Introduction*

Earthquake Subject Matter Experts Geological Surveys and their Earthquake Capabilities Supporting Emergency Response	
Purpose	This file documents earthquake response topics of focus for the state geological surveys. These topics can also impact emergency response efforts, plans, resources, and the human factor. The earthquake information collected and activities done by the geological surveys will be of interest to several of the emergency support functions. This document strives to answer these questions:
1	What are geologic-specific topics impacting earthquake response?
2	What resources do the state geological surveys have that can support response efforts in light of these topics?
3	Which ESFs may be helped with these resources?
Included	Tabs of information in this document:
1	*EarthquakeTopics* tab: geologic topics, their impacts to resources, and the ESFs that would be interested
2	*Geo Capabilities* tab: geologic topics, their relevance to emergency management during response, and state surveys with those capabilities
3	*ESFs* tab: for reference, emergency support functions at the EOC and their responsibilities
4	*Geologist Contacts* tab: for reference, contact information for state geological surveys and staff related to earthquakes
5	*EM Contacts* tab: Contact information for emergency management agencies and staff most likely to be contacted for earthquake-related response or exercises

* Geologist contacts and EM contacts are current through 3/29/2019. For updated contact information, contact the respective state geologist

Earthquake Topics

Earthquake Topics of Focus by Geologists	Topic Definitions and Impact on Emergency Management Interests	ESF-1	ESF-2	ESF-3	ESF-4	ESF-5	ESF-6	ESF-7	ESF-8	ESF-9	ESF-10	ESF-11	ESF-12	ESF-13	ESF-14	ESF-15
		Emergency Support Functions Potentially Affected/Interested														
		ESF 1 - Transportation	ESF 2 - Communications	ESF 3 - Public Works and Engineering	ESF 4 - Firefighting	ESF 5 - Emergency Management	ESF 6 - Mass Care, Emergency Assistance,	ESF 7 - Logistics Management and Resource	ESF 8 - Public Health and Medical Services	ESF 9 - Search and Rescue	ESF 10 - Oil and Hazardous Materials Response	ESF 11 - Agriculture and Natural Resources	ESF 12 - Energy	ESF 13 - Public Safety and Security	ESF 14 - Long-Term Community Recovery	ESF 15 - External Affairs
Shaking intensity	Damage is more likely in areas of stronger shaking intensity. Dependent on distance from epicenter and thickness/consistency of materials on bedrock. *Can impact:* • Buildings, schools, shelters • Communications, cell towers, utility lines • Transportation - roads, bridges, ports • Pipelines - water and gas	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Aftershocks	Aftershocks (large, moderate, and small magnitude) follow large magnitude earthquakes. *Can impact previously compromised:* • Response efforts • Resources • Infrastructure • Surface	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Landslides	During strong shaking portions of hillsides may separate and slide downslope, roadway embankments and levees may fail or be lowered *Can impact:* • Structures • Surface exposed infrastructure such as electric power and pipeline pump stations and communications towers • Roads and bridges • Travel/Transportation	x	x	x		x		x		x	x		x	x		
Liquefaction	During strong shaking sediment can lose vertical support and ability to support structures, bring sand to the surface in piles and water that may flood small areas. Areas most prone to liquefaction have sand in the subsurface in these settings: unconsolidated water-saturated sediments such as built up soils, floodplains, marshes, drained marsh/swamp, and low lying agricultural areas with high water tables. *Can impact:* • Structures • Towers for electric cables and communications • Road embankments of approaches to bridges • Roads and bridges • Pipelines • Agriculture	x	x	x		x					x	x	x		x	
Lateral Spreading	During strong shaking sediments along waterways can be displaced sideways, losing horizontal support and ability to support structures as ground moving into waterways is lowered Areas most prone to lateral spreading: Levees/earthen dams/berms/roadway embankments and structures on or near waterways. *Can impact:* • Piers and docks • Towers for electric cables • Roads and bridges • Structures • Agriculture	x		x		x						x	x		x	
Karst/ Sinkholes	Strong shaking can dislodge soil and underground rock in areas with limestone. Areas most prone to earthquake-triggered sinkholes are areas already having sinkholes, caves, and caverns. *Can impact:* • Roads and bridges • Ponds in sinkholes • Structures • Water supplies • Pipelines	x		x		x			x		x	x			x	
Groundwater Supply/Water Wells	Shaking can increase siltation in water supplies, including aquifers, reservoirs, and other water bodies. Groundwater levels can rise or fall, and increased siltation can clog and shut down or burn out pumps. *Can impact:* • Water supply • Water quality • Agriculture			x		x			x			x				
Environmental/ Toxic Pollutants	Strong shaking can impact structures and their contents, including storage chemicals, integrity of retaining ponds, treatment facilities, and industrial processes. Some toxic contents may pose environmental risk. *Can impact:* • Water supply • Water quality • Human health/safety • Environmental health/safety • Agriculture					x			x		x	x			x	
Oil/Gas Pipeline and Well Damage	During episodes of strong shaking pipelines and wells can be damaged near the ground surface. Partially empty pipelines may float to the ground surface in soil liquefaction areas during shaking – long-term partially filled pipelines are rare since it poses a corrosion problem. Potential release/spill of toxic contaminants, petroleum- or gas-related products is possible. *Can impact:* • Pipelines • Fire • Electric power generation • Water supply • Water quality • Human health/safety • Environmental health/safety • Agriculture				x	x			x		x	x			x	
GIS/Mapping and Imagery	Mapping, GIS data, and geospatial analyses of damage to land, structures, and infrastructure *Can impact:* • more information in the common operation picture (WebEOC) can provide more detail on damage to land, structures, and infrastructure	x		x	x	x	x	x		x	x	x		x	x	
Long Term Impacts	Potentially hundreds of researchers working throughout the impacted states depending on magnitude of event. Can impact: can provide data and information specified in the previous sections.					x										x
Debris	Large quantities of debris can be generated during large earthquakes. *Can impact:* • Infrastructure • Recovery • Health/safety • Environment			x		x					x				x	
Research Response Coordination Clearinghouse	Potentially thousands of researchers working throughout the impacted states. Can impact: more detailed information on the above previously listed topics					x		x								x
Mission Ready Package for Geologists /EMAC	For large earthquake events, some smaller state geological surveys may not have enough geologists to help support and interpret geology-related activities long term 24 hours a day. *Can impact:* • Timely support to EMA • Efficient interpretations of geologic information • Collection of geologic field data	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

Geo Capabilities

Earthquake Topics of Focus by State Geological Surveys	Capabilities and Importance/Relevance to Emergency Management Response	State Geological Surveys with Specified Capabilities							
		Alabama	Arkansas	Illinois	Indiana	Kentucky	Mississippi	Missouri	Tennessee
Shaking Intensity	Interpretation of the below products								
	• ShakeMap (computer estimated intensity)	Yes	Yes	Yes	Yes	yes	yes	yes	yes
	• Did-You-Feel-It (citizen report intensity)	Yes	Yes	Yes	Yes	yes	yes		yes
	• PAGER (computer estimated economic and social impact)	Yes	Yes	Yes	Yes	yes	yes		yes
	• Soil amplification maps for state	Yes	Yes	Yes	Yes	yes	yes		yes
	• GIS data for the above	Yes	Yes	Yes	Yes	yes	yes		yes
	Importance: These can help identify areas of greatest shaking (i.e. areas and population with potentially greatest damage immediately following quake)								
Aftershocks	Continual monitoring and data collection of seismic activity following an earthquake and assist in locations for deployment of portable seismic monitoring equipment brought in by outside experts	Yes	Yes	Yes	Yes	Yes	yes	yes	Yes
	Importance: to better monitor fault stability, fault locations, and potential aftershock locations								
Landslides	Field geologists will report location, descriptions, and photos of landslides.	Yes	Yes	Yes	Yes	Yes	yes	yes	
	Importance: identification of roads and bridges that may be impassable								
	Landslide susceptibility maps can be used to identify areas with a higher likelihood of triggered landslides. There are known areas and roadway/hillside settings that are areas of previous landslides in state	yes	Yes	Yes	Yes		yes	yes	
	Importance: identification of slopes/areas with highest fragility that may fail during aftershocks								
Liquefaction	Field geologists will report location and descriptions and photos of liquefaction.	Yes	Yes	Yes	Yes	Yes	yes	yes	
	Liquefaction/soil amplification susceptibility maps:	Yes	Yes	Yes	Yes		yes	yes	
	• Can be used to help identify areas with a higher likelihood of liquefaction.								
	• Can be referred to after large earthquakes as a planning tool prior to aftershocks for potential areas of damage type.								
	Importance: identification of areas with highest fragility that may fail during aftershocks; also may help identify areas underground that may have failed pipes and stormwater drains								
Lateral Spreading	Field geologists will report location and descriptions and photos of lateral spreading.	Yes	Yes	Yes	Yes	Yes	yes	yes	
	Importance: identification of areas with that may fail during aftershocks or that need inspecting by engineers for stability affecting roads, bridges, and dams; may also help identify areas underground that may have failed pipes and stormwater drains								
Karst/ Sinkholes	Field geologists will report location and descriptions and photos of newly formed sinkholes.	Yes	Yes	Yes	Yes	Yes	yes	yes	
	Importance: may help identify potential groundwater contamination and impacted water resources; may also help identify locations of potentially damaged pipes or stormwater drainage								
	Karst maps are available at the geological survey that identify location of karst geology and larger sinkholes.	Yes	Yes	Yes	Yes		yes	yes	
	Importance: can help identify areas more susceptible to groundwater contamination during spills and leaks of toxic substances								
Groundwater Supply/Water Wells	Hydrologists can collect and interpret groundwater effects, data, and alternative water well supplies.	Yes	Yes	Yes	Yes	Yes	yes	yes	
	Note: Some geological surveys have a prescribed message about these potential problems with wells and water treatment; some messages are in conjunction with the Health Department.								
	Importance: shaking can impact groundwater supply amount and quality for local, county, and city wells								
Environmental/ Toxic Pollutants	Hydrologists and biologists can test water quality. Some geological surveys test for both surface and groundwater quality. Some work with or independently of their state's Health or Environmental Departments for this.	Yes	Yes	Yes, wells	Yes, with ISDh	Yes	No	yes	
	Importance: shaking can impact groundwater supplies, stormwater drainage systems, and contaminants in surface water								
	Long term impacts to aquatic biology/ecosystems/critical habitat can be monitored and reported.	Yes	Yes	no	Yes, simple		Yes		
	Importance: shaking can impact stormwater drainage systems and other contaminants in surface water								
	Karst maps can be consulted for identifying connections between surface water (and contaminants) and groundwater.	Yes	Yes	Yes	Yes		yes	yes	
	Importance: shaking can impact water supplies, stormwater drainage systems, and contaminants in surface water - sinkholes are direct conduits to the groundwater (any toxic spills or leaks at the surface in a karst area can contaminate groundwater)								
	Groundwater flow paths/directions can be analyzed for plume analysis.	Yes	Yes	Yes	Yes		yes	yes	
	Importance: if a toxic release or spill occurs, hydrologists can model where these contaminants may move in relation to water well supplies.								
Oil/Gas Pipeline and Well Damage	Information and maps of locations of pipelines, wells, and operations for reference.	yes, wells	Yes	Yes	Yes	Yes	yes	yes	
	Interpretation of possible contamination risk from petroleum products. Risk may include impacts to surface water, groundwater, soil, or other.	Yes	Yes	yes	Yes		yes	yes	
	Importance: strong shaking can damage pipelines and wells, potentially leading to environmental problems								
GIS/Mapping, aerial/satellite imagery, and Lidar	Geologists and GIS specialists can help locate and acquire imagery.	Yes	Yes	Yes	Yes	Yes	Yes	yes	Yes
	Importance: aerial imagery is very important in response as it captures the effects of disaster, especially to buildings, roads, bridges, communication and power lines, and other structures								
	GIS analysts and specialists can plot field information, create maps, and analyze data.	yes	Yes	yes	Yes		Yes	yes	Yes
	Importance: GIS is critical in making maps and WebEOC common operation picture. Many data however, need to be analyzed or formatted first before putting into the WebEOC map								
	GIS and remote sensing specialists can analyze data to identify changes on land (such as landslides, liquefaction, etc.) which can then be used to assess impacts and identify areas with greater damage.	yes	Yes	yes	Yes		Yes	yes	Yes
	Importance: identifying location of damage is important in response and planning								
	Analyze and model changes and change detection in imagery in populated areas, structures, and ground surface (such as landslides, fault ruptures, etc. which impact safety/health/evacuation routes).	Yes	Yes	Yes	Yes	Yes	No		Yes
	Importance: change detection in before and after aerial imagery, satellite, and lidar can help pinpoint areas of damage - important in response and resource planning								
Long Term Impacts	Provide support in continued research for months to years following a major earthquake to study impacts to the land and communities in the state.	Yes	Yes	Yes	Yes	Yes	yes	yes	Yes
	Importance: support in planning and recovery efforts. Information, maps, and analyses that show location of damage or changes to the ground (landslides, liquefaction, etc.) and natural resources (groundwater, surface water, and others) can be made available as research and mapping efforts are conducted.								
Debris	Groundwater hydrologists and mapping staff can contribute to safe location of temporary debris storage by providing interpretation of groundwater protection maps.	Yes	Yes	Yes	Yes		yes	yes	
	Importance: not all landfills or potential landfill areas are safe to store debris; depending on the soil and rock types, some allow decay and chemicals to pass through to the groundwater, thus potentially contaminating drinking water resources								
Research Response Coordination Clearinghouse	Managing the research response will require coordination with local, state and national levels of government. In addition, coordination with geology Clearinghouse authorities to determine if there will be a virtual, physical, or no clearinghouse stood up.	Yes	Yes	Yes	Yes			yes	
	Importance: immediate and long term research provides information for help in response as well as future planning, building codes, and understanding safe locations to build in the future								
Mission Ready Package for Geologists /EMAC	CUSEC State Geologists have put together Mission Ready Packages that can be used to request geology support from other states. This specifies geologists with background in field work, mapping, and geologic hazards.	Yes	Yes	Yes	Yes			yes	
	Importance: these are in EMAC and can be used to request help from other states who have responded to earthquakes previously and have the best skill set to provide best response efforts								

ESFs

Essential Support Function (ESF)	ESF Scope/Responsibilities
ESF #1 – Transportation	Aviation/airspace management and control Transportation safety Restoration/recovery of transportation infrastructure Movement restrictions Damage and impact assessment
ESF #2 – Communications	Coordination with telecommunications and information technology industries Restoration and repair of telecommunications infrastructure Protection, restoration, and sustainment of national cyber and information technology resources Oversight of communications within the Federal incident management and response structures
ESF #3 – Public Works and Engineering	Infrastructure protection and emergency repair Infrastructure restoration Engineering services and construction management Emergency contracting support for life-saving and life-sustaining services
ESF #4 – Firefighting	Coordination of Federal firefighting activities Support to wildland, rural, and urban firefighting operations
ESF #5 – Emergency Management	Coordination of incident management and response efforts Issuance of mission assignments Resource and human capital Incident action planning Financial management
ESF #6 – Mass Care, Emergency Assistance, Housing, and Human Services	Mass care Emergency assistance Disaster housing Human services
ESF #7 – Logistics Management and Resource Support	Comprehensive, national incident logistics planning, management, and sustainment capability Resource support (facility space, office equipment and supplies, contracting services, etc.)
ESF #8 – Public Health and Medical Services	Public health Medical Mental health services Mass fatality management
ESF #9 – Search and Rescue	Life-saving assistance Search and rescue operations
ESF #10 – Oil and Hazardous Materials Response	ESF #10 – Oil and Hazardous Materials Response Oil and hazardous materials (chemical, biological, radiological, etc.) response Environmental short- and long-term cleanup
ESF #11 – Agriculture and Natural Resources	Nutrition assistance Animal and plant disease and pest response Food safety and security Natural and cultural resources and historic properties protection and restoration Safety and well-being of household pets
ESF #12 – Energy	Energy infrastructure assessment, repair, and restoration Energy industry utilities coordination Energy forecast
ESF #13 – Public Safety and Security	Facility and resource security Security planning and technical resource assistance Public safety and security support Support to access, traffic, and crowd control
ESF #14 – Long-Term Community Recovery	Social and economic community impact assessment Long-term community recovery assistance to States, local governments, and the private sector Analysis and review of mitigation program implementation
ESF #15 – External Affairs	Emergency public information and protective action guidance Media and community relations Congressional and international affairs Tribal and insular affairs

State Geologist Contacts

State	State Geologist
Alabama	Berry H. (Nick) Tew, Jr. office - 205-247-3679 email: ntew@gsa.state.al.us
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