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Open Geospatial Consortium

OGC DISASTER PILOT: DECISION READY OPERATIONAL CAPACITY GUIDE

ENGINEERING REPORT

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I KEYWORDS

The following are keywords to be used by search engines and document catalogues.

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IV ABSTRACT

The Operational Capacity Guide aims to provide disaster and emergency management communities with a set of incremental strategic actions to help them develop and enhance the infrastructure, training, support, and operational processes needed to deliver an effective and efficient geospatial response to disaster events. This guide was produced as part of the Open Geospatial Consortium's Disaster Pilot 2023 initiative.

1

INTRODUCTION

1 INTRODUCTION

Disasters are geographical, occurring in a location or sometimes multiple locations, affecting people and society within those locations. Geospatial information is critical as it provides insight into what is happening on the ground for the disaster and emergency community decision-makers, response teams, and affected communities to help them to make the right decisions at the right time.

Disaster and emergency planning and response are all about preparedness, putting systems in place to respond to various disaster scenarios and then practicing/enacting those systems to test the work. Capacity development is the process where people, organizations, and society develop the capabilities and capacities to have the systems, skills, and knowledge to respond appropriately to disasters and emergencies.

The importance of capacity development in disaster preparedness and response has been highlighted in recent global frameworks published by the United Nations Office for Disaster Risk Reduction. The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by the United Nations General Assembly and 187 members in 2015, with its predecessor, the Hyogo Framework for Action, adopted a decade earlier. These frameworks emphasize that unless capacity development is integrated into the overall process of disaster risk management, it will be extremely challenging, if not impossible, to deliver the required outcomes.

Emergency planning teams have for many years developed plans and tested their response to various disaster scenarios. As the importance of data and geospatial mapping has grown, not all teams have integrated these functions into their emergency plans. However, preparedness within geospatial functions is as critical as other parts of the emergency response community.

This guide was developed as part of the Open Geospatial Consortium's Disaster Pilot 2023 and aims to provide local disaster and emergency management communities, and the organizations within those, with a set of incremental strategic actions describing how to achieve the operational capacity needed to establish effective and robust geospatial readiness for disaster scenarios. Implementing these actions, or as many as possible, should ensure that when an incident occurs steps can happen quickly, efficiently, and effectively in terms of geospatial response.

It is not until geospatial capacity is developed and integrated into disaster and emergency operational management procedures and workflows that the real benefits of using geospatial information will be achieved.

2

TERMS, DEFINITIONS AND ABBREVIATED TERMS

2 TERMS, DEFINITIONS AND ABBREVIATED TERMS

This document uses the terms defined in OGC Policy Directive 49, which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this document and OGC documents do not use the equivalent phrases in the ISO/IEC Directives, Part 2.

This document also uses terms defined in the OGC Standard for Modular specifications (OGC 08-131r3), also known as the ‘ModSpec’. The definitions of terms such as standard, specification, requirement, and conformance test are provided in the ModSpec.

For the purposes of this document, the following additional terms and definitions apply.

2.1. Terms and definitions

2.1.1. **ARD; Analysis Ready Data and datasets**

raw data that have had some initial processing, created in a format that can be immediately integrated with other information, and used within a Geographic Information System (GIS)

2.1.2. **Capacity**

combination of all the strengths, attributes, and resources available within an organization, community, or society

2.1.3. **Capacity Development**

process by which people, organizations, and society systematically stimulate and develop their capacities over time to achieve social and economic goals

2.1.4. DRI; Decision Ready Information and indicators

ARDs that have undergone further processing to create information and knowledge in a format that provides specific support for actions and decisions that have to be made about the disaster

2.1.5. Geospatial Data

data that includes information related to a location, enabling it to be used to map objects, events, and anything else with a specific geographic location

2.1.6. Indicator

realistic and measurable criteria

2.1.7. Lidar

light detection and ranging ALTERNATIVE

common method for acquiring point clouds through aerial, terrestrial, and mobile acquisition methods

2.2. Abbreviated terms

API	Application Programming Interface
EO	Earth Observation
EOC	Emergency Operational Center
GIS	Geographical Information System
OGC	Open Geospatial Consortium

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ABOUT THE OPERATIONAL CAPACITY GUIDE

3 ABOUT THE OPERATIONAL CAPACITY GUIDE

This Operational Capacity Guide is a standalone document that provides a framework for a set of incremental strategic actions required for any disaster or emergency management teams who wish to establish, enhance, or improve their geospatial capacity and infrastructure concerning disaster and emergency planning, management, and response.

The framework, described in Clause 5, starts with a vision underpinned by two key principles, and then a set of incremental strategic actions for implementation to develop geospatial capacity and capability across the six key areas of: geospatial skills; technical infrastructure; geospatial data; standards; operational governance; and testing & exercises.

This document aims to provide guidance and be a training resource and was developed with emergency management administrators, operational managers, policymakers, emergency management program funding functions, together with emergency management teams and information technology support functions as the targeted audience.

To set the context, before moving to the framework itself, it is important to outline what is meant by capacity and capacity development.

3.1. What is Capacity and Capacity Development?

Capacity does not happen by chance, it has to be planned for and developed. Unfortunately, there is no single agreed definition for capacity and capacity development within the disaster and emergency response communities. However, some definitions have broad international consensus through the disaster risk reduction global frameworks and their associated bodies. Such that:

- **Capacity** is defined as the combination of all the strengths, attributes, and resources available within an organization, community, or society to manage and reduce disaster risks and strengthen resilience; and
- **Capacity Development** is defined as the process by which people, organizations, and society systematically stimulate and develop their capacities over time to achieve social and economic goals.

These definitions, and others, indicate that the following are three fundamental and interlinked levels of capacity and capacity development that need to be considered.

- The **Enabling Environment** describes the broader system within which people and organizations function, including the general interactions between government units, individual bodies, and society. The enabling environment can be described as context in which disaster preparedness and response operates.

- The **Organizational Level** sits within the Enabling Environment and includes the internal structures, policies, budgets, strategies, frameworks, arrangements, procedures, etc., within an individual organization that influences, or hinders, its ability to operate and achieve its objectives.
- The **Individual Level** focuses on the capacity of people within individual organizations, including their skills, knowledge, experience, and operational performance.

Capacity development needs to occur at all three levels to create success, as the different levels are interdependent on each other as shown in Figure 1.

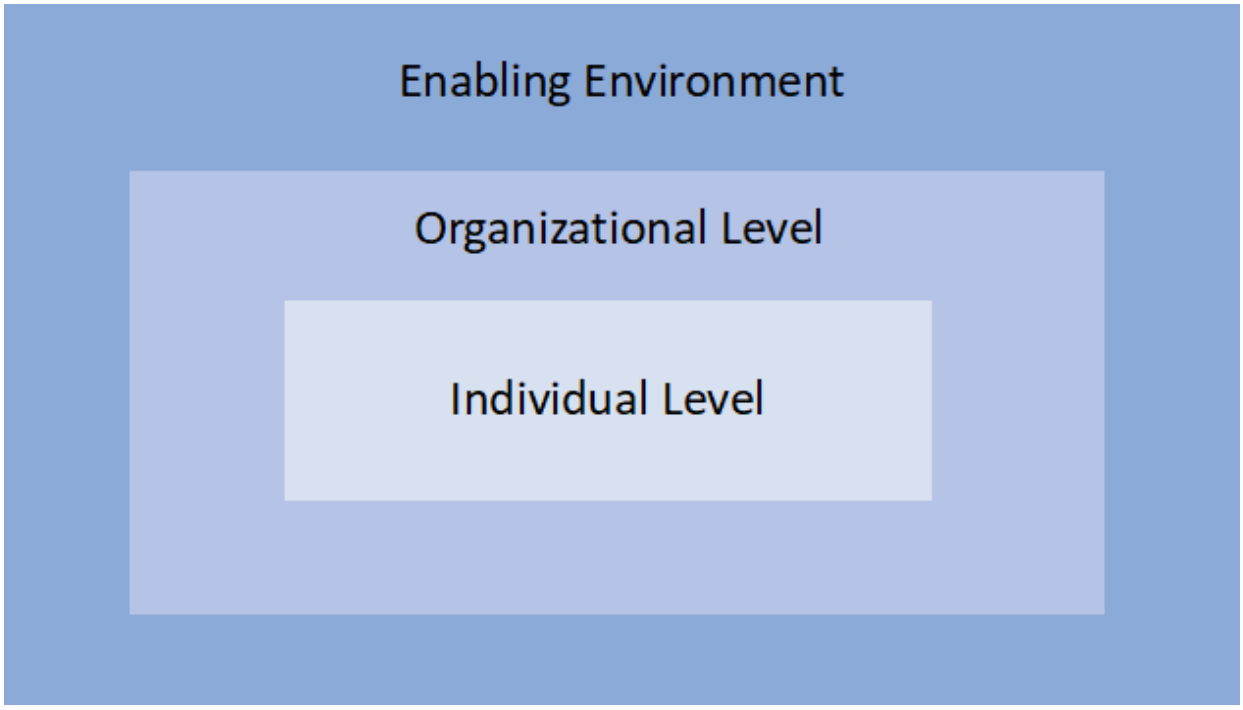

Figure 1 — Three levels of capacity.

Whilst this describes the different levels of capacity, there are also different types of capacities that need to be considered:

- **Technical Capacities** – subject matter knowledge such as Geographical Information Systems, remote sensing, data sharing skills, data integration skills, disaster-specific knowledge on drought, flooding, wildfire, health, etc.; and
- **Functional Capacities** — essential management skills for planning, implementation and monitoring. These are the heart of transformation and drive the process, without which, technical capacities alone do not translate into tangible results.

Organizations need to work together to align the environment with a strategic approach and the knowledge and skills of the individuals within the organizations needed to develop the geospatial capacity and capability required to support disaster planning and response.

Capacity development is not a process that can be started from scratch, as every community, organization, and individual must begin at current statuses, and this will differ at all levels. This Guide identifies a series of incremental strategic actions to take, offering a flexible model for capacity development. Every single action implemented will deliver tangible benefits and improvements to the disaster and emergency response community's ability to respond effectively to situations.

4

WHAT IS GEOSPATIAL OPERATIONAL CAPACITY READINESS?

4 WHAT IS GEOSPATIAL OPERATIONAL CAPACITY READINESS?

Using the model described in Clause 3 as the foundation, it can be overlaid with the disaster and emergency management ecosystem, which looks like the following.

Figure 2 — Three levels of capacity adapted for the disaster community.

- The **Enabling Environment** includes all relevant stakeholders involved in managing and monitoring any disaster. This group could be at a local, state, or potentially national level.
- The **Organizational Level** is each of the individual organizations, bodies, or groups, who are stakeholders in the Enabling Environment. Note, organizations, bodies, and groups are simply descriptive terms that should be considered in the broadest possible connotation and should not be limited by any form of formal designations. For example, people impacted by the disaster, and society more generally, would be considered groups within this level.
- The **Individual Level** encompasses all the people within the organization, bodies, and groups within the Enabling Environment.

5

CAPACITY DEVELOPMENT FRAMEWORK

5 CAPACITY DEVELOPMENT FRAMEWORK

The Capacity Development framework, shown in Figure 3 below, starts with a vision underpinned by two key principles, and then a set of incremental strategic actions for implementation to develop geospatial capacity and capability across the six key areas of:

- geospatial skills;
- technical infrastructure;
- geospatial data;
- standards;
- operational governance; and
- testing & exercises.

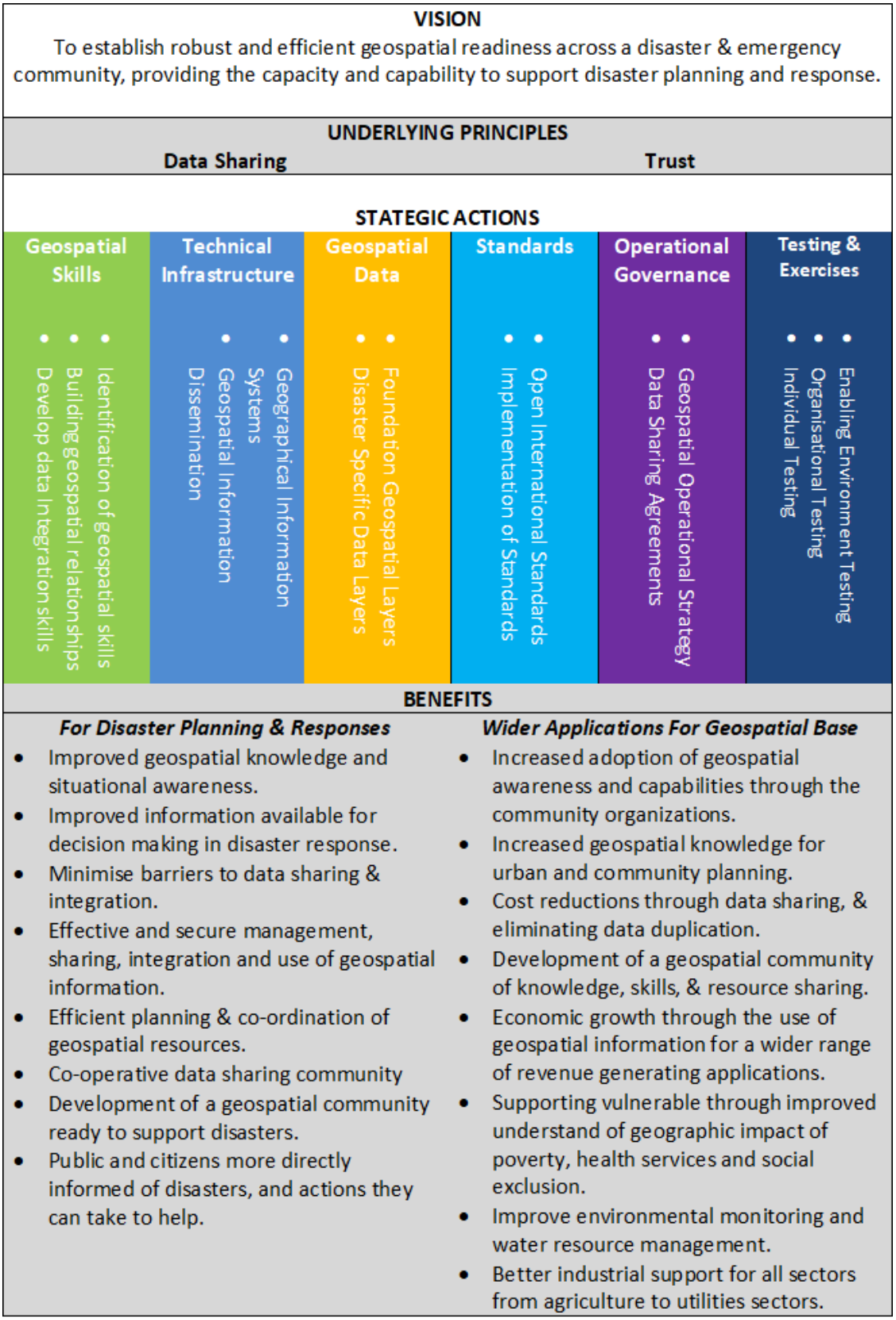

Figure 3 — Geospatial capacity framework.

5.1. Vision

The framework sets out a vision *'To establish robust and efficient geospatial readiness across a disaster and emergency community, providing the capacity and capability to support disaster planning and response'*, and the incremental strategic actions aim to take a community step-by-step towards this vision.

However, like all good vision statements, it achieves far more buy-in by stakeholders if it is developed by and for the stakeholders. Therefore, while this vision statement gives the framework an overarching focus and direction, it would be advantageous for each disaster and emergency community to set out their own vision statement based on current circumstances and goals.

5.2. Underpinning Principles

The underlying principles for this framework are the key characteristics required to deliver effective geospatial readiness support for disaster planning and response. The underlying principles are as follows.

- **Data Sharing** — Data sharing is absolutely critical to geospatial response, as it is unlikely that one single data source, or multiple data sources, held by one organization, will provide all of the insight the first responders and decisions-makers need. In addition, there are likely to be many agencies responding to a disaster which all need the relevant information for response actions.

  Many different agencies will have data, but the data are often kept in organizational silos and not routinely shared. The disaster situation will require all relevant data to be shared with the response team, as it is only from integrating multiple data sources, together with the expert knowledge held by disaster and emergency managers, that insights can be given to the first responders and decisions-makers to ensure the best decisions are made at the right time.

  For data sharing to occur, there needs to be trust. If there is trust, data sharing will be easier. Building the right processes and procedures for data sharing within a community, before a disaster occurs, will make data sharing in a time-sensitive and rapidly changing environment much easier.

- **Trust** — Trust is a less obvious principle than data sharing, but nevertheless, it is also vital to enable a smooth and efficient geospatial response to a disaster. There are several areas where trust is essential:

  - **Data Sources** — The quality of data sources being used needs to be trustworthy, have authority, and be clear about what the data are, when and where it came from, and what any uncertainties may be. Some data might be freely available, some will be available from government institutions or space agencies, some from private

companies or academic organizations, etc. Understanding all of this is vital in terms of how rapidly the data can be integrated, as faulty or incorrect data can cause issues for the geospatial response, or worse, give false information about the disaster situation. *For example, there was a network-wide failure of United Kingdom air traffic control systems in August 2023, for several hours, due to the receipt of faulty data from an aircraft flight plan.*

- **Data Indicators** — Decision makers who receive information that something is about to happen need to have trust in the methodology used to create that indicator and to trust its output. If decision makers are going to rely on the indicator to make decisions, again, it needs to have authority and confidence.
- **Geospatial Professionals** — The geospatial teams will have people joining remotely and in-person to work on the response together to integrate data for use in the response. Building relationships between those professionals will make it easier for the teams to discuss with each other, be confident about data being sent, and to know who to ask when help or support is needed.

Building trust is important through understanding the source of the data and indicators that will be used, and the people who will supply the data or support the response. Trust can be developed through the agreement of standards, transparency, development of relationships and collaboration, and, hopefully, data sharing can become more common.

5.3. Strategic Actions

The next section of this document aims to set out the incremental strategic actions, at all three capacity levels, disaster and emergency communities can take to establish, enhance, or improve geospatial readiness for disaster planning and response.

5.4. Benefits

This framework is focused on building geospatial capacity and capability for disaster planning and response, and there are clear benefits for a disaster and emergency community for implementing the outlined strategic actions.

However, those benefits will go far beyond the disaster and emergency community, as there should be a range of benefits for the wider activities of the organizations involved in the work. Having a strong geospatial function within an organization could offer several cost saving, and even revenue-producing, day-to-day activities that would be of benefit, depending on the starting point of the organization. If routine relevant data sharing and geospatial teams working together are added, then the benefits will increase. Examples of potential benefits are listed in the framework, although it will be down to individual organizations and communities to review the potential benefits they could achieve.

There is an argument that these geospatial strategic actions should focus on an organization's day-to-day activities and the benefits for the disaster and emergency community is a simple one of several benefits that will occur.

Looking at all the potential benefits achievable from this work may help with seeking funding and business cases for the investments that may be required, such as a geographic information system or a foundation base layer — although, note that a lot of the incremental actions outlined have minimal cost and will realize significant benefits.

6

IMPLEMENTATION APPROACH

6 IMPLEMENTATION APPROACH

It is recognized that disaster and emergency organizations and communities are all at different starting points, and some will have more strategic actions in place than others. Therefore, this Guide aims to outline a series of incremental strategic actions that any disaster and emergency community could implement to strengthen geospatial readiness.

It is acknowledged that these strategic actions will take time to deliver, and communities will prioritize the ones that are felt that will make the most significant impact given individual circumstances of each community. While ideally implementing all actions would deliver significant and sustainable geospatial benefits for a disaster and emergency response community, in essence, the more of these actions that are implemented, the better the geospatial readiness will be for response to disaster scenarios.

In addition, when building capacity with these strategic actions, it should be done with attention paid to the positive impacts they can have on day-to-day activities, not just the disaster response benefits. These strategic actions have the potential to offer economic and efficiency benefits to the communities and organizations involved.

Six elements need to be established to achieve geospatial readiness for a disaster scenario, and the key to the strategic actions listed below is preparedness and implementation ahead of any incident. The six elements are as follows.

1. **Geospatial Skills** — covers the people element with the geospatial skills and experiences needed to respond to a disaster.
2. **Technical Infrastructure** — covers the technical hardware and infrastructure that would be needed to respond in a disaster scenario.
3. **Geospatial Data** — covers the critical geospatial data necessary.
4. **Standards** — identifies all the technical standards needed to facilitate data sharing.
5. **Operational Governance** — covers the organizational requirements to support the geospatial response.
6. **Testing & Exercises** — plans on paper are only beneficial if testing is performed to ensure the plans work and that any gaps are identified.

Figure 4 — Six capacity elements.

All these six elements must be underpinned by data-sharing principles and trust if geospatial readiness is to be achieved. Historically, geospatial information has been collected, managed, and stored in silos. Cross-organization, sometimes even inter-organization, data sharing has been difficult, and often limited by various technical and governance factors. For a strong geospatial disaster response, data need to be collected, shared, exchanged, analyzed,and visualized across the community of responder organizations, field responders, and citizens affected.

History shows this is a challenging, but nevertheless, it should be the ambition.

6.1. Geospatial Skills

This Guide focuses on the technical, organizational, and enabling environment for disaster and emergency response, and more importantly the individual level: the people with the geospatial skills needed in a disaster scenario. Therefore, this element focuses on the actions required to establish and maintain a strong community of people with geospatial skills.

6.1.1. Identification Of Geospatial Skills

It is likely that most responder organizations will have geospatial skills within them. However, the number, experience, knowledge, and availability of these people will vary from organization to organization. Equally, in a major disaster scenario, there are unlikely to be sufficient people with geospatial skills in the responder organizations to manage the geospatial requests on a 24/7 basis. Therefore, there will be a need to pull other additional geospatial people in to bolster the team.

Actions:

1. Identify and map all the responder organizations with geospatial units within the local disaster and emergency community, and compile a directory of the geospatial people within those units. Don't forget to include units and people from bordering counties, states, provinces, etc., as no disaster stops at a border.

2. Compile a directory of all the geospatial skills in the wider local community, including private companies, other government departments, academics, student courses, and retired geospatial professionals.

6.1.2. Building Geospatial Relationships

As mentioned at the start of this section, trust needs to underpin the geospatial effort, and one way of building trust is to develop relationships and connections between the people working in the local geospatial ecosystem. If people know who their counterparts are in other organizations or districts, it will be easier to pick up the phone to ask for help and support and respond to those requests.

An example network is the New York City Geospatial Information Systems and Mapping Organization (GISMO), which is a user-oriented forum for sharing GIS news, software tips, data and data processing techniques, training, and more. GISMO played an important role in recruiting geospatial technicians in the New York area to support the response to the 9/11 attack on the World Trade Center.

Actions:

1. Bring all the geospatial professionals in the local community together to get to know each other and what the various organizations can offer in terms of access to data, skills, experience, etc., both within disaster scenarios, and how they might be able to support each other more with day-to-day service delivery operations

through data sharing, etc. This is about developing the relationships, connections, and trust that would be hugely beneficial in a disaster incident.

2. Establish a more comprehensive network of geospatial professionals within the local area, hold regular meetings, run training sessions, hold social events, etc. As well as developing a stronger geospatial community and further building relationships, this also acts as a social network. In the event of a significant disaster, this network would hold the details of all the geospatial people who could help.

6.1.3. Developing Data Integration Skills

The ability to integrate data into the GIS as it arrives from different sources will be a key skill for geospatial staff within a disaster scenario, together with the analysis of this new data and what insights it adds to the overall picture. It is the combination of different data sources that will give insights and improve overall decision making.

Unless staff are used to integrating multiple data sources at speed, this will be a new experience in a disaster scenario. While staff may be used to using and even integrating familiar data sources, responding to the disaster will involve using data sources the staff may not be familiar with. The staff will need to quickly understand what data is in the data set and how to pull that data into GIS. This work will also involve an understanding of the impact of standards as described in Clause 6.4.

Actions:

1. Ensure geospatial staff are familiar with various data sources and datasets used with the disaster and emergency community. Particularly, for datasets from other organizations, as sharing example datasets will be helpful with gaining familiarity and provide an opportunity to practice integrating quickly.

2. Practice integrating new data sources in real-time and integrating them into a GIS platform, either intra-organization or involving multiple organizations. Experiencing the pressure to deliver in real-time will create benefits for both individuals and organizations when an incident occurs.

6.2. Technical Infrastructure

It is impossible to produce a geospatial Operational Capacity Guide without discussing the technical infrastructure requirements, the key element of which is an Enterprise Geographical Information System (GIS). This GIS is not the only technical infrastructure to consider, but it is a vital one.

6.2.1. Enterprise Geographical Information System (GIS)

GIS is an acronym that describes the computer hardware and software needed to view, analyze, manage, integrate, and visualize geographic and geospatially-enabled information about what is happening in a specific location or locations. While an Enterprise GIS is one that is integrated throughout an entire organization, so that a large number of users can manage, share, and use spatial data and related information to address various needs. Although, as highlighted earlier for all these actions, an Enterprise GIS can be built incrementally, it does not always require a brand new solution as organizations can build on what they already have, for example, using data conversion software.

Various GIS solutions are available, and it is not expected that every organization will have the same solution. Some organizations might use the same GIS, others might use different ones, but so long as the solutions can manage, share, view, and disseminate geospatial data in common standardized formats (see the Standards and Data elements) it will be beneficial. A key point, once a solution has been built, is to ensure the solution is maintained, and ideally improved, over time.

Any organization that does not currently use an Enterprise GIS and feels this would be a significant cost just for disaster response should bear in mind that a common GIS, using the same geospatial frameworks across the organization, should offer multiple financial savings alongside revenue-generating applications, with the disaster support function being a bonus. These systems can be used to support the general delivery of services; some examples of these potential applications include:

- monitoring crime patterns and routing for police vehicles;
- monitoring traffic patterns in relation to accidents or other road obstructions;
- public transportation and routing for school catchments;
- health monitoring and disease mapping both for long-term illness and short-term epidemics;
- mapping agricultural threat migrations, such as pests; and
- monitoring the migration patterns of invasive species.

It is also worth highlighting that the data available due to regular day-to-operations is generally a degree of magnitude smaller from that generated during a disaster scenario. This potential increase required during a disaster should be taken into account when designing storage, processing capacity, and potential user numbers of the GIS.

Actions:

1. Develop an Enterprise GIS that complies with the standards described within Clause 6.4. However, this can be built incrementally component by component over time, rather than buying a new single system.

2. Ensure the GIS is populated with the core/base layers described in Clause 6.3 and that this is maintained, and ideally, improved over time.

3. Ensure all geospatial staff are trained to use the system and know how to import, export, integrate, analyze, visualize, and share information from the system.

4. Ensure all decision-makers are familiar with the types of geospatial outputs produced by GIS, and the decisions which can be supported through the outputs. Training on this aspect will be critical so that using the geospatial outputs is familiar when a disaster scenario occurs.

5. Enhance the routine use of GIS systems for day-to-day use. This will not only bring benefits to the communities and organizations, but it will develop a level of familiarity with using the system making integration into disaster response easier.

6.2.2. Geospatial Information Dissemination

Producing maps, charts, and detailed geospatial information is only beneficial if it gets to the people who can use it. Decision makers in the Emergency Operations Center (EOC) should be able to view the geospatial information on GIS. However, the field responders may not; therefore, there is a need to make provisions for how the information will be disseminated outwards from the EOC.

Traditionally, the way to provide maps to first responders was in printed format. Over the last decade, smartphones and handheld devices have become commonplace, and users have become comfortable with reading maps on such devices, such as using Google Maps™ or similar products. Dissemination may seem to be an issue that has been resolved, and maps should be supplied to first responders via handheld devices. However, there are a few issues to consider as follows.

- Communication networks are likely to be challenging in the aftermath of a disaster. The 911 or similar network is often the first to go down as thousands of people are trying to make contact with emergency services. Equally, the disaster may have taken down the communication network hardware such as mobile telephone masts, etc. For example, after 9/11 the telecommunications networks were down for around seven days. This lack of telecommunications and wireless networks is also relevant for getting information to the EOC.

- Plenty of locations still do not have strong Wi-Fi or mobile telephone signals, and so may struggle to receive or view maps on handheld devices.

- Communication with citizens impacted by the disaster will also be necessary. There is a need to inform the populous of what is happening, what people need to know, how to act, safe routes out of the area, places to avoid, etc. Giving people a solution, whether a website, text messages, or other method of communication, and giving relevant information will aid a successful response. Establishing a communication method, such as website, before the disaster for citizens, could also get them used to using this method, but also offer advice on pre-preparedness such as getting go-bags ready, masks, etc.

All of this means that a blended technical solution for dissemination may be needed.

Actions

1. Maintain up-to-date maps of the mobile and wireless signals within the local area, so that an understanding of the impact of the disaster on communications will be known.
2. Establish an inventory of all the handheld devices, numbers, etc., within the local responder organizations, so this information can be distributed to those who will most benefit from the information in a disaster scenario. It should also be noted that handheld devices may also be used for data collection, which is described more in the Data element.
3. Consider solutions available to disseminate information – including the solutions offered through the Disaster Pilot – to first responders and give the responders the information needed in a robust and timely manner.
4. Establish a communication method for the citizens involved in the disaster, and the wider general public, to maintain updates on the situation and actions to take.
5. Consider having dissemination solutions that can operate without a persistent telecommunications network, so that offline maps and information — even if slightly out of date — can be utilized in the field. For example, it might be possible to use mobile communication hubs from satellites, such as Starlink internet broadband system, drones, or similar solutions offering wireless support.
6. Consider having equipment on hand, or easily accessible, to set up networks and continuous telephone communications services access and persistent wireless connections for the EOC. It is acknowledged that this would be a significant undertaking.

6.3. Geospatial Data

The center of any geospatial response are the data, as these are the basis on which the information within the GIS is created that allows the decision-makers to determine how to respond to the disaster.

The first point to note is that the term geospatial data covers a lot of different sources of data, and that the data have a spatial reference, meaning the data have a geographical reference, which gives each datum a location.

There are many types of geospatial data, and all may offer benefits in a disaster scenario. The types of data that could be useful include:

- satellite imagery — which can include optical, thermal, radar, or lidar data;
- airborne imagery — which can include optical, thermal, radar, or lidar data;

- aerial photography;
- oblique angle photography;
- building or Computer Aided Design (CAD) drawings;
- 3D Renderings; and
- citizen science data – namely, data collected by first responders or general citizens, usually on handheld devices, giving precise snapshots of what is happening in specific locations.

Depending on the type of disaster, the location, or the information required, will determine which data sources may be helpful. However, it is unlikely that one single data source will answer all the questions about the disaster. The way problems are solved is through the integration of multiple data sources, and it is the combinations that give additional insights. The EOC must have the people and technology with geospatial capabilities to integrate and combine data layers.

6.3.1. Foundation Geospatial Layers

In order to make the most effective use of geospatial data, the GIS needs to be preloaded with a series of base layers containing the fundamental geographic, infrastructure, and location-based features within the local areas. Many cities and districts will already have a high-quality photogrammetric base map for GIS, which is fantastic as this underlying base map is the map onto which every other layer will be projected.

Ideally, these base layers would be at spatial resolution of at least 1 meter, which would be beneficial both to the day-to-day and disaster operations. However, less than 1 meter resolution is becoming more common; sometimes down to even 10 centimeters. The higher the resolution, potentially the greater the number of applications that can benefit. However, again, in terms of incremental development, if the available layers are at 2 meters spatial resolution, this is better than not having the layers at all.

In an ideal world, local disaster and emergency communities would use the same base map, making sharing data between organizations easier and faster. However, it is accepted that this may not be possible for various reasons.

Cost sharing for producing such a base map could make it easier for organizations financially. There are examples of organizations sharing base maps with the local community for free. *For example, the US Army has recently created a vector base map available for anyone in the US to download for free.*

Once the base map has been installed, other sets of foundation layers can be loaded on top. At a local level, there are often a lot of these layers available for free from an open data portal/catalog/registry for anyone to download. Examples of what constitutes a set of such layers include:

- United States Federal Geographic Data Committee's National Spatial Data Infrastructure (NSDI) Framework identifies seven geographic data themes that are geodetic control,

orthoimagery, elevation, transportation, hydrography, governmental units, and cadastral information; and

- the United Nations Committee of Experts on Global Geospatial Information Management produced the document 'The Global Fundamental Geospatial Data Themes' that lists 14 fundamental data themes.

An alternative way to consider the fundamental layers is for the local disaster and emergency community to get together and agree on what should be considered fundamental local layers. While there are likely many commonalities between organizations and areas, there could be local differences, and the community might find it helpful to agree on these.

For example, in Manitoba, hydro-power generation capabilities are critical factors for the locality and therefore datasets surrounding power generation, power consumption, river flows, hydrology, underground water resources, extraction licenses, etc., would be particularly important in drought, or similar, scenarios.

Once decisions have been made on which fundamental layers are required, these layers need to be sourced. It is worth investigating whether the community's required layers are freely available online. There are a surprising number of data layers offered by various sources, but consideration needs to be given to the authority and confidence in those layers. For example, layers provided freely by a government institution are likely to have more authority than those provided by a single individual.

For example, GeoBase has a selection of high quality geospatial layers for Canada, including administrative, emergency, environment, imagery, and infrastructure layers. These layers have authority and are maintained by trusted sources. These are all available freely without restrictions, under an Open Government Canada license.

One way of approaching this issue is to use catalogs and registries when searching for data, either for fundamental layers or disaster-specific information:

- a Catalog is a list of data sources that have been organized, managed and curated;
- while a Registry is a catalog with an authoritative level where data has to be registered, and there is often, although not always, a level of validation.

For example, space agencies, such as NASA, the Canadian Space Agency, or the Copernicus Programme from the European Union, apply a level of verification and validation to the products made available online. This approach should give a level of confidence that the data is of a high quality and is worth including in a GIS. However, this may not be the case for all data layers or satellite data.

It is still worth looking for freely available layers online, but it is essential to verify the source. *For example, in New York, they found 75 infrastructure layers online that could be downloaded at no cost.*

Once the fundamental layers are installed, organizations could then look to use these to develop other revenue-reducing applications such as those described in the GIS section.

Actions:

1. install the most accurate and up-to-date base map for local areas with the GIS;
2. determine the foundation layers that most benefit individual organizations and the local disaster and emergency community (the more commonality there is, the easier it will be to share data);
3. review all the identified required foundation layers and assess how many are already available — either as a free or paid for download — rather than the community having to build the layer from scratch;
4. ensure that all foundation datasets have their metadata completed; this is data that describes the data set and ensures that other users can search and catalog this data; and
5. review what other applications within the organization/community could benefit from using the foundation layers for revenue-saving or revenue-generating activities to offset any incurred costs.

6.3.2. Disaster Specific Workflows & Datasets

There will be a set of data layers relevant to the specific disaster scenario unfolding that will be useful to integrate into the GIS being worked on. The datasets that may be useful may need to be found and discovered through catalogs by geospatial staff.

There are some generic layers that are available from Space Agencies or national institutions that will be helpful, such as the following.

- Climate Data Canada is a climate data portal produced collaboratively by the country's leading climate organizations and supported, in part, by the Government of Canada.
- Copernicus Emergency Management System — uses satellite imagery and other geospatial data to provide details on floods, earthquakes, landslides, severe storms, fires, volcanic eruptions, tsunamis, and humanitarian crises.
- NASA's Disasters Mapping Portal is a website for viewing, analyzing, and downloading the latest near real-time and disaster specific data products in Geographic Information Systems (GIS) format.
- The International Charter Space and Major Disasters is a worldwide collaboration, through which satellite data from different space agencies are made available for the benefit of disaster management. Note, this charter does require an Authorized User to submit a request for data.

In addition, the OGC Disaster Pilot participants have developed a series of data workflows and supportive tools to provide Analysis Ready Datasets and/or Decision Ready Indicators, which means data that have already undergone a series of transformations and processing to create information and knowledge in a format that can either be integrated into a GIS, or provides specific support for actions and decisions that have to be made about a disaster.

Need to add hyperlinks to the headings below in the User Guide for the Final version.

The Pilot has developed:

- **Supportive Tools** — Data/Workflow Service Registry and Discovery Services, Mobile Crowdsourcing Survey & Reporting Applications, Data Visualizations Tools & Medical Supply Needs Index;
- **Datasets & Indicators and Workflows Related to Droughts** — Drought Severity Indicators, Drought Crop Indicator, Water Supply Indicator, Energy Production Indicator, and Drought Health Impact Indicator;
- **Datasets & Indicators and Workflows Related to Wildfires** — Wildland Fire Fuel Indicator, Wildland Fire Ignition Risk Indicator, Wildland Fire Evacuation Indicator, and Wildland Fire Health Impact Indicator;
- **Datasets and Workflows Related to Flooding** — Datasets on Sea Surface Temperature, Wing and Precipitation, Earth Observation Synthetic Aperture Radar datasets, Earth Observation Optical Datasets, Change Detection Products, Flood masks, and Dynamic Route Mapping for flooding; and
- **Datasets and Workflows Related to Landslides** — Change Detection Products.

Actions

1. Review the freely available disaster-specific datasets available from national and international sources.
2. Develop a directory of those freely available datasets relevant to the local area, with the disaster scenarios the datasets are relevant to, and where to find the datasets.
3. Develop a directory of authoritative registries and catalogs that could be used for finding data.
4. Review the available workflows developed by the Disaster Pilot 23 participants and determine which might be helpful for the local disaster and emergency community.

6.4. Standards

As has been described, the Operational Capacity Guide is governed by the underlying principles of data sharing and trust. The Standards element is key to these underpinning aspects and critical to supporting data interoperability.

Standards are essentially the rules and guidelines governing how data can be shared and integrated. Using agreed technical standards alongside common data formats will ease the

process of integrating data, not only within the disaster and emergency community, but also across organizational and jurisdictional boundaries.

Ideally, the standards should be agreed across as broad an area as possible, not just the local community, but also at state/province level or wider because cross-boundary elements are critical within disaster and emergency response. Infrastructures such as roads or utility networks go across borders, and the response will need data for the whole area. The greater the area to adopt the standards approach, the smoother the process for bringing data together.

Standards also support data providers who want to offer new datasets, as it makes clear what the requirements are for any new data flows to ensure that the effort, time, and cost to implement the datasets is minimized.

6.4.1. Open International Standards

Open international standards are voluntary consensus-driven standards that are developed, approved, and maintained via a collective approach, ensuring that standards focus on generic needs, rather than the preferred approach of any one individual or organization.

There are three key international organizations that work on developing open geospatial information standards. One of which is the **Open Geospatial Consortium** which focuses on making location-based information FAIR — Findable, Accessible, Interoperable, and Reusable, such that:

- **Findable** — The first step in (re)using datasets is to find them;
- **Accessible** — Once the required data are found, the user needs to know how the data can be accessed, possibly including authentication and authorization;
- **Interoperable** — The data usually need to be integrated with other data. In addition, the data need to interoperate with applications or workflows for analysis, storage, and processing; and
- **Reusable** — Data should be well-described so that the data can be replicated and/or combined in different settings.

The other international standards organizations include the following.

- **International Hydrographic Office** that focuses on standards related to nautical charts and documents.
- **International Organization for Standardisation Technical Committee Geographic information/Geomatics (ISO/TC 211)** that focuses on standards related to defining the geographic location of an object.

In addition, there are various standards for use of IT and the internet, such as those developed by the World Wide Web Consortium (W3C) or the International Standards Organization (ISO).

6.4.1.1. OGC Recommended Standards

Through the work of this Pilot, it has been identified that the OGC standards most beneficial to adopt to support geospatial readiness include the following.

- **OGC APIs** — OGC Application Programming Interface (API) Standards define modular API building blocks to spatially enable Web APIs in a consistent way. Details are available on how the family of OGC API Standards work together to provide modular "building blocks for location:" https://ogcapi.org
- **OGC Model for Underground Data Definition and Integration (MUDDI)** — The purpose for MUDDI is to identify, organize, and properly relate together the different kinds of underground features and the characteristics of the features so that information about the underground can be systematically collected in a standardized format enabling a wide variety of applications vital to the physical environment in which all people live, and to related social and economic activities. https://docs.ogc.org/per/17-090r1.html
- **OGC Web Feature Service (WFS)** — The WFS offers direct fine-grained access to geographic information at the feature and feature property level. This standard specifies operations such as discovery and query alongside operations to manage stored, parameterized query expressions. https://www.ogc.org/standard/wfs/
- **OGC Web Processing Services (WPS)** — The OpenGIS® WPS Interface Standard provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay. The standard also defines how a client can request the execution of a process and how the output from the process is handled: https://www.ogc.org/standard/wps/

There are many other OGC standards which could be beneficial for a community, and it would be valuable to review these alongside other standards to determine the community's strategy for standards.

Actions

1. Local disaster and emergency community organizations make a commitment to agree, establish, and maintain the common standards framework to support all aspects of data sharing.
2. Discuss and agree on a strategy for the standards which will operate within the disaster and emergency community — note, this might be dictated by the current organization's GIS and associated technical infrastructures. It is recommended that the OGC standards listed above are the starting point for this strategy, but also to review other OGC and organizations standards.
3. Review the standards the community operates regularly, for example: annually, to ensure the standards continue to meet the community needs, take account of changes in the technology used within the community, and wider technology trends.

6.4.2. Implementation of Standards

Having agreed to operate a standards-based approach, the obvious next step is to implement the standards. However, this is more than simply the technical implementation, there is also a requirement to raise awareness of the selected standards and why the standards are being used, together with compliance testing to ensure that everyone is implementing the standards in the correct way.

Raising awareness is important to bring together both geospatial and IT infrastructure professionals to highlight the benefits and value of adopting open international standards and discussions over the standards adopted within the local community. It is essentially creating a community of practice, sharing knowledge and best practice, together with providing the basis of standards training.

In terms of compliance, while there are compliance and certification organizations who will verify that standards are being implemented correctly, this is not the only option. Using the community is a more cost-effective and beneficial approach, where geospatial and IT professionals from within one organization review the approach adopted by another organization to determine if the organization has implemented the standards correctly. The two organizations can discuss the findings and any agreed changes be made. This will further boost the links between the geospatial and IT professionals and improve understanding and knowledge of the standards.

Actions

1. Implement all the standards that have been agreed locally to support data sharing and dissemination.
2. Establish a local community of practice for standards with the geospatial and IT professionals to share best practice.
3. Establish a process for verification and compliance with the standards.

6.5. Operational Governance

6.5.1. Geospatial Operational Strategy

All disaster and emergency communities will have a variety of operational strategies and activities to kick off in the event of a disaster. All of these are documented, and everyone knows what to do. The geospatial function should be no different,requiring an operational strategy tied into the overall response, allowing geospatial activities to operate quickly, effectively, and efficiently regarding disaster response.

This strategy should describe the geospatial team's role in the overall response, what support the team will provide, how the support will be provided, where the support will be carried out, and how the team will interact with the broader overall response. The document would cover the following elements.

- Is there a physical space in the normal Emergency Operations Center? Will the physical space be in the same building or elsewhere?
- What are the most common types of maps and information likely to be required in any disaster scenario? This knowledge will enable the geospatial team to start developing the maps required immediately to support the golden hour response.
- What will be the process for the response team to request new maps and information?
- What is the process for getting data from other organizations and sources?
- How are the maps and information disseminated?

Like all disaster responses, the strategy will vary depending on the scenario, but should focus on the most likely potential disasters, like normal emergency planning.

Example: In the United States, Homeland Security has produced the Geospatial Concept of Operations (GeoCONOPS), which describes the geospatial leadership activities for any disaster response. GeoCONOPS is a positive document which focuses on the response of the Federal Government and does not provide details for state or local municipalities. However, the document does provide a helpful guide on the potential content for the geospatial operational strategy.

Given a disaster scenario, many agencies can be involved, including both government and private sector, which all need to be coordinated not only from an emergency planning viewpoint, but also from the geospatial operational viewpoint. So, ideally, developing this operational strategy would be done with the broader geospatial community, rather than simply within one organization.

However, like all aspects of this Guide, an incremental approach is best. Two organizations working together is better than one organization working alone; three organizations are better than two, and so on. Don't let perfection be the enemy of having a acceptable geospatial strategy.

Actions

1. Develop an operational strategy for the geospatial function that ties into the community emergency response plan, and where necessary, modify existing emergency operational procedures to bring geospatial data into the workflow and decision-making procedures — consider both the physical EOC and remote options.
2. Develop a set of first response map and information output templates, based on what sort of information is needed for anticipated local disasters, that can be acted upon as soon as a state of emergency is declared.

3. Establish a common process for requesting data and analysis, including a tracking element, so that everyone knows what has already been requested to ensure duplication is kept to a minimum and limit any repeat work.

4. Practice implementing the plan – this can be undertaken as part of any broader emergency planning exercises. It is also possible to practice the geospatial response as a standalone to get people used to responding to information requests.

6.5.2. Data Sharing Agreements

This Guide has highlighted the importance of data sharing and how combining information from different sources can provide new knowledge to the disaster response team. This Guide has also talked about building trust and relationships between geospatial teams to smooth the process of requesting data from other teams, organizations, and other administrations.

While sharing data in disaster situations has enormous potential benefits, it must be recognized that sharing data does not always happen automatically and there are numerous examples of organizations and departments being unwilling to share datasets, even plenty of examples of departments within the same organization unwilling to share data with each other. While some of these issues stem from the silo mentality of developing and managing datasets only for one purpose or service, plenty of other challenges need to be resolved.

Some of the biggest challenges for sharing data are data protection issues both actual and perceived: where liabilities rest in relation to any data shared; custodianship of any data shared in terms of what the data can be used for; what other data the data can be combined with; and what needs to happen with the data after the emergency is over. Often, however, such personal data are precisely the types of data first responders and decision-makers require to save lives, such as identifying vulnerable people needing additional help in a disaster situation.

In addition, other challenges might include jurisdiction responsibilities or issues, commercial confidentiality, lack of approval from the Board level, technical inability to deliver the datasets, etc.

The issues that prevent the sharing of datasets aren't easy to resolve, generally, and in the heat of a disaster, the pressure on individuals to react quickly may mean incorrect decisions are made to share, or not share, data. It would make sense to try and establish data-sharing agreements for all the obvious datasets that would be useful within the local disaster and emergency community and the bordering communities. Hopefully, agreements such as this will tease out all the obstacles which can be discussed and resolved before a disaster scenario occurs. However, it is acknowledged that some of the obstacles may be significant and will take time to resolve, for example, the sharing of personal data is a significant challenge, even within life-saving scenarios. Ideally, data-sharing plans would go beyond local communities and involve state and federal government departments.

It would also be useful to maintain a community-wide register of datasets and current statuses in terms of data sharing which will enable all parties to not only know what is easily available, but also know what other data sets might be out there, even if the data are not immediately available.

Actions

1. Agree on the types of datasets the local community would require for the most likely disaster scenarios and identify who owns them.

2. Agree, and sign, data-sharing agreements for the most needed data sets with the data owner.

3. Establish a register of datasets and the status of the datasets in terms of data sharing.

4. Develop a data-sharing agreement template that could address the majority of issues for any datasets not covered in the most needed dataset list. The template will hopefully allow any new request to be dealt with more rapidly by the data owner during a disaster situation.

5. Discuss the sharing and use of personal data within the community to see what can be achieved, what can be put in place in advance of a disaster, what security/privacy measures could be implemented, what needs to be in place, etc. Even if the outcome is very limited access to personal data, everyone will know the situation, which will prevent discussion during any disaster response.

6.6. Testing

Anyone who has worked in disaster planning will know that establishing the plan and approach is only the first step, the key is repeated testing so that the operational response is familiar, and hopefully seamless, when a disaster occurs. Once again, the geospatial response is no different, it is important that everyone realizes the need for exercises to test the process, systems, and thinking required to use geospatial data to the best advantage.

This section of the Guide will look at testing and exercises that could be utilized to help develop and embed geospatial readiness for the different stakeholders involved.

It is acknowledged that it's very challenging to pull together multiple agencies to undertake a full disaster response exercise, and this section will focus on exercises below that level. However, should any full-scale multi-agency exercises take place, geospatial teams should be fully integrated and participating in them.

This section will look at testing and exercise options for the geospatial readiness capacity level of the enabling environment, organizational, and individual. Like all disaster planning exercises, it is almost impossible to recreate the pressure of a disaster scenario; this is about getting staff used to taking specific actions and activities so that these actions are familiar if a disaster occurs. In fact, it is often helpful to run such exercises to fail, so staff know what it feels like for things not to go to plan and how to react and adapt to the changing environment. These exercises can be done as standalone events, or brought together to create workflows and better simulate a disaster response environment.

An example set of exercises is suggested below, but it is acknowledged that each community and organization will need to assess which type of exercises will be most beneficial to the community or organization and the individuals therein — each community might also identify other exercises that would be useful. It is recommended that these exercises are repeated regularly, to ensure that everyone involved experiences what could happen in a disaster situation.

6.6.1. Enabling Environment

- **Real-time Data sharing** — Have geospatial teams from different organizations exchange datasets in real-time, and then have analysts import, process, and visualize the data to produce information and maps for decision-makers.
- **Standards Compliance Testing** — As highlighted in Clause 6.4 on standards, it would be helpful to use the community approach to allow geospatial and IT professionals from within one organization review the approach adopted by another to determine if it has been implemented correctly. The findings can be discussed by the two organizations and any agreed upon changes made.

6.6.2. Organizational

- **Decision making** — Provide decision makers with geospatial data, information, and knowledge and ask the decision makers to make individual decisions on how a disaster should be responded to in those circumstances. Give several people the same information to make decisions with, and then discuss those decisions and see whether people made the same decisions, and if not, why different people made different decisions. The emphasis is not about deciding on a single right answer, but exploring the different ways that data can be interpreted and used for decision-making in a safer, less pressurized situation.
- **Supporting Responders & Decision Makers Information Requests** — Get responders and decision makers to request knowledge and maps from geospatial analysts, and then discuss the supplied details. The focus should be on how the analysts can make the information clear, concise, and easy to understand for both the responders and decision-makers. All participants can learn how to improve both the request and the response.

6.6.3. Individual

- **Operational Training** — Ensure all geospatial analysts are trained on the operational procedures, systems, and data for use in the case of a disaster. Consider expanding training to include anyone in the local directory, as discussed in Clause 6.1, who might be asked to support the geospatial team in the case of a large event.
- **Dataset Manipulation** — Running exercises with geospatial analysts to get staff used to rapidly integrating datasets into the staff's GIS solutions, and rapidly extracting and providing a dataset to other organizations. Again, pushing this exercise to a point of failure

will help expose the weak spots, and will give staff an insight into what might happen and how the staff would react.

Actions

1. Set-up and regularly repeat geospatial readiness exercises for the disaster and emergency community, with a focus on real-time data sharing and standards compliance testing.

2. Set-up and regularly repeat geospatial readiness exercises for organizations, focusing on decision-making and support information requests.

3. Set-up and regularly repeat geospatial readiness exercises for individuals, focusing on operational training and dataset manipulation.

7

SUMMARY

7 SUMMARY

This document describes a set of incremental strategic actions that emergency management administrators, operational managers, and policy and decision makers can use to help understand the infrastructure, training, support, and operational processes that need to be put in place to help disaster and emergency communities develop a robust geospatial function to support disaster response.

The outlined actions are not prescriptive, as every disaster and emergency community will have a different starting point, and the actions can be achieved in a number of different ways. Each community will need to decide which actions to implement, and in which order, to deliver the greatest benefits.

This Guide is a starting point and it is hoped that continued development and improvement of the document over time will be a part of OGC's ongoing Disaster Pilot work.

The following section contains a list of all the actions, with the detailed supporting information within the relevant section of the document. Appendix A contains an example of what a Geospatial Action Checklist might look like once a state of emergency or disaster is declared, assuming the majority of the actions in this Guide have been implemented.

Implementing any of the actions will enhance or improve a community's geospatial capacity and infrastructure and improve geospatial readiness to respond to disaster events, which will hopefully save more lives and reduce the impact of disasters.

8

ACTION LIST

8 ACTION LIST

Listed in Figure 5, Figure 6 and Figure 7 are a summary of all actions within this Operational Capacity Guide.

Geospatial Skills
Identification of Geospatial Skills
Identify and map all the responder organizations with geospatial units within the local disaster and emergency community; and compile a directory of the geospatial people within those units.
Compile a directory of all the geospatial skills in the wider local community, including private companies, other government departments, academics, student courses and retired geospatial professionals.
Building Geospatial Relationships
Bring all the geospatial professionals in the local community together and get them to know what each other, and what their different organizations can offer in terms of access to data, skills, experience, etc.
Establish a more comprehensive network of geospatial professionals within the local area, hold regular meetings, run training sessions, hold social events, etc.
Developing Data Integration Skills
Ensure geospatial staff are familiar with various data sources and datasets used within the disaster and emergency community.
Practice integrating new data sources in real-time and integrating them into a GIS platform, either intra-organization or involving multiple organizations.

Technical Infrastructure
Enterprise Geographical Information System
Develop an Enterprise GIS that complies with the standards described within the Guide. However, this can be built incrementally component by component over time, rather than buying a new single system.
Ensure the GIS is populated with the core/base layers described in the Geospatial Data section, and that this is maintained, and ideally, improved over time.
Ensure all geospatial staff are trained to use the system and know how to import, export, integrate, analyze, visualize, and share information from the system.
Ensure all decision-makers are familiar with the types of geospatial outputs produced by the GIS, and the decisions which can be supported through the outputs.
Enhance the routine use of GIS systems for day-to-day use, bringing benefits to the communities and organizations, but it will also develop a level of familiarity with using the systems making their integration into disaster response easier.
Geospatial Information Dissemination
Maintain up-to-date maps of the mobile and wireless signals within the local area, so that an understanding of the impact of the disaster on communications will be known.
Establish an inventory of all the handheld devices, numbers, etc., within the local responder organizations, so these can be distributed to those who will most benefit from them in a disaster scenario.
Consider solutions available to disseminate information to first responders and give them the information they need, in a robust and timely manner.
Establish a communication method for the citizens involved in the disaster, and the wider public, to keep them updated on the situation and actions to take.
Consider having dissemination solutions that can operate without a persistent telecommunications network, so that offline maps and information can be utilized in the field - such as satellite phones, or Starlink internet broadband connections.
Consider having equipment on hand, or easily accessible, to set up networks and continuous telephone communications services access & persistent wireless connections for the EOC.

Figure 5 — Geospatial skills and technical infrastructure.

Geospatial Data
Foundation Geospatial layers
Install the most accurate and up-to-date base map for local areas with the GIS.
Determine the foundation layers that most benefit individual organizations and the local disaster and emergency community.
Review all the identified required foundation layers and assess how many are already available — either as a free or paid for download — rather than the community having to build the layer from scratch.
Ensure that all foundation datasets have their metadata completed; this is data that describes the data set and ensures that other users can search and catalog this data.
Review what other applications within the organization/community could benefit from using the foundation layers for revenue-saving, or revenue-generating activities, to offset any incurred costs.
Disaster Specific Workflows and Datasets
Review the freely available disaster specific datasets available from national and international sources.
Develop a directory of those freely available datasets relevant to the local area, with the disaster scenarios they are relevant to, and where to find the datasets.
Develop a directory of authoritative registries and catalogs that could be used for finding data.
Review the available workflows developed by the Disaster Pilot 23 participants and determine which might be helpful for the local disaster and emergency community.

Standards
Open International Standards
Local disaster and emergency community organizations make a commitment to agree, establish and maintain the common standards framework to support all aspects of data sharing.
Discuss and agree a strategy for the standards which will operate within the disaster and emergency community — note, this might be dictated by the current organizations GIS and associated technical infrastructures.
Review the standards the community operates are regularly, for example, annually, to ensure they continue to meet the community needs, take account of changes in the technology used within the community, and wider technology trends.
Implementation of Standards
Implement all the standards that have been agreed locally to support data sharing and dissemination.
Establish a local community of practice for standards with the geospatial and IT professionals to share best practice.
Establish a process for verification and compliance with the standards.

Figure 6 — Geospatial data and standards.

Operational Governance
Geospatial Operational Strategy
Develop an operational strategy for the geospatial function that ties into the community emergency response plan, and where necessary, modify existing emergency operational procedures to bring geospatial data into the workflow and decision-making procedures.
Develop a set of first response map & information output templates, based on what sort of information is needed for anticipated local disasters, that can be actioned as soon as a state of emergency is declared.
Establish a common process for requesting data and analysis, including a tracking element, so that everyone knows what has already been requested to ensure duplication is kept to a minimum and limit any repeat work.
Practice implementing the plan – this can be undertaken as part of any broader emergency planning exercises. It is also possible to practice the geospatial response as a standalone to get people used to responding to information requests.
Data Sharing Agreements
Agree on the types of datasets the local community would require for the most likely disaster scenarios and identify who owns them.
Agree and sign data-sharing agreements for the most needed data sets with the data owner.
Establish a register of datasets and their status in terms of data sharing.
Develop a data-sharing agreement template that could be used to address most issues for any datasets not covered in the most needed list in a disaster situation, and hopefully smooth the process any request to a data owner.
Discuss the sharing & use of personal data within the community to see what can be achieved, what can be put in place in advance of a disaster, what security/privacy measures could be implemented, etc.

Testing & Exercises
Set-up, and regularly repeat, geospatial readiness exercises for the disaster and emergency community, with a focus on real-time data sharing & standards compliance testing.
Set-up, and regularly repeat, geospatial readiness exercises for organizations, focusing on decision making and support information requests.
Set-up, and regularly repeat, geospatial readiness exercises for individuals, focusing on operational training and dataset manipulation.

Figure 7 — Operational governance and testing & exercises.

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A

ANNEX A (INFORMATIVE) REVISION HISTORY

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DATE	RELEASE	AUTHOR	PRIMARY CLAUSES MODIFIED	DESCRIPTION
2023-08-28	0.1	A.Lavender, Pixalytics Ltd	all	initial version
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2023-10-06	0.3	A.Lavender, Pixalytics Ltd	all	third draft