

**GISCorps –Guerilla Mapping**  
**for**  
**Hurricane Katrina Relief Effort**

**ESRI User Conference – Communicating Our World**

**August 7 – 11, 2006**

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July 2006

## **GISCorps – Guerilla Mapping for Hurricane Katrina Relief Effort**

### **Abstract**

GISCorps volunteers worked and lived in a badly damaged train depot in Wiggins, Mississippi 35 miles from the Mississippi coast. They assisted FEMA Community Relations, U.S. Army Corps of Engineers, and community leaders of Stone County creating damage assessment maps and reports. Damage reports of severe roof damage, trees on roof and excessive debris were collected by rural postal carriers and compiled on 'Gatekeeper Referral Cards'. The data were entered as attributes into a 911 address geodatabase. The address geodatabase was spatially joined with a search grid. Map books with search grid enabled FEMA to easily locate each address and give special attention to addresses reporting damage. Other mapping activities included development of a church map for FEMA to notify citizens of the opening of a FEMA registration center, location of blue roof program and availability of temporary housing. Over 500 maps were made to support the recovery effort in Stone County.

### **GISCorps – Guerilla Mapping for Hurricane Katrina Relief Effort**

On August 29, 2005, shortly after Katrina made landfall, the GISCorps issued a call for volunteers to assist in the recovery effort (figure 1). Founded in 2003, GISCorps, a subsidiary of the Urban and Regional Information Systems Association (URISA), provides short-term GIS support to underprivileged communities world-wide from professional GIS volunteers. In the weeks after the storm made landfall over 900 GIS professionals offered to serve. GISCorps volunteers were contacted suddenly, and didn't know exactly where they would be deployed or what to expect. In total the GISCorps sent 33 volunteers to work in the Jackson Emergency Operations Center and five southern Mississippi counties for the Katrina mission. Prior to their deployment GISCorps volunteers were informed they would be stationed at local county Emergency Operations Centers, provided housing, meals and shower facilities.

One requirement of GISCorps volunteers was for them to deploy within 24 hours. On September 11<sup>th</sup>, Shoreh Elhami, chairperson and GISCorps co-founder, contacted me to go to Mississippi. I arrived in Jackson, Mississippi the night of September 12<sup>th</sup> and met other GISCorps volunteers from across the country. Rich Minnis, Assistant Research Professor Mississippi State University Department of Wildlife and Fisheries, met us at the airport. He and others at Mississippi State played a major role in the response, recovery, and logistical support to GISCorps volunteers. Also arriving that night was Katy Carpenter, GIS Programmer Analyst, from the City of Fort Collins, Colorado. She would become my colleague in Wiggins, Mississippi for the first week of my two-week deployment. We were transported to a hotel in Jackson where we met John Goddard, GIS Analyst, from the City of Fayetteville, Ark. The three of us found ourselves roommates for the night.

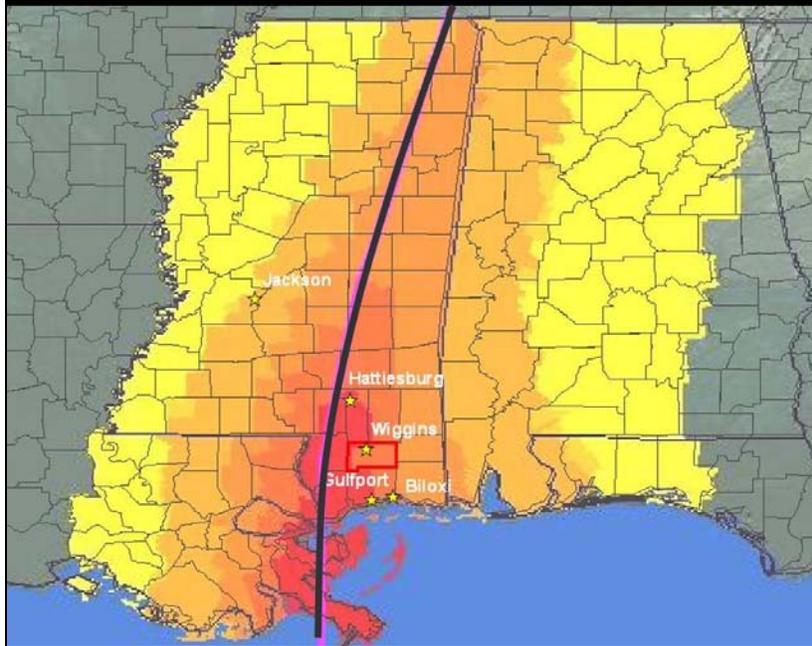


Figure 1. Path of Hurricane Katrina.

We arrived at the Jackson EOC the morning of the 13<sup>th</sup> and were briefed by Minnis. We learned our mission was to provide maps, analysis and data management for the Mississippi Emergency Management Agency (MEMA), Federal Emergency Management Agency (FEMA), and U.S. Army Corps of Engineers (COE) recovery teams. Moreover, our mission included support to local community leaders, and other agencies requiring our capabilities. To accomplish this mission our main objective was to carry out damage assessment operations. This included identifying and mapping roofs on which trees had fallen, and damaged roofs that needed a temporary Blue Roof. A Blue Roof is a temporary tarp installed by approved COE contractors designed to provide protection from the elements until the homeowner can make permanent repairs by a qualified professional (FEMA, 2006).

At the briefing Goddard volunteered for duty in Gautier located immediately west of Pascagoula on the coast. Carpenter and I volunteered to go to Stone County to relieve two Mississippi State graduate students. These students relieved the first team of GISCorps volunteers who had set up laptops, printers, and prepared initial maps. These earlier efforts allowed us to make maps and reports for recovery teams almost immediately upon our arrival. The coordination of GIS and GISCorps volunteers was a choreography designed moment by moment by many deeply dedicated people from GISCorps and Mississippi State. The success of the operation should be attributed to far more people than I will ever know. The morning of the 13<sup>th</sup> Carpenter, Goddard and I were transported south to Stone County via a Mississippi State van. The GIS professionals and graduate students who volunteered in Stone County and their time of service are shown in figure 2.

<b>GIS Team for Stone County, MS</b>						
<b>Volunteers</b>	<b>Organization</b>	<b>Arrived</b>		<b>Departed</b>		
<b>GISCorps - A</b>						
Twyla McDermott	City of Charlotte, NC	Wed	9/7	Sat	9/10	
Tom Chatfield	BLM, Northrop-Grumman	Wed	9/7	Sat	9/10	
Hanna Ford	Ark. Game & Fish Comm.	Thu	9/8	Mon	9/11	
Laura Horton	US Coast Guard, San Diego	Thu	9/8	Sat	9/10	
<b>Mississippi State Grad Students</b>						
John Gilreath	Mississippi State University	Sat	9/10	Tue	9/13	
Chitra Prabhu	Mississippi State University	Sat	9/10	Tue	9/13	
<b>GISCorps - B</b>						
Katy Carpenter	City of Ft. Collins, CO	Tue	9/13	Mon	9/19	
Lucia Barbato	Texas Tech University, TX	Tue	9/13	Sat	9/24	
<b>Mississippi State Extension</b>						
Louis Wasson	GeoResources Inst. Miss St.	Wed	9/21	Sat	9/24	

Figure 2. GIS and GISCorps volunteers in Stone County, Mississippi.

During the two-hour drive south from Jackson the storm damage became increasingly worse. In the vicinity of Hattiesburg, approximately two thirds of the way to our destination, we observed missing shingles, holes in roofs, twisted metal pieces, and three steel I-beams from a large sign bent like a hairpin. We also noticed stands of trees broken in half that had the appearance of tornado damage. Upon our arrival in Wiggins we observed many large trees, some 5 feet in diameter, downed from the storm. In previous hurricanes people from the coast would come to Wiggins to weather the storms. No one had expected the winds from Katrina to be so strong 35 miles from the coast.

As we approached the Wiggins train depot we saw that part of the roof had been blown off (figure 3). We learned that this was the site where the GISCorps was stationed. It would also be my home for the next two weeks.

Stone County, population just over 17,000, is located in the southern pine belt about thirty-five miles from Gulfport. The county seat of Wiggins has a population of around 4,000 and became the home of GISCorps volunteers over a period of three weeks. In coordination with the GISCorps, Mississippi State University faculty contacted counties in southern Mississippi immediately after the storm, asking where our services could be used. The Stone County Economic Development Office gratefully accepted the offer of assistance. There teams of GIS volunteers developed maps to help the community recover from Hurricane Katrina. In particular the damage assessment maps helped recovery teams locate over 700 homes that had trees on their roof and/or extreme roof damage.



Figure 3. This historic train depot in Wiggins, Mississippi served as the GISCorps operational facility.

Upon our arrival at the Wiggins Depot we met Mississippi State graduate students John Gilreath and Chitra Prabuhu. They were continuing the efforts from the first GISCorps team deployed a week earlier. We had four hours to exchange information, and then it was our turn. Although Internet and telephone service was spotty, we received an e-mail from Elhami the afternoon of the September 13<sup>th</sup> stating “I think by now you are either in Jackson or will get there in a few hours and I hope that you had an uneventful trip”. She asked us to notify her as soon as we found out where we would be sent. Elhami was surprised to learn that our location was not at the county EOC as anticipated.

The recovery effort after a disaster is especially difficult in rural counties. In Stone County trees blocked many roads and fell on thousands of homes. Landmarks and street signs were destroyed. Residents were dispersed throughout the county, which in some cases made them difficult to reach. Recovery crews arrived from all over the United States, and weren’t familiar with the rural road network. It became a priority to generate maps to help these responders locate people so they could provide assistance and help them rebuild. The first week after landfall Navy SeaBees teams had completed their work of clearing roads of fallen trees and repairing the schools. They, too, needed maps to show progress and where their efforts were still needed.

The situation in Stone County was unlike the impressive Emergency Operations Center (EOC) and facilities in Jackson. Stone County’s EOC was a medium-sized trailer periodically occupied by county emergency personnel with limited equipment (figure 4). The EOC was located 5 blocks from the Depot and placed in the parking lot of the County Emergency Communication building where a modest 911 office was located. In

either facility there was no room to support additional GISCorps functions, no meals, and no shower facilities. So we would remain at the Depot and maintain coordination as best as possible.



Figure 4. Stone County Emergency Operations Center.

Prior to Katrina the Wiggins Depot housed the county Chamber of Commerce and Economic Development office where Mr. Russell Hatten, Director of Economic Development, and his assistant worked. They graciously shared their facility with GISCorps volunteers. One of Hatten’s responsibilities after Katrina was to coordinate volunteers who arrived from all over the country. He would greet them with a warm ‘welcome to Mississippi’. Hatten permitted the GISCorps and others to use their office supplies and provided access to their copier. By the end of our stay their supplies were depleted.

Not having the benefit of crossing paths with the first GISCorps team, Carpenter and I began by organizing papers into separate piles of maps, documentation, and contact information. Next we reviewed the available documentation on the two laptops provided by Mississippi State. We acquainted ourselves with the directory structure, available data, and began examining map documents. An HP800 42 inch plotter was precariously placed on a mismatched stand. Taped to it was a hand-written sign stating “Please do not move plotter it is not secured onto its stand and will fall off”. Only one laptop had a cable connecting it to the plotter. After locating some USB extension cables, I daisy chained them from my laptop where they just made it to the printer. Unfortunately the USB cables crossed in front of the rear exit door about 6 inches off the floor. This configuration necessitated attaching yellow sticky notes to the cable to warn people of the



deployment. I made modifications to the database to incorporate requests from Breland to support the Gatekeeper program. We received stacks of Gatekeeper forms on a daily basis. We carefully entered the information from each form into the ACCESS database. From this database I developed daily reports of tree and roof damage. Hatten used the reports on a daily basis to assign volunteer crews to addresses requiring removal of trees and debris.

Figure 6. Gatekeeper form in MS Access with address information for geocoding (name modified for privacy.)

The process of generating accurate damage assessment maps from the Gatekeeper data would not have been possible without the 911 streets feature class from the Wiggins Emergency Communications office. This feature class was acquired by the first GISCorps team. The 911 system in Stone County was excellent. The 911 street data was the result of Homeland Security funding that the county had secured the year before. The funding was used to purchase an ESRI third-party 911 solution. The system had been in place only three months prior to Katrina. We considered ourselves fortunate to have this data to facilitate address geocoding of the street addresses from the Gatekeeper forms. Initially we thought it would be a fairly simple process to update the database with Gatekeeper data as it arrived, and then perform the geocoding. However, the geocoding process for Stone County streets was not straightforward. Many street names on the Gatekeeper forms did not match the street names in the feature class. An address on “Rogers Lake Road” was actually “Poplar Drive” in the 911 database. One street address written as “All Will Road” was actually “Oil Well Road”. We relied on the economic

development staff, and a local map that was distributed by the Chamber of Commerce to help us identify alternate street names.

In the evening Breland drove us to the county courthouse for the nightly Katrina town meeting. Assembled at our first meeting were 24 people representing various organizations reporting the status of their operations to the county commissioners. The Pearl River Valley Electric Company reported the status power as it was restored to the community. Power had been restored to about half of the county residents and the situation was improving daily. But the remaining half had no ability to cook nor had hot water. There was little that could be done where houses were destroyed or where power lines were disconnected or ripped from the homes. The Navy SeaBees construction crews reported the status of repairs at school facilities and showed a GIS map of roads they had cleared. Local volunteers reported the status and location of ice, water, and food distribution sites. Ice and water remained necessities as the 'boil water' notice would not be lifted for several days. The local volunteer fire department discussed the severe need for tarps for roofs. The County Homeland Security Officer, Raven James also gave a report. The county commissioners discussed the need for temporary housing units. Everything that was rentable in Stone County was occupied, and many residents were in homes that were unsuitable for living. Representatives from local churches reported on the ever-present need for fresh volunteers. Red Cross workers also brought a GIS map of their activities made by GISCorps volunteers. The county public health nurse and coordinator, Mary Ann Cunningham, reported on deliveries of medical supplies and the tetanus and hepatitis A inoculations she gave to hundreds of people every day at various locations. Breland reported on the status of the Gatekeeper project and the coordination with rural postal workers. Finally Carpenter and I had an opportunity to announce the continued presence of the GISCorps and GIS support for Stone County. We stated our availability to develop maps as needed, and that we were awaiting post-hurricane imagery (that never came) to help with planning sites for temporary housing.

After one of the nightly town meetings Breland offered us showers. It was a trade-off between shower and dinner. We went for the showers. During our stay we got to know Breland a little better. Breland is an intrepid 67-yr-old with abounding energy and generosity. One evening when she picked us up at the Depot she had toxic muck on her clothes and was disheveled. She had been to the coast to her mother's house in Gulfport. The storm had filled it with 4 feet of water that had since drained. She recovered what she could before coming to get us. Besides handling the 'Blue Roof / Gatekeeper Project', she was caretaker for her 84-year-old mother (formerly from Gulfport) and 2-1/2-yr old niece all living in her 'Big Farm House'. It was a 100-yr old farm house that sustained significant damage with large trees fallen around it. We were given clean towels and again wonderful southern hospitality.

Over the course of the next two days we worked on several maps. One involved finalizing a "Navy SeaBees Disaster Relief Status" map for Lt. Bailey and Major Hendrick. This map identified the roads they had cleared of trees and debris, cleanup and reconstruction progress at the local schools, and the location of the volunteer fire departments needing rolling doors for all their garages. I made a report of street address ranges for the SeaBees to check off when they were cleared. Katy obtained data from the

Internet and produced a wildfire map. This was of interest to the community with so much downed and drying wood. The damage to timber and trees in Mississippi was estimated at \$2.4B (Mississippi Forestry Commission, 2005)

In general the workload during the first days was not nearly as great as expected. I found myself performing outreach and began marketing our capabilities to appropriate persons. We knew people needed maps and reports, but they either didn't know we were at the Depot or didn't have the time to come to the Depot and request a map. Our presence was not as widely known as I had originally imagined it would be. One concern was offering maps to rogue contractors who might take advantage of local residents with roofing scams. So ascertaining intentions was important prior to offering maps. During lunch at a local restaurant I introduced myself to a Fire Department Battalion Chief from the City of Fairfax, VA. He was one of the few people we met who knew about GIS. He was pleased to learn of the GISCorps presence and he requested maps of Harrison County. Minnis gave the ok to provide mapping support for Harrison County. Being closer to the eye of Katrina, the situation was reported to be worse than in Stone County. It turned out that Minnis had been trying to make contact with someone there. We were fortunate to have that chance meeting. As with most major disaster situations the best opportunities to meet and coordinate with people from other agencies was during meal times at local restaurants that had re-opened or at church facilities. Two favorite lunch meeting places were the Whistle Stop Café where they served fried green tomatoes and Serendipity for their monster Po Boys.

At dinner at the Vardaman Street Baptist Church the evening of the 15<sup>th</sup> I met Jan Leader from a COE office in Portland, Oregon. She was manning a Blue Roof registration site at the county library (figure 7). We learned that the blue tarps we saw all over town were not official COE Blue Roofs. There was much confusion among homeowners who thought they had a Blue Roof when all they had was a Home Depot tarp of the same color. The Navy SeaBees installed what I thought was a Blue Roof at the Depot, when it was actually a tarp. We took the opportunity to discuss coordination opportunities with the COE.

Leader explained that before a resident could receive a Blue Roof that they were required to fill out and sign a Right of Entry (ROE) release form and have a COE Quality Assurance (QA) representative could inspect their house. The ROE form would allow a contractor to perform the work at their residence. The forms had the names and addresses of residents who applied for Blue Roofs. We knew it would be advantageous to coordinate the Gatekeeper records with a ROE database. If we had access to the ROE data, then we could use GIS to reconcile which residents had submitted Gatekeeper cards and still need to apply for Blue Roof and reduce the confusion.

I obtained the names and number of COE facility in Hattiesburg where Jan's supervisor, Pam Reed worked. The goal now was to coordinate a way we could share our data. After numerous calls to I was able to talk briefly to Reed and described our GIS capabilities and data we had in Stone County. She was extremely busy and I could only hope the message got through.



Figure 7. Corps of Engineers Blue Roof program facility at library with fallen tree on roof.

We continued working on the Gatekeeper project and provided daily morning reports to Hatten. I used Maplex to tidy up a map book series that had been set up by Twyla McDermott, City of Charlotte, NC, from the first GISCorps deployment. Maplex performed extremely well in this application and significantly improved the road labels to display them more clearly and avoid over-posting. Both Maplex and the map book developer sample turned out to be profoundly useful tools in the field. Learning Maplex was simple ... just press a lot of buttons.

One afternoon we had the opportunity to view the damage in some of the more rural parts of the county first hand. The number of damaged trees was considerable as was the strong scent of pine. Our driver commented that the pine scent was extremely strong during the storm as trees snapped in half all over the county. We noticed several nice houses with tents pitched outside. Although the outside of the homes and the roofs appeared fine, the ceilings inside had sustained water damage from leaky shingles which were not readily seen from a helicopter flyover.

At the town meeting that evening we presented a Damage Assessment map from the geocoded Gatekeeper data. Breland had been trying to explain what was going on with the GISCorps, but the city and county supervisors needed to see the damage assessment map to understand what we could do. We were asked to provide seven copies additional copies. The supervisor for District 4, Mr. Wendell Patton, asked us if we had ever heard of a T-1 line. He was very proud that Stone County would be getting one later that year.

After the meeting we returned to the Depot for the evening. It was unnerving to be alone in the Depot at night. We were reminded of the constant comings and goings during the

day of contractors, the trustees from the prison in their green and white striped uniforms who mowed the grass around the Depot, and later an obvious drug deal in the rear parking lot. While we occupied the north half of the Depot, the southern half was vacant. It had approximately 2,000 square feet, several long tables, and except for the holes in the roof, would make an excellent planning or operations facility..

By Saturday afternoon of September 17<sup>th</sup> we had yet to encounter anyone from FEMA and a Disaster Recover Center (DRC) had not yet been established in Stone County. The Navy SeaBees completed their construction and debris removal mission and left Stone County. Our interaction with the Red Cross was limited to the town meetings. There was also a noticeable strain in the relations between the Red Cross and community leaders. The Red Cross would soon downsize and remove their operations from Stone County. Other than Leader who took Blue Roof applications in the library, we saw no other COE presence. We observed that the major burden of the recovery operations was in the hands of community leaders and the County EOC Coordinator. The principal work continued to involve clearing trees from houses, and keeping volunteer fire stations supplied with ice and water. Many people remained without power in the more rural parts of the county, and sustained significant damage to their roofs. County officials described the rural residents as ‘strong country people who think they must take care of things themselves and aren’t aware of the available support or programs’ (Hatten, 2005)

We continued our geocoding efforts and become more comfortable learning the various aliases for streets names. Many of the street names did not appear on any map or in the 911 database. Fortunately we developed a good working relationship with Susan, the 911 Specialist at the Communications Center, who assisted us with street names. We continued to spend many hours geocoding on a daily basis. Carpenter set up composite geocoding services which improved our performance and number of matches.

The calls I made to the COE in Hattiesburg several days earlier finally paid off. On Saturday afternoon Steve Dierker from the St. Louis COE burst into the Depot and announced “I heard GIS was here. Will you help organize us?” He had heard through channels in Hattiesburg that there were some GIS people in Stone County and was sent down to find us. He would be the leader for a Blue Roof operations team who would perform the ROE inspections for the Blue Roof program. His team was comprised of staff from COE and Bureau of Land Management (BLM) offices from around the country. We invited him to set up their operations in the Depot (figure 8).

We took the opportunity to discuss sharing the ROE data with Dierker. He was willing to share the ROE information, but only if some type of Memorandum of Agreement was established. Otherwise he was concerned about possibly “going to jail” if he did. We explained that we already had the names and addresses of the residents, and what we needed from the ROE form was whether or not the resident had applied for the Blue Roof. We would simply check a box in our database to make that indication. But the ROEs contained the cost information to pay contractors and they were deemed too sensitive for non-authorized persons to access.



Figure 8. Carpenter with COE Blue Roof team.

Due to the confidential nature of their data we could only stand by and watch as the ROE forms were collected each day and sent to Hattiesburg to be entered in a separate database. Despite calls to Hattiesburg and the obvious benefit to the community, the efforts to coordinate the local Gatekeeper information with the COE ROE forms would never come to fruition. Coordinating a Memorandum of Agreement would take too long so we were resigned to watching the COE collect the information right in front of us and send it to Hattiesburg.

At one point, however, Carpenter was able to work out a method where she was allowed to go through each ROE form and compare it to a street map with a reference grid that she created (figure 9). Carpenter hand wrote the grid reference number in the upper corner of each ROE form and then sorted them by grid. This mental GIS method allowed her to organized the unruly piles of ROE forms and present them to Dierker. This was deemed appropriate as long as we didn't collect any information from the forms.

With the newly organized ROE forms, COE team members were able to inspect a significantly larger number of homes each day. They no longer had to drive all over the county trying to locate addresses from the previously unorganized piles of ROE forms they were handed each morning. In the remaining time that the GISCorps was at the Depot, we continued to support the COE by looking up addresses on the ROE forms that they had difficulty locating. We also provided maps to help them navigate the long country roads to find houses to inspect. When the COE learned that they would be expanding operations into Forrest County to the north, I made a map of the southern part

of the county they requested. Unfortunately due to the ROE regulations, our efforts could not be reciprocated.

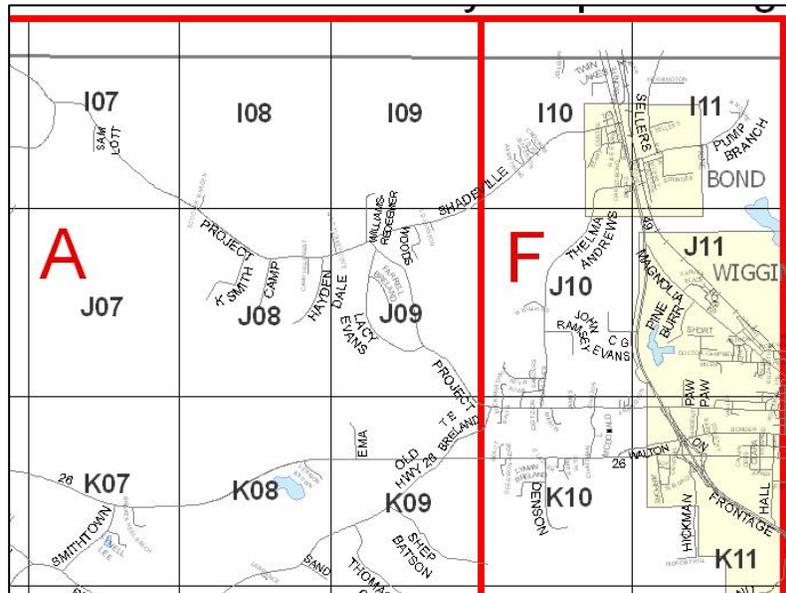


Figure 9. Section of a grid reference map for COE.

The day Dierker arrived at the Depot we suggested he go to the EOC to check in. Carpenter and I accompanied him. At the EOC we met Hector Mendez and Gary Bernard with FEMA shirts. It was our first encounter with FEMA personnel, but we were not to see these individuals again. Breland was in the parking lot with her farm truck talking with FEMA. This was the first time that FEMA, COE, a community leader and GISCorps were together (figure 10). I told FEMA about the Depot and the large vacant space and invited them to view our mapping operations.

Shortly after returning to the Depot a group of FEMA staff arrived. They inspected the vacant east side of the building which now had a Navy SeaBees tarp and was adequately protected from leaves and rain. As more FEMA personnel started arriving we learned they were a tight-knit team of firefighters from Chesapeake, Virginia. All of a sudden we weren't alone anymore. The leader for the FEMA Community Relations (CR) team was Brian Howard. They were a self-reliant team with a planning and operations mission. This was unlike the COE operations team, who took direction from management in Hattiesburg.

When Breland arrived, we had a meeting with FEMA to discuss their mission. Howard announced that they would be ready to begin their community relations effort and start door-to-door visits the next morning. Breland immediately explained that FEMA would not find anyone at home Sunday morning because everyone would be at church. Carpenter and I immediately began compiling a Stone County church database from the

local phone book and from newspapers we found in the Depot. Stone County is a strong faith-based community and we had 70 entries of churches by that evening. When we asked Breland about the number of churches, she explained that every time someone got into a disagreement, they would start a new church. That explained the large number of churches. We geocoded the church addresses and produced 8 ½ x 11 maps and an associated list of churches with addresses that FEMA could use to organize their effort.



Figure 10. First meeting in Stone County with FEMA, Breland, COE and GISCorps by the EOC.

On Sunday Morning our church maps were ready for FEMA. FEMA used the maps to visit the churches within the Wiggins city limits while services took place (figure 11). FEMA announced to the congregations the location of a FEMA registration center, where residents could sign up for the Blue Roof program, and provided information about temporary housing. In this application, GIS helped FEMA to make a positive impact on the community. It also formed the basis of a great working relationship between GISCorps and FEMA. Lt. Barbara Greene of FEMA wrote a note on the back of one of the map request forms stating how helpful the church maps were, because they had helped them visit 19 of the in-town churches during services (Greene, pers. comm. 2005).

Although the situation in Wiggins was improving daily, the County lacked a Disaster Response Center (DRC) and there was not the remotest possibility of establishing an integrated command post (ICP). An ICP is a facility where leaders from each organization have authority to make decisions. In a command structure, planning as well as logistics is required for coordination among agencies. At the Depot the FEMA team conducted planning efforts, while the Corps team performed operational tasks. The Corps received their instructions from Hattiesburg where someone else performed the major planning and directed them to what areas they would go to inspect.

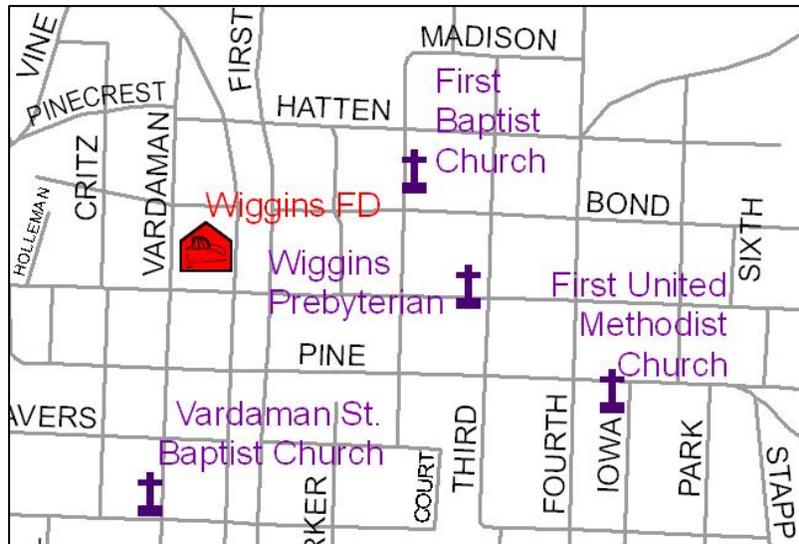


Figure 11. Church map for FEMA Community Relations.

In Stone County community leaders, rather than Federal representatives, were principally in charge. They coordinated with the Federal agencies to the best extent possible as they arrived. In the chaos after Katrina community leaders did an outstanding job of supporting their community. Although most of the efforts at the Depot were not pre-planned, operations at the Depot and in Stone County were overall successful. Unlike the coordinated activities in Jackson where large numbers of people had to be managed within a strong incident command structure, the politics in this rural community appeared minimal. Community leaders fully supported the coordination that occurred among various organizations as a result of coincidental meetings. Information flowed between groups at the nightly town meetings. It would be a week after my departure before a DRC would be established in Stone County.

With the COE and FEMA at the Depot (figure 12), our GISCorps services were finally being used to their full potential. With the return of the COE on Monday morning, we facilitated a meeting to discuss coordination of ROE forms and the FEMA CR mission. We knew if FEMA had access to both the Gatekeeper and ROE information, they could inform those who still needed to fill out an ROE form. In subsequent FEMA tours of Stone County, many residents repeatedly told the FEMA team that they had applied for a Blue Roof (via the Gatekeeper form), when in fact they did not.

If the GISCorps had access to both data sets, we could reconcile which residents actually filled out an ROE. During their CR effort FEMA team members repeatedly commented on being bogged down going house to house trying to find out and explain to people the difference between the blue roof program and the Gatekeeper forms. They had been in the Magnolia and Silver Run volunteer fire district areas for three days, when they knew they could have started visiting residents in the McHenry and Wiggins districts.

For the FEMA CR team we produced a map book organized by volunteer fire district. Stone County was organized into eight volunteer fire districts. These districts were established in recent years to serve the eight main geographies of the county. We made an E sized plot of the county showing current damage assessment information from the Gatekeeper forms with roads and fire districts. It was gratifying to see the COE and FEMA Captain use the maps to organize their teams. They would continue to collect damage information during their daily tours which we would ultimately incorporate into our geodatabase.



Figure 12. FEMA planning meeting on east side of Depot.

Monday morning the Economic Development staff of Mr. Hatten and his secretary, Linda, found their once quiet office commandeered by half a dozen FEMA personnel, a crew of COE QA inspectors, and of course the GISCorps. We continued providing the daily trees on roofs reports. We also provided a report of addresses with damaged roofs to the County Homeland Security Officer, Raven James. The report assisted him in a meeting with contractors who would perform the debris removal.

Over the course of a week Carpenter's support to the COE significantly improved their efficiency. Her expertise was appreciated by Stone County and she was missed after her departure.

While Carpenter principally supported the COE, my efforts were spent mainly supporting the FEMA CR mission, and continue updating the trees-on-roof reports. The FEMA CR mission involved visiting each residence in the county at least once. At first FEMA wasn't sure how GIS could assist them. Initially FEMA crews returned from their daily tours with pieces of paper or with note pads with lists of addresses and damage status. I noticed Captain Dan compiling the papers from the crew and comparing the addresses to a set of our printed map books. He was searching through the 167 maps to locate an address. Once he found it he used a pencil to mark the address on the map. A short

conversation later and we were designing a system where the FEMA reports could be integrated with the Gatekeeper database. To facilitate this, a report with all addresses by volunteer fire district and associated maps were required. The reports had to include all addresses, not just the addresses with reported damage. FEMA also needed a grid reference number associated with each address as did the COE.

To make this map and report a reality the Gatekeeper damage data from the ACCESS database needed to be merged with the 911 address feature class. The idea here was to consolidate all the data into one geodatabase including the trees on roof data, the Gatekeeper data, and all of the 911 addresses in the county. Then when FEMA visited a house, they would know if any damage had been previously reported, if a tree had been cleared, if driveways were accessible, or if the resident requested a Blue Roof. FEMA also required two additional attributes to assess the damage and livability of a home. These included 1) if the roof had less than 50% damage or 2) greater than 50% damage. Homes with less than 50% damage were eligible for a Blue Roof, while residents with more significant damage would be directed toward temporary housing. These attributes were in addition to the four previously developed for the Gatekeeper damage assessment. These included 'owner requested a Blue roof', 'tree on roof', and 'major debris in yard'. The roof cleared attribute would be added later.

I worked with Captain Dan to design a form that would allow us entry of information from the field crews into the database. It would also serve as a means to search for addresses. Space was included for a name if they talked to a resident. Blank pieces of paper would be attached to the final reports so FEMA crews could write in any "addresses" that weren't currently in the 911 database. Until the reports were completed, however, FEMA crews continued to write each address with accompanying damage information on various pieces of paper and reporting data somewhat inconsistently.

To generate this report for FEMA required using the 7,800 geocoded addresses stored in the 911 feature class for the entire county. Knowing my limitations with ACCESS it was a better decision to develop a form to re-enter the Gatekeeper records as the geodatabase attributes. Next a grid index from the ESRI Map Book Developer Sample was added to the damage assessment map. To assign the grid reference number to each address, a spatial join between the address feature class and the grid feature class was performed. I also learned that FEMA preferred UTM coordinates which was no problem. Finally a report of all address with the grid reference number could be created (figure 13a and 13b). FEMA could then use this report to update the status of each residence for their final community relations inspections.

The plan now was to print the address reports by fire district. This was accomplished with a few queries. FEMA could then use the reports to locate each address for their door-to-door community relations outreach. While the method appeared straight-forward the actual effort took several days to accomplish. This was mainly due to address issues. Susan at the 911 communications center assisted me with the addresses that would not geocode. She verified that the 911 database did not have entries for all the residents in the county. So we agreed that if FEMA brought in an address that wasn't in the

database, that I would add it in ArcMap. That way the record would be available for updating damage assessment attributes. We noticed that most of the addresses that were added were for people requesting special assistance.

STONE COUNTY ADDRESSES - DAMAGE STATUS					Tree	Major	<50%	Ext	Roof	Assn	ROE	Need	Comments
GRID	ADDR	Town	First	Last	Need on Roof	Roof Debris	Dam	Dam	Clear	Crew		Help	
M14	649 CITY BRIDGE RD	WIGGINS			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vacant
M14	697 CITY BRIDGE RD	WIGGINS			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	destroyed living on porch
L15	1275 CITY BRIDGE RD	WIGGINS			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
M14	662 CITY BRIDGE RD	WIGGINS			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
M14	649 CITY BRIDGE RD	WIGGINS			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	649A - Living in tent

<i>Magnolia VFD</i>												<i>For FEMA CR Team</i>		
<i>Addresses and Damage Assessment</i>												<i>By GISCorps</i>		
												<i>9/24/2005</i>		
GRID	Address	Name	Req on Roof	Tree on Roof	Debris in Yard	Assgn to Crew	Roof Cleared	Roof Dam <=50	Ext Damage	Appl ROE	Need Assist	Comments		
I15	151 CLEAR CREEK R		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	destroyed living on porch		
I16	152 CLEAR CREEK R		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	84 woman, diabetic, heart trouble, hip surgery		
I16	162 CLEAR CREEK R		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	tree on car, log in rafters		
I15	2 TYNER BRANCH RD		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vacant - 4 dogs need food		
I16	230 CLEAR CREEK R		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vacant - trailer next door destroyed		
I16	233 CLEAR CREEK R		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	trailer next door destroyed		
I16	270 CLEAR CREEK R		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	total loss, severe, not livable		

Figure 13. Damage Assessment form and report developed in ACCESS.

Also a new 167 page-report organized by fire district was needed as well as a current map book. We lacked a fast black and white printer and the previous report took over 3 hours to print as did the map book. I wound up borrowing the printer from the Homeland Security Officers desk. My last day at the Depot I left a note on the printer, and hoped the printer would be returned.

Once the feature class, forms and reports were completed they became an invaluable asset to both COE and FEMA to facilitate their missions. They also aided in searches for addresses they had difficulty locating. The large format damage assessment reference map showing the status of their planning operations was also an important asset (figure 14).

The 911 system in Stone County was excellent. They received a homeland security grant the year before and their 911 CAD system was in place for about three months. One issue that remained with the 911 database however, was that many people in the county did not have assigned addresses. In many cases there were multiple trailers on a parcel with only one mail box. This created problems for agencies when distributing funds and providing support. One afternoon FEMA team members Mike and Justin reported two

trailers in ditches where people were living. These trailers did not have an assigned address. The roofs were blown off and there were no windows. This was the condition of these trailers before the storm. He also found four different families living at this one address. Only one person per address, however, is entitled to FEMA assistance. The residents told Mike that they had never seen any law enforcement in that part of the county before and were surprised to see him. They lost all their perishable food while the power was out the past three weeks. When Mike told them about food stamp assistance, they told him that he could give it to people who were in more in need. Mike and Justin tried to convince them that they were indeed needy. The FEMA team said they were some of the poorest of the poor he had ever seen, but they were very proud people and as with most rural residents they strove for self-sufficiency.

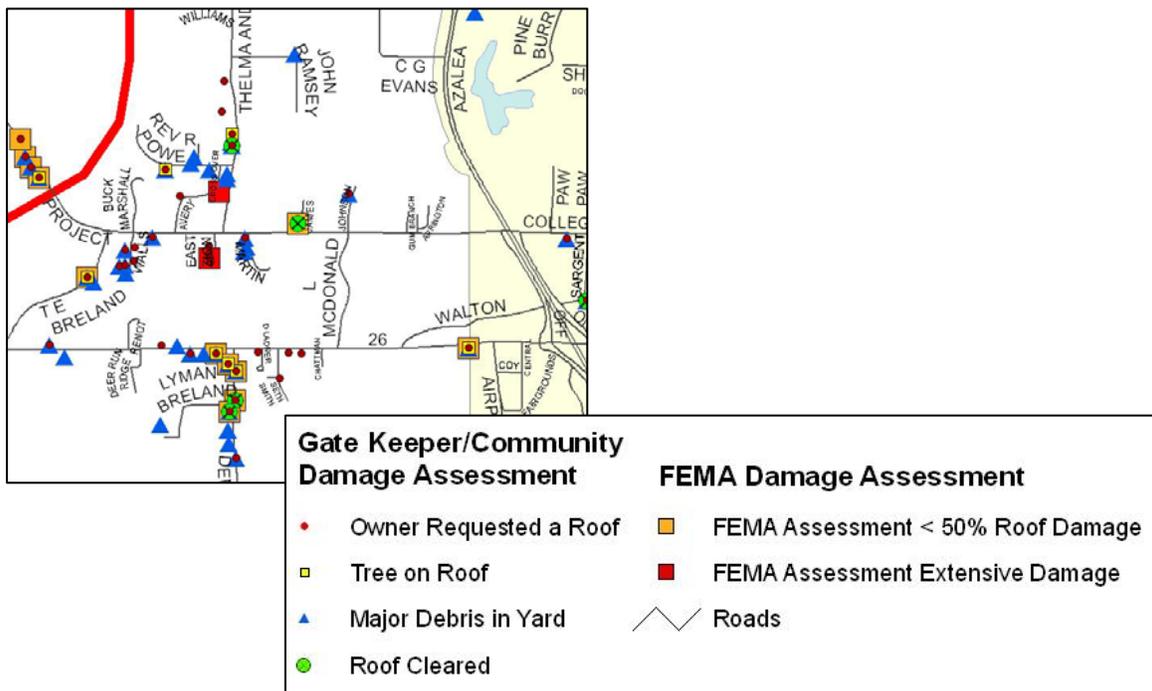


Figure 14. Section of the integrated FEMA Damage Assessment map.

When I asked Team Leader Howard his opinion of what percent of the residents were really qualified for assistance. He replied “all of them”. Everyone agreed there was a need to develop a way to embed GISCorps or GIS into future recovery efforts. It was hoped that officials would understand the value of incorporating GIS at the operational level by having GIS in plans before a disaster occurs. The presence of GIS in Stone County definitely increased the awareness of the potential of this technology. Discussions with James, Homeland Security Officer, made it clear that he understood the value of having geospatial technology as an active part of their local response plan.

The last three days at the Depot I was privileged to have the company of Louis Wasson, GeoResources Institute at Mississippi State, whose help made it possible for us to

complete the FEMA maps and reports. Wasson continued the mapping support for the COE as was an invaluable asset to the mapping and reporting efforts.

A few days before I was due to leave, Elhami issued a call to GISCorps volunteers asking if they could stay a few days longer. I made arrangements to extend my stay two more days. Hurricane Rita was brewing in the gulf, and the storm would ultimately delay my departure an additional day with the closing of the Houston airport.

In the remaining days the last of the Gatekeeper Referral Forms were entered. More and more the reports began coming in with "roof cleared" checked. I provided the final tree on roof report to Hatten. It was a major milestone to have the roof cleared designation included on the forms and to see that a number of roofs had been cleared. We entered 100 more FEMA reports from the residences they had visited. Louis printed eleven Forrest County driving maps (C sized plots) for COE personnel to assist with their remaining ROE inspections. These maps with the grid sectors helped the COE inspectors compare their ROE forms to the grid IDs and assign the ROE forms for inspection. The maps also assisted them in navigating this new county.

I noticed Hatten working on a project for the past several days. He was trying to locate sites for temporary housing trailers. He was coordinating with a representative from a timber company who offered to remove the wood for free in areas Hatten would designate for trailers. To assist in this effort the best we could do was to print a pre-Katrina NAIP image with roads, fire districts and county boundary. There was a lot of hype about post-storm imagery for the coastal areas, but being one county inland excluded Stone County from the benefit.

During our tenure at the Depot we fulfilled many other miscellaneous requests that ranged from making door signs to printing contact phone lists for FEMA. But it was the final set of map books with the accompanying address report that had the most profound positive impact on the FEMA mission.

Hurricane Rita arrived the last days at the Depot. Fortunately there were no leaks over the GISCorps computers, however, the roof over the FEMA planning area was leaking, and the plaster on the planning wall became wet causing the maps to deteriorate (figure 15).

At our last town meeting we learned that power had been restored to most of the county and FEMA had begun to deliver temporary trailers for shelters. James stated that the situation in Stone County had improved greatly and that the town meetings would be held weekly instead of every evening. James reported approximately 1,000 applications for Blue Roofs were taken in Stone County and about 800 were for Stone County residents. As Rita continued to rain on Stone County, tarps once again were in very short supply. Because GISCorps volunteers were living in the Depot, that qualified us as a residence and I previously filled out an ROE form for the Depot. The morning of our departure from Wiggins, contractors were attempting to install a Blue Roof, but the winds from Rita made it very difficult.



Figure 15. FEMA planning wall and pans to catch leaks from Hurricane Rita.

Captain Dan and I entered the last of the updates from the FEMA tours. Once the geocoding was finished, I printed the final damage assessment map for Stone County and hung it on the planning wall. Prior to our departure Wasson and I cleaned up our stations and swept up piles of ever present love bugs. Some FEMA team member asked us to locate a few last addresses with our “GSI”. The FEMA team would remain in Stone County for another month and they let us know how much we would be missed. Wasson and I finished by making a set of road maps for each volunteer fire district. I made a copy of the 911 geodatabase for Susan at the Emergency Communications Office. We packed up the laptops and gear, left some notes and the final maps for Stone County.

## Summary

During the time the GISCorps spent in Stone County, over 500 maps were produced, many databases developed, and hundreds of pages of reports generated. These products supported the missions of several organizations. The functionality most often required by the community leaders, FEMA and COE was fairly basic and involved mainly geocoding, map visualization and report generation. Familiarity with both ArcGIS and MS ACCESS was imperative. Both Maplex and the Map Book Developer sample were vital to the success of our operation.

Although GISCorps activities were slow at first, being present in the community gave us the opportunity to familiarize ourselves with the data, learn the needs of the community, and establish relationships. This also gave us the advantage of being well prepared for the subsequent arrival of the COE and FMEA. It was evident that GIS had a positive

impact on the rural community of Stone County. The damage assessment maps and reports facilitated multiple visits by the FEMA CR team doubling their original goal. A message I received from Howard stated “your help increased our mission effectiveness more than you know” (Howard, e-mail comm., 2005). Even though politics prevented coordinating Gatekeeper data with the COE ROE information, the COE benefited greatly from the planning maps which increased the efficiency of the COE QA inspections. The tree damage reports allowed community leaders to coordinate volunteers to remove trees and debris from residential roofs.

It was the coordination efforts of Elhami to get GISCorps volunteers in place that allowed GIS to make a significant impact in the Hurricane Katrina Relief effort. The Mississippi State faculty, staff and students were responsible for the logistical support to the GISCorps. Their contributions of time, hardware, data and people for the relief effort cannot be overemphasized. The level of expertise and cooperation among the agencies in Stone County was outstanding in this rural community. It was a privilege working with the community who worked tirelessly to help themselves. Although Stone County would have been fine without us, overall GIS had a profoundly positive impact on the community.

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