compilation of over 450 geospatial datasets, characterizing domestic infrastructure and base map features, which have been assembled from a variety of Federal agencies and commercial sources. HSIP Freedom data is a subset of the HSIP Gold datasets developed and compiled through a partnership amongst National Geospatial-Intelligence Agency (NGA), DHS GMO, Department of Interior (DOI), and Office of the Secretary of Defense for Homeland Defense (OSD HD) since 2006. HSIP Freedom can be distributed among state and local government agencies and is being made available through the DHS Geospatial Information Infrastructure (GII) enterprise platform. HSIP Gold can be requested through HIFLD after a federal disaster declaration.

#### HSIP-NAVTEQ State Release

The commercial street & transportation data from HSIP Gold is also available separately upon special request by eligible state agencies. This data set is the only commercial dataset found in HSIP Gold that is available to States without a presidentially declared disaster. This data release includes street data, points of interest data, and route analysis information as generated by NAVTEQ. It includes the navigation features for routing and route analysis that are particularly valuable in public safety GIS. At this time, this data is only available on special request via the Homeland Infrastructure Foundation - Level Data (HIFLD) WG and only to eligible state agencies. For more information about the HSIP-NAVTEQ State Release visit HIFLD Working Group website at <http://www.hifldwg.org/>.

#### The National Map

The National Map makes accessible the base geographic data layers found on USGS Topographic maps. They are useful in planning and responding to disasters. In a flood situation, for example, the integration of feature attribute data from the hydrography data layer with real-time stream flow-gage data allows scientists to predict the timing and magnitude of downstream flooding in support of emergency operations. The National Map provides access and download capabilities for the critical geospatial information needed to respond effectively to disasters of all types. For more information on The National Map, go to: <http://nationalmap.gov/>.

### State/Local Geospatial Products and Programs

Included in this document are examples of state and local geospatial products and programs that are used during an emergency event. We encourage you to customize this list, and add any products or programs relevant to individual agencies. Examples can be found in Appendix 4.

### Data Dissemination

Section 2.6.2 of the Homeland Security GeoCONOPS gives an overview of recommended ways to share data:

*Vector data products are fairly compact in individual file size, facilitating data sharing through web services, e-mail, and web postings. With agile delivery options, emergency managers have access to these data products in a timely manner to assist in their decision-making. Larger data files such as imagery or national datasets are more difficult to manage. Frequently these data types are shared through the physical transfer of external hard drives and other portable media or provided virtually through the cloud.*

For dynamic data exchanges, DHS supports NIEM and OGC standards to facilitate data dissemination and information exchange. NIEM represents a collaborative partnership of agencies and organizations across all levels of government (federal, state, tribal, and local) and with private industry. The purpose of NIEM is to effectively and efficiently share critical information at key decision points throughout the whole of the justice, public safety, emergency and disaster management, intelligence, and homeland security enterprise. NIEM is designed to develop, disseminate, and support enterprise-wide information exchange standards and processes that will enable jurisdictions to automate information sharing. NIEM includes twelve domains. NIEM emergency management domain data elements and attributes were derived from existing messaging standards promulgated by the EDXL initiative, including the Common Alert Protocol (CAP v1.1), Distribution Element (DE), and Hospital Availability Exchange (HAVE), EDXL functions as a stand-alone suite of messaging standards. NIEM leverages EDXL concepts and methods. OGC is an international industry consortium of government agencies and organizations, universities, and the private sector that develops publicly available interface standards that are geo-enabled and interoperable.

A common information storage system must be identified to maintain transparency and access to response information as well as for archival purposes. This system should not be based on proprietary software (unless information sharing agreements are in place) and should have the ability to store high volumes of multiple types of information (databases, GIS files, documents, maps, photos, etc.). The system must be accessible by all responders and must account for certain software and hardware restrictions that both private industry and government organizations require. For GIS files, the system must offer the ability to quickly refer back to the previous day’s data view. If ESRI ArcGIS server, ArcGIS Online or Google Earth environments are used, they must allow for easy access to old data views and the “archiving” process must not include overwriting old datasets. If a Secure FTP (SFTP) site is used, it must be backed up daily, have restricted access, and be closely managed. If a cloud platform is used, local backups are suggested in the event of power or Internet service outages.

In the past events a SFTP has been stood up for incidents. This technology is useful since it is accessible to all including the USCG. We recommend an SFTP type structure be used as a “working” information environment. An SFTP allows personnel distributed across the country to access and upload documents. Other more appropriate archival databases could be utilized as well.

Applicable local, state, and federal open records/freedom of information/right to know laws may have bearing on the availability of information developed during or subsequent to an event.

### Data Dissemination Protocols

**Example Data Connections**

Example: <<Server name>>

Personal/File GDB, Shapefiles, Coverages: <<Folder location>>

CD/DVD: <<CD/DVD name>>

Data dissemination is a vital part of incident response. This process needs to be as simple, efficient, secure, and accessible as possible. Automation of data updates and methods for seamlessly providing data, that does not require human intervention, will maximize interoperability and effectiveness. A detailed work plan of designated paths by which data can be transferred from an ICP in the field to MACC’s to State Operations Centers to Federal Operations Centers should be outlined if possible.

### Information Dissemination Protocols

Local agencies should research visualization platforms as well as data transfer protocols as a way of sharing information. Location information can be easily shared via visualization tools and provide decision makers with needed information to effectively manage disasters.

## Data Connections

### Enterprise Geodatabase

**Example Enterprise Database**

<<Provide process and connection properties for SDE databases>>

Open GIS File Management Program

* Double Click Database Connections
* Select Add Spatial Database Connection
* Enter connection information:
  + Server: <server>
  + Service: <service>
  + Database: <database>
  + Username: <username>

Password: <password>

<<Data from the coastal storm event should be stored in an enterprise Geodatabase or in a secure cloud environment. Create the file structure the data will be stored in and save all data there. It is recommended that someone monitor the database to ensure its organization and accuracy>>

### GIS Emergency DVD or Hard Drive

*<<If applicable, describe the datasets and other content provided on CD/DVD, HARD DRIVE OR SIMILAR INSTRUMENT. Include information on how the data is produced and distributed and identify any usage restrictions. Identify the physical location of the media. THIS IS PARTICULARLY VALUABLE WHEN RESPONDERS (I.E. URBAN SEARCH AND RESCUE TEAMS) COME INTO THE AREA AND HAVE LITTLE OR NO ACCURATE GEOSPATIAL DATA. >>*

### Public Data Sharing/Exchange Policy

#### Web Applications

<<Describe web applications and systems. Provide guidance and outline the processes for sharing data and map products. provide step by step instructions for working with these systems>>

#### Mobile Applications

Gartner predicted that 2013 would be the first year that access of the Internet by mobile devices would exceed its access by PC’s. With more than half of the U.S. population owning smart phones, mobile applications must be considered as an expeditious way to provide information to citizens. States and major metropolitan communities should consider developing, distributing and testing applications when possible.

#### GIS Press Package (optional)

<<If data will also be shared with the public outline policies and procedures for data release or reference existing policies >>

**ExampleGIS Press Package Policy**

To further ensure the security and/or confidentiality of all incident related data:

* Do not share files through web applications unless the data are complete and ready-for-use, and you have been given the proper authority for their dissemination.
* When sharing GIS files, ALWAYS properly document the projection (include a projection file, if necessary). Projection information is REQUIRED to be posted with all GIS data formats (including web services). An appropriate projection to use should be determined well before the event.
* When using web applications to share files, use the meta\_tag to alert GIS users as to status of the data/map/etc. (i.e. FACT, DRAFT, etc.)
* Clear data and map transfer with your Operation Center Manager or Director, as needed, when sharing data and map products between ICP, DOC and/or MOC GIS Staff and/or through web applications. Data should not go out directly through the GIS shop.
* The Public Information Officer is responsible for sharing ALL data and/or maps with the media.
* (Public Access to <<jurisdiction>> GIS Data During a Disaster) When the need to distribute certain types of GIS information is first apparent, certain assurances must be made. In order for a data layer to be made available publicly in a GIS press package, it must meet the following eight criteria. The questions must be applied individually to each data set that is to be included in the GIS press package. A “No” answer on any of the following questions should prohibit the release of the specific data layer in the press package.

1. Is the incident the source of the information (were the data generated as a part of the response)?
2. Is the data is essential in the press package? Does the press package not make sense without it?
3. Has the data has been cleared to be in the press package by its authors, GIS Manager and the PIO?
4. Has the data been cleared to be released by the incident PIO in the current briefing cycle (if any doubt, see question 3)?
5. Has the data been checked for quality and consistency?
6. Is the data or subject matter releasable and not described on the Release Constrained Data layer list?
7. Is the data still current with recent events?
8. Does the data have metadata (see metadata standard in definition)?

Additionally, if the data passes the above questions with a “Yes” answer to all of them, the data must be summarily vetted.

Figure 21-Example of a GIS Press Package Policy

## Documentation and Metadata

**Background:** It is recommended that metadata be provided for all GIS data created in the Multi-Agency Coordination Center, especially any data to be released to other responders and the public. Due to the proliferation of geospatial data during an incident from other agencies, news organizations, and social networks (crowd sourced information), it is very important to attach a minimum set of metadata on data released to the public to identify it as authoritative. Due to the significant time needed to complete FGDC (Federal Geographic Data Committee) compliant metadata, the file naming convention may serve as a good fit for data residing in the Multi-Agency Coordination System (MACS) facility during extremely busy during the response.

Not all MACC’s are alike. Please be sure to modify the examples below to fit facility needs. Examples are for reference purposes only and are not intended to represent a standard.

* ***Purpose*:** This chapter provides guidance for the creation of metadata for all incident data and modified base data and other GIS products.

### Dissemination of Metadata

During an event it is not always possible to create metadata in compliance with existing content standards. This may be due to time constraints or lack of complete information. To minimize these issues, a template or set of templates can be created that contain minimal information and can be imported into datasets and other GIS resources, as they are created or modified. For example, templates can be created for data tables, feature classes, map documents, and any other GIS resource. To do this, establish a guideline for the minimum content of metadata to document each type of GIS resource. Metadata templates, as discussed earlier in the document will help others to understand the data and use it appropriately. However, it does not eliminate the requirements for full metadata (i.e., ISO/TC 211 compliant) for data intended to be released beyond the ICS. Metadata ‘lite’ should include basic information such as the incident name, description, source of the data, contact information (if practical), the date and time it was created/collected and any limitations the data may have.

The metadata file can be exported in HTML, SGML or .txt format and should be named in the same convention as the data to which it refers (date/time stamp, incident name, *etc*.)

### Indexing Metadata to Facilitate Discoverability

Metadata is designed to be indexed. Indexing services can be created that provide a means to create a searchable catalog of available GIS content. Indexing services and their features depend on the software in use. Indexing services are independent of the data and can be designed to auto update to keep current. These services can be implemented on a server and made available to the appropriate audience.

## Training/Exercises

**Background:** There is no better way to insure that GIS is used successfully in the EOC (and for first responders) than through repeated use of it in training scenario drills. These scenarios must test the capabilities of the GIS team to deliver scheduled standard products as well as ad hoc product requests in a timely manner. They must also test the capabilities of the emergency managers and first responders to use the products effectively within their decision-making and response workflows. Finally, these exercises must test the capacity of the information technology to deliver the required products and services. It is recommended that evaluations and after action reports from these exercises be used to improve GIS and emergency management processes, workflows and techniques within the EOC. Pre-event training and exercises can help to greatly ensure that the emergency managers, first responders and GIS team are prepared to respond at the highest levels when a coastal storm strikes.

* ***Purpose*:** This chapter provides guidance for the training of GIS professionals, emergency managers and first responders to insure that GIS is effectively delivered and used to improve the emergency response capabilities of the EOC.

### Training

GIS professionals need to understand the emergency management environment that they are working in. It is recommended that individuals responding in an EOC take the following on-line courses offered by FEMA:

1. IS 100.b - Intro to the Incident Command System
2. IS 200.b - ICS for Single Resources and Initial Action Incidents
3. IS 700.a - National Incident Management System (NIMS) an Introduction
4. IS-922: Applications of GIS for Emergency Management
5. IS 60 - GeoCONOPS Overview
6. IS 61 - GeoCONOPS In-Depth
7. IS 62 - GeoCONOPS In-Use
8. IS 63 - Introduction and Overview - DHS Geospatial Information Infrastructure (GII)

Equally important, GIS professionals need to be current on GIS software and use of data/models available to track and predict the impact of a coastal storm. GIS professionals also need to understand the speed, pressure, and intensity that they will need to work in as they are responding to the impact of a coastal storm.

Emergency managers and first responders need to understand what GIS can provide to assist them in their decision-making capacities. It is suggested that the GIS professionals provide them with presentations (and/or demonstrations) on the capabilities that the technology can provide them in their response efforts. First responders also need to be trained in the use of tools that they may be assigned to use for data collection in the field.

It is suggested that GIS professionals (as well as appropriate emergency managers and first responders) take the courses available from FEMA’s Emergency Management Institute on the Homeland Security Geospatial Concept-of-Operations (items 5-8 above) that identifies points of collaboration, best practices, technical capabilities and authoritative data sources. These courses can be found on the FEMA website: <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-60>, <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-61>, and <https://training.fema.gov/EMIWeb/IS/courseOverview.aspx?code=IS-62>.

The Homeland Security GeoCONOPS was developed by emergency managers and GIS professionals as well as first responders who have worked major disasters and developed ways to take advantage of GIS technology in the context of disaster response. It will help everyone know what types of situations to expect, decide what GIS products are most useful and how rapidly they must be protected to be effective, and encourage overall teamwork and smooth communication during an actual event.

### Exercises

Once all parties have a basic understanding of the GIS and emergency management needs and capabilities, it is time to begin to exercise those capabilities. Initially, it is suggested that the GIS team engage in scenario exercises by themselves to allow team members to understand their roles, insure that they have easy access to the relevant data and models and develop speed in fulfilling standard as well as unique product requests.

At the same time, emergency managers and first responders should examine their standard operating procedures to best use the GIS products in their decision-making and response workflows.

Once the GIS team has had a chance to develop workflows, templates, *etc*. and test their standard operating procedures (and adjust as necessary), they should begin to participate in full-scale scenario training exercises with emergency managers and first responders. This should feature GIS ingests and the delivery of standardized GIS products and special requests throughout the scenarios. After each training scenario, it is important that all parties to participate in an after-action analysis with the goal of identifying where things went well, where they need improvement, and how those improvements will be achieved!

# Appendix 1: GIS Preparation Checklist

This checklist was based primarily on a National Research Council report titled *Successful Response Starts with a Map: Improving Geospatial Support for Disaster Management*, which was published by The National Academies Press.

**Integration**

❑ Does your incident command post (ICP) have geospatial technology available?  
❑ Do you have a permanent workspace or office for your geospatial team?  
❑ Have you met with the emergency managers/responders to determine their geospatial needs for coastal storms?  
❑ Have you published a list of and schedule for the delivery of standard geospatial products for based on those needs?  
❑ Is the use of geospatial information integrated into your emergency management operations and used in emergencies?  
❑ Do your written standard operating procedures include the use of geospatial information in your workflow and decision-making processes?  
❑ Do you know the name of your state GIS coordinator?  
❑ Do you have contact information for the state GIS coordinator and his or her backup?  
❑ Have you established agreements with adjoining jurisdictions and with state and federal governments to share data and products?  
❑ Have you established agreements with adjoining jurisdictions and with state and federal governments that determine what data and tools will be used during an emergency?  
❑ Have you developed agreements between geospatial professional teams at the municipal, state, and federal levels that identify the roles that each level will play and who will produce what in order to avoid duplication of effort during a large event?  
❑ Have you worked with the state GIS coordinator to develop an inventory with around-the-clock contact information for GIS coordinators, their emergency management counterparts, and their respective backups in each county or major municipality in your state?  
❑ Has this information been distributed to the emergency management community and the GIS coordinators in each county or major municipality in your state?

**Human Resources**

❑ Do you have a designated geospatial team that is regularly deployed during coastal storm?

❑ Have you developed an organizational structure for your team that defines the roles of team members (manager, liaison, and technical support staff)?  
❑ Does your organization have a geospatial team (away team) that you can deploy to incident sites to assist in emergency response?  
❑ Have you developed a secure web site to distribute this information to authorized users?

**Training**

❑ Is the use of geospatial workflows, data and tools included as part of your emergency training exercises?  
❑ Are these exercises conducted on a regular schedule?  
❑ Do your emergency response professionals understand the capabilities that geospatial data and tools offer to improve their ability to plan for and respond to coastal storm?  
❑ Have you established a training program for your geospatial team in emergency management organization concepts and operational procedures?  
❑ Does your geospatial team train with pre-developed map templates?  
❑ Do you conduct scenario-based training exercises that include geospatial professionals and the use of geospatial data and tools in the emergency management work cycle and decision-making process?  
❑ Are the geospatial professional team manager and liaison included in the scenario training exercise meetings and briefings to allow them to understand better how geospatial data and tools are being used in the decision-making process?  
❑ Are the results of these exercises posted to a secure web site so that other authorized responders not involved in the exercise can learn from them?

❑ Are the emergency managers, first responders, and GIS team trained on the Homeland Security Geospatial concept of Operations (GeoCONOPS)?

**Data Access**

❑ Have you developed relationships through the Regional Response Teams (RRT’s) with the data custodians and established protocols and agreements, where required, to ensure access to and use of the data you require for planning, training, and emergency response activities?  
❑ Have you developed a methodology to ensure regular updates to those data?  
❑ Are your geospatial data backed up on a regular basis?  
❑ Do you have a full copy of the data?  
❑ Do you have copies of the data securely stored in different geographic regions of your state?  
❑ Do you have a copy of the data securely stored in a different state or geographic region of the country?  
❑ Do you have a Continuity of Operations Plan (COOP)? Have you tested your methodologies for rebuilding your servers using the backed-up data within the past year?  
❑ Have you tested the process for accessing data from data-sharing partners during simulations to ensure the viability of your methodology?  
❑ Have you established a web-based GIS service to encourage rapid access to and delivery of event-based/operational data?  
❑ Have you worked with the state GIS coordinator to develop a secure web site within each state with an inventory (with around-the-clock contact information for the data custodians) of geospatial data in each state for use in emergency management operations?  
❑ Have you worked with the state GIS coordinator to develop links to each of these state inventories and made this resource available to local, county, state, and federal agencies that would respond to a catastrophe?

**Data**

❑ Refer to the Data Acquisition and Distribution section in the general text.

**Data Gathering**

❑ Have you established a team to identify and gather all geospatial data needed for coastal storm?  
❑ Has your geospatial data team determined the quality and usability of the geospatial data gathered?  
❑ Have you developed an inventory of municipal, county, state, and federal data that you require for use in emergency response?  
❑ Does this inventory include metadata documenting and describing the veracity of the geospatial data?  
❑ Does your state have contracts in place for emergency aerial imagery?

❑ Does your state have a designated coordinator for emergency aerial imagery from the International Charter?  
❑ Do you have agreements in place to acquire digital images via government or private-sector plane or helicopter, of event sites immediately after an event occurs?  
❑ Do you have live or near-live geospatial weather data?  
❑ Do you have the capability to track the distribution of your emergency equipment or supplies geographically?  
❑ Have you established data gathering procedures for coastal storms and tested those methodologies in training exercises?  
❑ Do you have a geospatial web-based service application that provides rapid access to your event-related data by regional, state, or federal organizations responding to a large event?

**Data Improvement**

❑ Has the geospatial data team identified which data may not have sufficient accuracy to support emergency operations and require improvements and which data are missing and need development?  
❑ Do you get updates to your data (not including imagery) on an annual basis at a minimum?  
❑ Is the imagery for your state less than five years old?  
❑ Do you have a system for improving geospatial data to meet your emergency response requirements?

**Information Delivery**

❑ Has your geospatial team practiced rapid delivery of geospatial information to meet emergency management decision-making requirements?  
❑ Has your geospatial team developed templates to improve the speed of delivery of geospatial information?  
❑ Do you have automated geocoding capabilities that will allow your geospatial team to convert field data and address locations to latitude and longitude quickly?  
❑ Are your requests for assistance during an emergency tracked in a database and tracked via a GIS application to provide visual analysis of problem patterns, etc.?  
❑ Have your geospatial professionals developed agreements with geospatial professional teams in adjacent communities or the state, and at the federal level, to determine the data and tools to be used and shared during coastal storms?  
❑ Has a list of standard geospatial products and their delivery schedule been developed in consultation with emergency managers?

❑ Has a schedule for the delivery of standard products been distributed to GIS and Emergency Management staff?

❑ Have a system of tracking all standard geospatial products, or unique product requests, development and delivery been developed (this can either be in a simple spreadsheet or a database)? Does the system insure that PDF’s of all products are created and archived (date & time stamped)?

**Equipment and Infrastructure**

❑ Do you have a service level agreement for 24/7 IT support?  
❑ Do you have facilities to deed and house staff, on-site?  
❑ Do you have up-to-date geospatial software and hardware available?  
❑ Do you have electronic field data collection methods (using GPS, smart phones, tablets, etc.) available to collect field data?  
❑ Do you have capabilities of obtaining digital photographs of incident sites and transmitting them wirelessly to the ICP?  
❑ Does your state have geospatial equipment and data prepared for deployment near an incident site?  
❑ Do you have the ability to push out or pull in geospatial data or web-based services across the Internet?  
❑ Do you have backup satellite communications systems to transmit geospatial data when necessary?  
❑ Have you developed an up-to-date inventory of geospatial hardware available for use in an emergency (and around-the-clock contact information) in your state?  
❑ Have you developed a secure web site with this inventory and around-the-clock contact information for each state?  
❑ Have you developed a secure, national GIS web-based application to enable data to be accessed by authorized users across the country?

❑ If you use Esri software, does your facility have, if needed, an ESRI “failover” license to continue running the software if no Internet connection is available?

# Appendix 2: List of Acronyms

**Acronyms**

AAR After Action Report

CAP Common Alert Protocol (v1.1)

CFI Critical Facility Inventory

COI Community of Interest

BNTM Broadcast Notice to Mariners

COP Common Operating Picture

COTP Captain of the Port (United States Coast Guard)

CP Command Post

DE Distribution Element

DHS Department of Homeland Security

DOC Department Operations Center

DOI Department of the Interior

EDLX Emergency Data Exchange Language

EMAC Emergency Management Assistance Compact

EMS MOC Emergency Medical Services Medical Operations Center

EMT Emergency Medical Technician

EOC Emergency Operations Center

ERT Emergency Response Teams

ESF Emergency Support Function

FGDC Federal Geographic Data Committee

GeoCONOPS Homeland Security Geospatial Concept of Operations

GII Department of Homeland Security’s Geospatial Information Infrastructure

GIS Geographic Information System

GSTOP National Wildfire Coordinating Group GIS Standard Operating Procedures

HAVE Hospital Availability Exchange

HAZMAT Hazardous Materials

HAZUS Hazards US

HIFLD Homeland Infrastructure Foundation-Level Data

HSIN Homeland Security Information Network

HSIP Homeland Security Infrastructure Program

IC Incident Commander

ICP Incident Command Post

ICS Incident Command System

IMT Incident Management Team

JIC Joint Information Center

PIO Public Information Officer

LO Liaison Officer

JIC Joint Information Center

MAC Multi-Agency Coordination (Unit)

MACC Multi-Agency Coordination Center

MACS Multi-Agency Coordination System

MEOW Maximum Envelope of Winds

MOA Memorandum of Agreement

MOC Medical Operations Center

MOM Maximum of Maximum (for storm surge)

MOU Memorandum of Understanding

NGA National Geospatial-Intelligence Agency

NIEM National Information Exchange Model

NIMS National Interagency Incident Management System

NOAA National Oceanic and Atmospheric Administration

NRDA Natural Resource Damage Assessment

NRF National Response Framework – Stafford

NSGIC National States Geographic Information Council

NWCG National Wildfire Coordinating Group

NWS National Weather Service

OGC Open Geospatial Consortium

PDA Teams Preliminary Damage Assessment Teams

PIO Public Information Officer

SEMS Standardized Emergency Management System

SITREP Situation Report

SLOSH Sea, Lake, and Overland Surge from Hurricanes

SOG Standard Operating Guidance

SOP Standard Operating Procedure

S&R Search and Rescue

SSZ Storm Surge Zones

UC Unified Command

USCG United States Coast Guard

USNG US National Grid

# Appendix 3: Glossary of Emergency Management Terms and Definitions

Action plans: Written or verbal plans that reflect the overall incident goal (control objectives) and incident strategy, objectives for the designated operational period, specific tactical actions and assignments, and supporting information for the designated operational period.

Activation: A notification category that provides urgent information about an unusual occurrence or threat of occurrence, and orders or recommends that the notified entity activate its emergency response (usually via its emergency operations plan). An activation may be partial or full.

Advisory: A notification category that provides urgent information about an unusual occurrence or threat of an occurrence, but no activation of the notified entity is ordered or expected at that time.

After Action Report (AAR): The document that describes the incident response and findings related to system response performance.

Alert: A notification category between “advisory” and “activation” that provides urgent information and indicates that system action may be necessary.

Chain of Command: A series of command, control, executive, or management positions in hierarchical order of authority. (NIMS)

Command Post (CP): An ad hoc location established at or as near as possible to a disaster site, from which the incident commander (IC) functions.

Common Operating Picture: A broad view of the overall situation as reflected by situation reports, aerial photography, and other information or intelligence (sometimes map based). (NIMS) This is to ensure all decision-makers have a common understanding of the incident and incident response situation.

Damage Assessment: An appraisal or determination of the effects of the disaster on human, physical, economic, and natural resources.

Emergency Management Team: The management unit that operates at the EOC, and is responsible for all Emergency Management Operations during an incident (this is different from an *incident management team* which operates at the incident command post). Responsibilities include:

1. Directly supporting the Incident Management Team (IMT)
2. Directly managing emergency issues (or delegating the management) related to the incident but outside the defined scope of the Incident Management Team.

Emergency Operations Center (EOC): The physical location at which the coordination of information and resources to support domestic incident management activities normally takes place. An EOC may be a temporary facility or may be located in a more central or permanently established facility, perhaps at a higher level of organization within a jurisdiction. EOCs may be organized by major functional disciplines (e.g., fire, law enforcement, and medical services), by jurisdiction (e.g., Federal, State, regional, county, city, tribal), or some combination thereof. (NIMS)

Essential Functions: Functions required to be performed by statute, Executive Order, or otherwise deemed essential meet mission requirements.

Evacuation: Organized, phased, and supervised withdrawal, dispersal, or removal of civilians from dangerous or potentially dangerous areas, and their reception and care in safe areas. (NIMS)

Exercise: A scripted, scenario-based activity designed to evaluate an agency’s or multiple agencies’ emergency preparedness plans. Can take for as a *tabletop* (minimal or no physical activity), *functional* (outside agencies are simulated), or *full-scale* (includes all or most functions).

Hazardous Material (HAZMAT): Any material, which is explosive, flammable, poisonous, corrosive, reactive, or radioactive (or any combination), and requires special care in handling because of the hazards posed to public health, safety, and/or the environment. (Firescope 1994)

Joint Information Center (JIC): A facility established to coordinate all incident-related public information activities. It is the central point of contact for all news media at the scene of the incident. Public information officials from all participating agencies should collocate at the JIC.

National Incident Management System (NIMS): The National Incident Management System (NIMS) identifies concepts and principles that answer how to manage emergencies from preparedness to recovery regardless of their cause, size, location or complexity.  NIMS provides a consistent, nationwide approach and vocabulary for multiple agencies or jurisdictions to work together to build, sustain and deliver the core capabilities needed to achieve a secure and resilient nation.

Planning Section: Section of EOC responsible for the collection, evaluation, and dissemination of operational information related to the incident, and for the preparation and documentation of the IAP. This section also maintains information on the current and forecasted situation and on the status of resources assigned to the incident. In many cases GIS is placed in the planning section. (NIMS)

Public Information Officer: A member of the Command Staff responsible for interfacing with the public and media or with other agencies with incident-related information requirements. (NIMS)

Situation report (SITREP): A document that is developed and distributed during response as a means for disseminating a current situation assessment.

# Appendix 4: Geospatial Products and Programs

Alabama – <https://virtual.alabama.gov>

Florida – <http://www.map.floridadisaster.org/GATOR>

Mississippi – <http://www.maris.state.ms.us/>

Virginia – <http://vdemgis.maps.arcgis.com/home/>; <https://cop.vdem.virginia.gov>

Cyclocane (International Hurricane/Cyclone/Typhoon Tracking Map – <http://www.cyclocane.com/>

Esri’s ArcGIS Online – <http://www.disasterresponse.maps.arcgis.com>

FEMA’s ArcGIS Online - http://fema.maps.arcgis.com/home/

Google’s Crisis Map – <http://google.org/crisismap/weather_and_events>

International Charter Space and Major Disasters, <http://www.disasterscharter.org/home>

National Map – <http://nationalmap.gov/>

National Alliance for Public Safety GIS Foundation (NAPSG), Geospatial Standard Operating Guidance for Multi-Agency Coordination Centers (September 2011). For a digital copy visit: <http://napsgfoundation.org/wp-content/uploads/2013/10/NAPSG-SOG-V-3-FINAL.pdf>

National Research Council, Successful Response Starts with a Map: Improving Geospatial Support for Disaster Management, Washington, DC: The National Academies Press, 2007. For more information visit: <http://www.nap.edu/openbook.php?record_id=11793&page=163>

National States Geographic Information Council (NSGIC) provides detailed information on the capabilities of each state. This information is available at: <http://www.nsgic.org/state-information>

NOAA’s Extratropical Storm Surge Forecasting – <http://www.nws.noaa.gov/mdl/marine/etsurge.php>

NOAA’s Potential Storm Surge Flooding Tips for Emergency Managers – <http://www.nhc.noaa.gov/surge/PotentialStormSurgeTips-em.pdf>

United States Coast Guard, Department of Homeland Security, Homeport: <https://homeport.uscg.mil/mycg/portal/ep/home.do>

# Appendix 5: NOAA WEATHER DEFINITIONS

The following definitions were obtained from the National Weather Service Forecast Office’s web site:

Tropical Depression: A tropical system in which the maximum sustained surface wind is 33 knots (38 mph) or less. Though the wind speeds are significantly less than those in a hurricane, tropical depressions are capable of producing tremendous rainfall amounts. During the week of July 3rd through the 7th in 1994, Tropical Storm Alberto moved inland and weakened to a depression. It then moved into Georgia and produced up to 28 inches of rainfall causing catastrophic river and small stream flooding.

Tropical Storm: A tropical system in which the maximum sustained surface wind ranges from 34 to 63 knots (39 to 73 mph). These systems are also intense rainfall producers, but often cause enough wind and waves to cause some beach erosion and minor boat damage.

Hurricane: A tropical system in which the maximum sustained surface wind is 64 knots (74 mph) or greater. This is the worst and strongest of all tropical systems. New England was the recipient of one of the worst hurricanes ever, when the Great New England Hurricane of 1938 came crashing ashore on September 21st.

Hurricane Watch: An announcement for specific areas that hurricane conditions pose a possible threat to coastal areas within 36 hours. In New England, due to the rapid acceleration of most of our hurricanes, it is a necessity that you take action during the watch.

Hurricane Warning: A warning that hurricane conditions, including sustained winds of 74 mph or greater, associated with a hurricane are expected in a specified coastal area within 24 hours or less. Any preparedness measures must be rushed to completion once the warning is issued. High winds and coastal flooding will develop many hours before the eye of the storm actually comes ashore.

Hurricane Wind Watch: An announcement for inland areas that sustained winds of 74 mph or greater associated with a hurricane are anticipated beyond the coastal areas. The actual occurrence, timing and location are still uncertain.

Hurricane Wind Warning: An announcement for inland areas that sustained winds of 74 mph or greater associated with a hurricane are anticipated beyond the coastal areas in the next 6 to 24 hours.

Tropical Storm Watch: An announcement for specific areas that tropical storm conditions pose a possible threat to coastal areas within 36 hours.

Tropical Storm Warning: A warning that tropical storm conditions, including sustained winds of 39-73 mph, associated with a tropical storm are expected in a specified coastal area within 24 hours or less. Any preparedness measures should be completed as soon as possible.

Tropical Storm Wind Watch: An announcement for inland areas that sustained winds of 39-73 mph or greater associated with a tropical storm are anticipated beyond the coastal areas. The actual occurrence, timing and location are still uncertain.

Tropical Storm Wind Warning: An announcement for inland areas that sustained winds of 39-73 mph or greater associated with a tropical storm are anticipated beyond the coastal areas in the next 6 to 24 hours.

Hurricane Eye: A relatively calm area in the center of the storm. In this area, winds are light and the sky often is only partly covered by clouds. Never go outside in the eye of a storm. This period of relative calm may only last 10 to 20 minutes before hurricane force winds and torrential rains return from the opposite direction.

Storm Surge: An abnormal rise in sea level accompanying a hurricane or other intense storm. The height of the storm surge is the difference between the observed level of the sea surface and the astronomical tide that would have occurred in the absence of the storm. In Southern New England, storm surges of 10 to 20 feet have occurred, totally devastating the coastline.

Saffir-Simpson Hurricane Scale: A scale ranging from 1 to 5 based on the maximum sustained wind speed of the hurricane. This can be used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane. Extreme care should be used if using this scale as a guide to preparation steps when the sustained wind speed brings the storm within 10 mph of the next highest scale category. There is not much difference between a 110 mph (Cat 2) storm and a 111 mph (Cat 3) storm.

Hurricane Local Statement (HLS): A public release prepared by the local National Weather Service office serving the threatened area. This statement will provide specific details on: expected and observed weather conditions, evacuation decisions made by local officials, and other precautions necessary to protect life and property.

# Appendix 6: EXAMPLE OF GEOSPATIAL ROLES AND RESPONSIBILITIES

|  |  |
| --- | --- |
| **Position Title** | **Roles &/or Responsibilities** |
| Team Leader | * Responsible for the coordination of geospatial information system (GIS) production, remote sensing, and geospatial database efforts. * Conducts briefings, attends meetings, and directs overall geospatial support operations. * Interfaces with federal, state, and local authorities establishing Memorandums of Understanding (MOU’s), partnerships, and data sharing agreements where appropriate. * Proactively seeks opportunities to integrate geospatial products into executive decision-making. |
| Deputy Team Leader | * Reports to the Geospatial Team Leader and acts in their place when directed to do so. . * Responsible for maintaining the coordinated efforts of the geospatial team. * During times of absence of the Team Leader, becomes the representative of the Team. (Potentially, the Team Leader on alternate shifts.) |
| Geospatial Liaison | * Reports to the Team Leader. * Informally, meets with EOC section heads, task forces, etc. * Determines latest needs, suggests potential geospatial solutions, * Determines if standard map products are meeting needs, * Informs the Geospatial Team what is happening across EOC and works with them to develop needed and potential geospatial solutions to current and anticipated issues. * Greets customers and assists them in filling out request forms. |
| Geospatial Production Manager | * Reports to the Team Leader. * Coordinates GIS requirements and supervises assigned Geospatial Analysts. * Prioritizes GIS production and activities. * Defines and insures timely delivery of standard and unique products. * Works with product requesters to properly define requirements and ensures the timely preparation and delivery of recurring and ad hoc GIS products. |

|  |  |
| --- | --- |
| Geospatial Analyst | * Reports to the Geospatial Production Manager. * Prepares recurring and ad hoc GIS products. * Compiles various types of geospatial information into map and data products. * Responsible for posting, updating, and managing web services. * Analyzes and models geospatial data from various sources to answer diverse questions and populate geospatial products. |
| Geospatial Imagery Manager | * Reports to the Team Leader. * Responsible for the coordination of RS requirements, resources, and requests for the team. * Operates as task originator & collection manager for assets related to the operation. * Works with Geospatial Production Manager to ensure imagery- derived products are delivered in a timely manner. * Supervises Imagery Analysts. |
| Imagery Analyst | * Reports to the Geospatial Imagery Manager. * Processes and interprets acquired imagery. * Processes imagery in native and/or other formats. * Prepares image data files for use by the Geospatial Analyst Staff. * Creates imagery-derived datasets and products. |
| Geospatial Database Manager | * Reports to Team Leader. * Responsible for creating and managing the file-based data storage system, updating and distributing associated documentation, answering all queries for use, and briefing teams on use of data. * Initiates data sharing agreements or purchases for data as required and arranges for data updates as necessary. |
| Geospatial Database Administrator | * Reports to the Geospatial Database Manager. * Develops, maintains, and coordinates the geospatial data used. * Implements database access rights and privileges. * Responsible for data backups as required. |
| Geospatial Data Analyst | * Reports to the Geospatial Database Manager. * Designs and builds custom database queries as requested by task force members. * Performs quality control and corrects anomalies in the data. * Loads data sets as directed by the Database Manager. |
| Field Data Entry Technician | * Reports to the Geospatial Production Manager. * Inputs data in the field to record current conditions. * Transfers data to EOC. |

# Appendix 7: Imagery Types

**HDDS Imagery Types**

Aerial Photography (high resolution)

CAP oblique

Handheld oblique

UAV SAR

**Satellite Imagery**

Landsat TM

Landsat ETM+

ASTER

EO ALI

EO Hyperion

SPOT (Restricted) \*

GeoEye (Restricted) \*

Worldview-1/2 (Restricted) \*

QuickBird (Restricted) \*

IKONOS (Restricted) \*

MODIS

AQUA

ALOS (Restricted) \*

Cartosat (Restricted) \*

RapidEye (Restricted) \*

Envisat MERIS (Restricted) \*

Radarsat-1/2 (Restricted) \*

TerraSAR-X (Restricted) \*

Envisat ASAR (Restricted) \*

COSMO SkyMed (Restricted) \*

Orbview

DMCii

AVHRR

Topsat

Awifs

LISS

IRS

\* *Note – This data is available to State and Local Government. Restricted indicates that the requestor must set up a user profile on HDDS prior to gaining access to the imagery.*