GIS in the Emergency Operations Center

SANDY SPRINGS, GEORGIA

Application to the URISA Exemplary Systems in Government award (ESIG), a Single Process System.
A. GIS in Emergency Operations Center

A1. Name of System and Category

_Name_
GIS in the Emergency Operations Center (EOC) for Sandy Springs, Georgia.

_Category_
Single Process System
A2. Letter from Executive Administrator

The letter supporting this application is provided by Jonathan Crowe, Director of Information Technology for Sandy Springs, Georgia.

May 23rd, 2017

Dear Sir/Madame,

On behalf of the GIS Services Division of the Information Technology department at the City of Sandy Springs, I am pleased to support the submission of GIS for Emergency Management for the URISA ESIG Award in the Single Process Systems category.

In early 2017, Sandy Springs experienced a winter ice event prompting the activation of our Emergency Operations Center. A central GIS live map enhanced situation awareness by displaying field-collected road temperatures, GPS locations of fleet vehicles, and mapped incidents as reported through the E911 center and field crews. This Common Operating Picture (COP) improved management and responsiveness throughout the event utilizing two GIS staff members working 12-hour shifts. Data layers provide historical records for reporting and potential FEMA reimbursement. Sandy Springs additionally leveraged the system for consecutive storm events to monitor downed trees and power line incidents.

Situational awareness during an emergency of any kind is invaluable and the enhancements provided by GIS for Emergency Management allows the city to better focus on priorities including public safety and incident remediation in such a critical time.

Thank you for considering the City of Sandy Springs for the URISA ESIG award.

Jonathan Crowe
Director of Information Technology
City of Sandy Springs
A3. Summary

The Emergency Operations Center (EOC) is the primary hub of planning, deployment response, and information management during an emergency event. In late 2016 through early 2017, the City of Sandy Springs developed an agile mapping system for tracking real-time data during storm events. The GIS map hosted through ArcGIS Online was a centrally managed communication tool to facilitate dispatch of snow and salt operations and field crews to clear incidents such as fallen trees.

In past winter events, road temperatures were monitored by handheld devices and reported hourly to the EOC through email, calls, and text messages. The GIS team saw an opportunity to improve field collection services and reduce email chatter. During an emergency planning session, GIS offered to create a mobile application using Esri ArcGIS software for this specific task. This initiative was a targeted task-based approach to bringing real-time GIS to emergency operations. Focusing the application on specific tasks allowed staff to develop solutions with needs, users, and roles already identified. The project quickly proved successful and was expanded in functionality and deployment.

Key components of the system include a central web map displaying real-time field data collection, accurate reference layers, and mobile access to the same map for all parties. The map allows user input of data such as road temperatures and active incidents including uploading of photos, updating statuses, and adding notes. After the event, data can be exported for reporting to other agencies and clean-up efforts.

User accounts and software are provided through an Esri Enterprise License Agreement. Primary hardware consists of the EOC infrastructure such as large monitor displays, public safety radios, data hosting on ArcGIS Online, field hardware and temperature gauges, and mobile devices for field collection. The GIS Team worked closely with Information Technology to federate ArcGIS Online user accounts with Windows Active Directory to maintain a single-sign-on experience.

Using a centrally managed GIS map increased efficiencies, reduced redundancy, and helped provide a clear picture of current conditions. Using a Common Operating Picture, managers, field and administrative staff were all able to quickly understand the same status of operations. Briefings and shift changes were easily facilitated by walking through the various incident locations placed on the map. The GIS map with mobile data access is currently deployed during any EOC activation or used by Field Services when three or more trees have fallen in a storm event.

Although multiple departments use this tool, it is submitted as a Single Process system because the GIS map and data collection are used during singular events to facilitate a specific process, the activation of the EOC and emergency response management. Full-time GIS and IT services for the City are provided by InterDev, LCC, a managed IT and security company.
A4. User Testimonials

User testimonials have been provided by departments impacted by this system. This includes Public Works managers and administrative staff, Field Services workers who used the mobile applications during the event, and the Fire department coordinating the Emergency Operations Center. Additionally, a public highlight published on the city’s Facebook page by the Communications department is also included.

1. Donald Kahn, Field Services Manager
2. Cheryl Oslund, Administrative Coordinator for Field Services
3. David Johnson, Field Services Superintendent
4. Craig Miceli, Administrative Affairs Officer for Fire Department
5. City of Sandy Springs Facebook page highlighting the GIS EOC map.
May 31, 2017

Dear Sir/Madame,

I am writing you on behalf of the City of Sandy Springs GIS Division of the Information Technology department’s submission of GIS for Emergency Management for the URISA ESIG Award in the Single Process Systems category.

In late 2016 our GIS staff began development of a GIS map for the live tracking of road temperatures, to be utilized during winter events. During a winter event that began January 6, 2017 and went thru January 8, 2017, we began utilizing the GIS map for recording our road temperatures. During the event we also started utilizing the map for tracking all the incidents which ranged from road temperatures, localized icy conditions, trees down, to traffic accidents all totaling 130 temperature readings collected and 76 incidents reported and mapped to name just a few. This map was utilized by all Public Works staff members both in the field and all departments in the incident command center, enabling us to better manage each incident and keep all departments updated. The map also provided real time information to everyone that had access to it, to include the general public that accessed the map through the City of Sandy Springs web site.

After the weather event ended and City staff returned to normal operations, the map provided valuable information to the Public Works staff to assist in the cleanup efforts.

Thank you for considering the City of Sandy Springs for this award.

Sincerely,

Donald Kahn
Field Services Unit Manager | Public Works
City of Sandy Springs
7840 Roswell Road, Building 500
Sandy Springs, GA 30350
May 25, 2017

To Whom it May Concern:

As a Field Services Coordinator in the Public Works department for the City of Sandy Springs, one of my responsibilities is to work in the Emergency Operations Center (EOC), alongside members of our Fire, Police, 911 Services, Communications, IT and Public Works staff, as well as our city contractors. My primary role during storm/emergency events is to record and track incidents, dispatch our crews and contractors, provide status updates, and follow up with storm recovery and clean up. All of this, in an effort to provide Public Safety and manage costs. Having worked numerous storm/emergency events without having access to GIS in the EOC, I can attest to its many benefits after working a January 2017 winter storm event with GIS and GIS staff.

Our Field Staff were equipped with iPads allowing them to access the GIS on-line map of the snow routes, and allowing management to track the staff’s location. As each of our sand/salt trucks were accompanied by Field Staff, managers were also able to track the sand/salt crews and to monitor their progress. In addition, Field Staff were able to upload road and bridge temperatures, giving management the ability to monitor the temperatures real time.

From my perspective, one of the most valuable benefits was the real time tracking of road closures and incidents, including fallen trees, down power lines and water leaks/ice patches. Having dedicated GIS staff on site, entering the real time events and updating the status of the events, allowed us to track and respond to the incidents and to accurately report on them after the event was over. For this particular storm we had over 30 incidents of fallen trees, limbs and utility lines. Being able to generate a report, which identified the locations of the incidents, was invaluable for following up with utility repairs, cleanup of tree debris, retrieval of staff equipment such as barricades and cones, and ultimately reconciling invoices from our contractors. Should this have been an event which qualified for FEMA funding, this data and reporting would be an excellent source of documentation for reimbursement.

As we improve/expand our use of GIS during future storm/emergency events, I see it becoming an even more effective tool in managing, documenting and following up on such events.

Cheryl R. Oslund
Administrative Coordinator, Field Services

7640 Roswell Road, Building 500, Sandy Springs, Georgia 30350 • 770-730-5600 • SandySpringsGA.gov
Date: May 22, 2017

To whom it may concern,

Sandy Springs ArcGIS is an excellent tool for collecting data in the field for Field Services in the City of Sandy Springs. I am able to arrive on any field incident and easily add photos and real event data, for example icy bridges temperatures, stormy weather and flooding in roads, trees down, power wires down, etc. All this data is added to the map collector on any new request. This shows my work progress, emergency cleared and issue closed. In summary this is a perfect tool for real event recording.

Sincerely,

David Johnson
Field Services Superintendent
City of Sandy Springs Public Works
7840 Roswell Road, Building 500
Sandy Springs, GA 30350
Office: (770)206-4390
Mobile: (404)216-8087
5/24/2017

To Whom It May Concern:

Our City GIS team has been valuable to the fire department. We have collaborated with the City GIS department for the purposes of plotting fire and EMS incident data on maps. These maps have been used to show call volume concentration for planning future station locations and identifying high fire risk areas to use for fire safety programs. GIS has also been used to organize our fire hydrant repair program.

The City GIS department has also been present in some Emergency Operations Center (EOC) activations for the purpose of visually showing pertinent data to various emergency support functions. Our City GIS works well to supplement information in the County’s WebEOC program and is currently working with the County to tie in City GIS data into the County’s system for information sharing. Our City GIS department is helping our City increase efficiency and taking us into the future with superior data gathering, analysis, and visual mapping.

Sincerely,

Craig P. Miceli
Administrative Affairs Officer
Sandy Springs Fire Rescue
7840 Roswell Rd., Bld. 500
Sandy Springs, GA 30350
(770) 206-2076
City of Sandy Springs Facebook page highlighting the GIS EOC map.

“We love technology and the winter weather has provided an exciting challenge for our GIS team. To help us track our bridges and roadways, along with temperatures and road conditions, they’ve created this mapping system. It also includes an overlay showing wind and temperature and tracks our personnel as they check hotspots around the city.” - City of Sandy Springs Jan 6, 2017
B. Jurisdiction: The City of Sandy Springs, Georgia

B1. Name of Jurisdiction

City of Sandy Springs, Georgia

B2. Population served

Sandy Springs is home to 105,703 residents (US Census Bureau 2016).

B3. Annual Total Budget of the Jurisdiction

“The proposed budgets for all operating, capital and special revenue funds total $401,735,771. The City’s General Fund provides for general government operations of the City and maintains adequate working capital necessary for the City’s financial health and stability. This fund accounts for most of Sandy Springs’ operations and has a budget of $103,562,695.”

John McDonough, City Manager. 2017 Approved Budget.

http://www.sandyspringsga.gov/home/showdocument?id=11305

B4. Chief Elected Official

The Honorable Rusty Paul
Mayor of the City of Sandy Springs
7840 Roswell Road, Bldg. 500
Sandy Springs, GA 30350
Phone: 770.730.5600
Email: r paul@sandyspringsga.gov
B5. System Contact

Primary

Langdon Sanders
GIS Analyst II, Information Technology
Public Works, City of Sandy Springs
7840 Roswell Road, Bldg 500
Sandy Springs, GA 30350
Phone: 770-206-2084
Fax: 770-206-1480
Email: LSanders@sandyspringsga.gov

Secondary

Phone: 770-730-5600
Email: GIS@sandyspringsga.gov

C. System Design

C1. What motivated the system development?

In the fall of 2016, the City of Sandy Springs reviewed emergency operation plans for winter weather events. With the chance of ice forming on roadways, Public Works and Public Safety personnel planned to closely monitor road and bridge surface temperatures to quickly deploy targeted de-icing operations. Communication during the event was identified as a clear opportunity for improvement. In past years, radio exchange, email chains, and telephone calls were the primary means of exchanging pertinent information between field staff and the Emergency Operations Center (EOC). During these discussions, the GIS team proposed using mobile GIS data collection and the Esri ArcGIS Online platform for data sharing. Digitally recording data in the field with live results shown on a central map would reduce time and inefficiencies in communicating these important environmental factors.
C2. What specific service or services was the system intended to improve?

The initial scope was intentionally narrow. The first task was to facilitate the collection and reporting of road temperatures and display readings on a centralized map. After its initial success, functionality was broadened to show additional layers such as weather conditions, road closures, real-time incidents (such as fallen trees, major accidents, and icy conditions), and GPS tracking. This visual display improved resource management during the event.

C3. What, if any, unexpected benefits did you achieve?

This project introduced departments to practical applications of GIS beyond traditional cartography. The system was a highly effective educational device. Fire, Police, Field Services, and Communications personnel monitored the event with real-time and reference information in one place. Additional projects were requested using the same GIS platform, demonstrating the new knowledge of GIS applications.

The system also proved a valuable pilot exercise for other projects and acted as a training exercise. Documentation for this system was the foundation for non-emergency related field activities, serving as a model for future projects. Staff were trained on how to use ArcGIS Collector, ArcGIS Online, and engage in the Enterprise GIS services at Sandy Springs. Starting with only limited participation by GIS and Planners, the ArcGIS Online user group has grown to 109 users from all City departments.

C4. What system design problems were encountered?

The project team experienced technical limitations and matters of human resource management. Technical difficulties were relatively minimal and less than expected upon the launch of the system. Instead, training and user tracking required more time than setting up the initial map and deploying the software.

Technical Limitations:

The system uses enterprise logins of the City’s Windows Active Directory Federated Services (ADFS) accounts integrated with ArcGIS Online.¹ This feature is available through ArcGIS Online organizational settings but requires specific setup and coordination with the IT department. While there is an initial layer of complexity on setup, this allowed users to manage their own passwords, not have to create new passwords or logins for the system, and reduced the user management role of the GIS team. This required the use of a Virtual Private Network (VPN) software on each mobile device and additional training on logging in. This was the only source of dependency on Sandy Springs hardware resources. If a connection through VPN to the Sandy Springs

network failed, users were unable to login. Back-up accounts managed entirely by ArcGIS Online were generated as a fallback plan to mitigate this risk.

**Human Capital:**

Design problems for human capital did not take into account the large user base and need for ongoing reminders and training. Some users did not bring their mobile devices to the event so they were not able to participate in the field collection services. Battery life of mobile devices is a potential limitation but was alleviated by in-vehicle chargers. Additionally, the current collection process requires manual data entry on tablets which is not safely possible for one-person driving crews. Only two-person crews were able to participate in active field collection. Creation of custom documentation with screen captures of each step was somewhat time intensive; however, this resource proved invaluable during the event as it could be quickly printed and distributed to new users and was also used in other projects.

Although the current map provides a common view of operational data, it is still maintained by a largely manual process. Field collected events are manually inputted with mobile devices and touch pad entry of data. Active incidents from E911, the citizen Call Center, and other reports are manually drawn on the map using ArcGIS Online edits. Only the reference REST web services such as weather conditions are automatically updated. Future integrations with other emergency management software, dedicated GPS devices, and temperature hardware would strengthen the system.

As calls and incident update requests were reported in quick succession, they were recoded briefly as notes, then demarcated when they had been entered in the mapping system.

Handwritten log of incidents and map update requests quickly noted before adding details to the map.
C5. What differentiates this system from other similar systems?

The system is unique at the city because it displays all pertinent field activities for the emergency event regardless of source. Public Works Field Services and Public Safety personnel utilize different systems for their daily operations. The Emergency 911 Computer Aided Dispatch (CAD) currently supports display and dispatch of incoming calls for Police, Fire, and other daily emergencies, but did not have other data from Field Services such as downed trees, snow routes, or clean-up tasks. While 911 calls were available to Public Safety departments, this data was not readily available for Field Services workers. Field Services use a different system for asset management and work order tracking which is not utilized by Public Safety personnel. The GIS map allowed for easy input of basic information without being bogged down in software dependencies or complicated integrations.

Additionally, all data and maps were hosted using Esri ArcGIS Online with no hard dependencies on servers at the city. This guaranteed access to the maps with only an internet connection, safeguarding against any potential disruptions at the City servers. This system was also the first major implementation of a new Enterprise License Agreement purchased in Fall of 2016.

D. Implementation

D1. What phases did you go through in developing the system?

1. Proposal
   a. During review of previous events, inefficiencies of communication were identified.
   b. Knowledge of existing GIS technology was used to propose a map-centric solution for mobile field collection.

2. Design
   a. An ArcGIS Online web map was created as the main viewport for data.
   b. Reference data such as snow and salt routes were organized and hosted on ArcGIS Online.
   c. An editable feature service for road temperatures was designed with limited number of data fields for ease of data entry.
   d. A mock-up of the map was demonstrated to managers for feedback and field collection was tested on mobile devices.
   e. Review comments were used to improve field collection and map design.
   f. ArcGIS Online content was organized and shared to departmental groups such as Fire, Public Works, and Communications.
   g. Enterprise logins using Windows Active Directory Federated Services was integrated with ArcGIS Online.
3. **Training**
   a. Detailed documentation was created with screen captures and step-by-step instructions. These "how-to" guides were written for the end user who does not have any GIS knowledge and has never used Collector for ArcGIS previously.
   b. A spreadsheet was used to track each user and their setup process such as access to their account, VPN software, and ability to collect data.
   c. Two mandatory training sessions were scheduled with Public Works field staff as an overview of the system and live demo with required steps for follow-up with GIS Staff. Each user also received at least 15 minutes of individual training and walk-through to make sure they completed the enrollment and setup process.

4. **Deployment**
   a. A winter weather event in January 2017 was the first live deployment. The GIS team staffed two 12-hour shifts in the EOC, provided copies of user documentation, and oversaw the use of the EOC web map.
   b. **During the event, a new editable layer was created on-the-fly to store incident locations.** This layer then became the key focal point of the project and later deployments.

5. **Refinement**
   a. The GIS team conducted a written review of the event and identified successes and areas of improvement. Additional review and refinement was completed with Field Services and Fire staff to improve the system for other events.
   b. A new dedicated map for Field Services Incidents during non EOC activation events was created using the same platform.

D2. Were there any modifications to the original system design?

The original system design was focused on one area of the EOC operations, road temperature collections, and did not include additional layers in the initial scope. During the deployment of the system, it became clear the GIS web map could display a great deal more useful information.

A GPS live tracking layer was added that displays the current location of field users with the application running. This was requested by the Field Services manager and was implemented without the purchase of additional hardware (though dedicated GPS units would offer enhanced tracking capabilities in the future).

The GPS tracking layer shows a "bread-crumbs" trail of user locations every 30 seconds. This can be filtered to show only the current most recent points or viewed for historic reporting purposes.
At the start of the winter event, only road temperatures were collected digitally. Incidents such as icy conditions, fallen trees, and power line issues were reported by radio, phone call, and emails. These were initially managed by EOC staff with paper processes. GIS staff saw this opportunity and quickly created a new data layer to track incidents during the event. GIS analysts then entered incidents on the map in real-time as they were notified by Public Works and Public Safety personnel by radio, calls, or email.

During later storm events, the active incident layer became the central focus of the map. New fields for comments and descriptions such as whether a road closure was needed or if utility lines were involved were added. The ability to upload attachments was enabled allowing users to share photos from the field of the event. Photos could be accessed by simply clicking a point on the map or viewing the data table and greatly improved the understanding of each incident and record keeping.

E. Organizational Impact

E1. What user community does the system serve and how?

The GIS system primarily serves staff responding to an emergency event from multiple departments including Public Works Field Services, Fire, Police, and Communications. It provides a centralized map of information for all users to view the same data. Additionally, the map allows user input of data such as road temperatures and active incidents including uploading of photos, updating statuses, and adding notes. After the event, data can be exported for reporting to other agencies and clean-up efforts. The current user community consists of city staff and contractors and other agencies for reporting, but could be expanded to the public and media outlets with a simplified non-editable release.

A public image of the map published to the City’s social media. https://twitter.com/SandySpringsGA/status/817683701781958656
E2. What are the ultimate decisions/operations/services being affected?

Emergency management involves a wide range of decisions and operations both before, during, and after an event. In pre-incident planning, the GIS map allows for easily distributable maps and sharing of information for training and orientation. Reference layers show snow and salt routes, vehicle and salt depot locations, bridges, as well as historically dangerous intersections. This lowers the cost and need for large format paper maps which are also cumbersome to use in the field.

During the event, the map served as a live briefing of the current conditions. Temperature readings allowed managers to understand when bridges would begin freezing and to manage salt dispensing activities. Managers could reroute nearby trucks to specific incidents based on proximity shown in the GPS tracking layer.

During a severe thunderstorm event, the fire department used the map to determine areas of potential flooding with FEMA flood plain reference layers and bridge locations. Crews were dispatched to preemptively inspect these flood sites. Issues identified were added to the map. Photos from specific incidents like roadway flooding were shared on social media to inform citizens and motorists of the hazards.

Social media report showing a field collected image of flooding.

There is often just as much if not more operations after the emergency event has passed. Clean-up and reporting efforts were supported by the digital database of incidents. The entire database is exportable to standard spreadsheet formats which are easily shareable or used to input into the regular contractor tracking and billing software. Should an event require Federal or outside assistance, this data would help document the needs for reimbursement.
E3. What were the quantitative and qualitative impacts of the system?

Using a centrally managed GIS map increased efficiencies, reduced redundancy, and helped provide a clear picture of current conditions. Using a Common Operating Picture, managers, field and administrative staff were all able to quickly understand the same statuses of operations. Whether there were two incidents or twenty, briefings and shift changes were easily facilitated by walking through the various incident locations placed on the map. The EOC was responsible for reporting hourly situational summaries to elected officials and senior administration. Temperature data as viewed on the map, number and type of incidents, were readily available for these reports without requiring additional staff time.

Hundreds of temperature readings were reported during the event through the mobile app which reduced email and radio chatter significantly. Instead of hourly phone calls and emails, data entry was provided in real-time from users directly freeing up this recording process of staff in the EOC. Managers were able to see pictures of incidents without having to dig through email chains, simply by clicking a point on the map.

<table>
<thead>
<tr>
<th>Location</th>
<th>Temperature</th>
<th>CollectionDate</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeKalb Rd @ Roswell Rd</td>
<td>21.00</td>
<td>1/7/2017, 7:29</td>
</tr>
<tr>
<td>DeKalb Rd &amp; Old Indian Trce Way</td>
<td>32.00</td>
<td>1/7/2017, 7:54</td>
</tr>
<tr>
<td>JRF &amp; Riverside</td>
<td>26.00</td>
<td>1/7/2017, 7:49</td>
</tr>
</tbody>
</table>

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*Temperature readings, Temperatures below freezing, Incident reports*
View of the map showing temperatures and pop-up window when a feature is clicked. Access to photos is provided with a link (example below).

Photo taken from field worker, attached to the temperature reading point. The temperature gauge is visible on the bottom left and icy conditions on the roadway.

In the field, large format paper maps are cumbersome and difficult to read in low-light settings. The digital map viewed on mobile devices provided a compact and zoomable experience of the same data in addition to automatic geolocation. This reduced cabin clutter and provided more efficient readings of the snow/salt routes.

Over 76 incident points were recorded for the first winter event. These were exported in an easy to use spreadsheet for remedial or clean-up actions. In disaster events, this reporting can be used for reimbursement through the Federal Emergency Management Agency (FEMA).

E4. What effect has the system had on productivity?

The current system is only activated during an emergency event. During the event the GIS map reduces redundancy of reporting and reduces the time needed to brief workers and managers on the current situation. Event managers can quickly identify active incident such as areas for potential icing or fallen trees and direct crews based on their current location. While users can still email photos and text descriptions, this information is inputted on the map allowing for tracking and consolidation of information. Photos and descriptions are easy to share and view rather than forwarding of lengthy email chains.

Productivity during and after an event increased as time was saved on communication tasks. Additionally, the automatic storage of data in a database allows for historic archiving, walk-throughs of the event, and reports and exporting of data for follow-up or sharing with other agencies.
Administrative staff requesting data for follow-up.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Time Reported</th>
<th>Tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ACCIDENT</td>
<td>GLENWIDGE DR AND ROSWELL RD</td>
<td>Vehicle crash</td>
<td>1/7/2017 11:45</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>ACCIDENT</td>
<td>GA-400 NB AT ABERNATHY</td>
<td></td>
<td>1/7/2017 12:15</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>ACCIDENT</td>
<td>GA-400 NB AT NORTHSPACE RD</td>
<td></td>
<td>1/7/2017 13:23</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>ACCIDENT</td>
<td>1-285 WB AT GA-400</td>
<td></td>
<td>1/7/2017 12:30</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ACCIDENT</td>
<td>1-285 WB AT GA-400</td>
<td></td>
<td>1/7/2017 12:30</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>TRAFFIC SIGNAL ISSUE</td>
<td>JOHNSON FERRY RD AND MT VERNON HWY</td>
<td>Signal on flash</td>
<td>1/7/2017 2:45</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>ICY CONDITIONS</td>
<td>NORTHSPACE DR AT 1-285</td>
<td>Icy Conditions</td>
<td>1/7/2017 3:00</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>ICY CONDITIONS</td>
<td>NEW NORTHSPACE DR AT 1-285</td>
<td></td>
<td>1/7/2017 3:00</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>ICY CONDITIONS</td>
<td>RADER DR AT 1-285</td>
<td></td>
<td>1/7/2017 3:00</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>ICY CONDITIONS</td>
<td>ROSWELL RD AT CHATTAHOOCHEE RIVER</td>
<td></td>
<td>1/7/2017 4:00</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>ICY CONDITIONS</td>
<td>NORTHSPACE RD AT GA-400</td>
<td></td>
<td>1/7/2017 4:00</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>ICY CONDITIONS</td>
<td>ROTS RD AT GA-400</td>
<td></td>
<td>1/7/2017 4:00</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>ICY CONDITIONS</td>
<td>HAMMOND DR AT GA-400</td>
<td></td>
<td>1/7/2017 4:00</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>TREE DOWNS</td>
<td>NORTHSPACE DR AND HARRIS TR</td>
<td>TREE DOWN BLOCKING ROAD</td>
<td>1/7/2017 4:15</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>TREE DOWNS</td>
<td>NORTHSPACE DR AND HARRIS TR</td>
<td>TREE DOWN BLOCKING ROAD</td>
<td>1/7/2017 4:15</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>TREE DOWNS</td>
<td>WINDSOR PKWY WEST OF GA-400</td>
<td>HANGING TREE LIMITS ON WINDSOR</td>
<td>1/7/2017 4:30</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>TREE DOWNS</td>
<td>WINDSOR PKWY EAST OF GA-400</td>
<td>HANGING TREE LIMITS ON WINDSOR</td>
<td>1/7/2017 4:30</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>TREE DOWNS</td>
<td>RIVERSIDE DR AT RIVERDIX WAY</td>
<td>TREE DOWN BLOCKING WEST/SOUT</td>
<td>1/7/2017 4:45</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>TREE DOWNS</td>
<td>RIVERSIDE DR AT RIVERDIX WAY</td>
<td>TREE DOWN BLOCKING WEST/SOUT</td>
<td>1/7/2017 4:45</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>TREE DOWNS</td>
<td>ROBERTS DR AND PROPE PL</td>
<td>TREE DEBRIS HANGING</td>
<td>1/7/2017 4:45</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>TREE DOWNS</td>
<td>MT VERNON WAY EAST OF SANDY SPRINGS CR</td>
<td>TREE DEBRIS BRANCH OR SMALL TRI</td>
<td>1/7/2017 4:45</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>TREE DOWNS</td>
<td>NORTHSPACE DR NEAR RIVEREDGE PKWY</td>
<td>TREE DOWN</td>
<td>1/7/2017 5:00</td>
<td>1</td>
</tr>
</tbody>
</table>

Exported table of incidents provided.

E5. What, if any, other impacts has the system had?

As a pilot system, the use of GIS in the EOC prompted further interest and utilization of the GIS department at the city as a whole. The Fire Department requested additional GIS services for other projects which used the same technology. Specifically, field data collection was used for Fire hydrant inspection rather than previous paper based methods. The map was so successful in the winter event deployment, it has been expanded to become a necessary tool whenever three or more trees have fallen during other storms even when the EOC is not officially activated.
E6. How did the system change the way business is conducted with and/or service delivered to clients?

The current system is an internally focused productivity tool; however, its derivative products have allowed for improved interaction with other agencies and citizens. Each data point collected on the map is stored in a relational database. These records can be exported to tables useable in any spreadsheet software. During an event only the immediate travel surface of the right-of-way is cleared of debris. Administrative staff used these records to ensure each incident is appropriately cleaned and closed out during regular business hours after the event, improving customer service to citizens.

During a shift change, the briefing of events was facilitated by viewing the incident map conversationally with the ability to zoom in on geographic areas of interest rather than having to sift through tabular lists of information. Future iterations of the map could be published for the public and media agencies to view similar information.

F. System Resources

F1. What are the system’s primary hardware components?

- ArcGIS Online hosting services
- Desktop GIS for editing and creation of source data
- Public Safety Radios
- Cell phones
- Apple iPads with cellular data plans
- Temperature monitors (built-in vehicle sensors and handheld infrared guns)
- Emergency Operation Center
  - multiple large screens
  - planning and training room
  - computer work stations for each functional group (Communications, Field Services, Police, Fire, etc.)

F2. What are the system’s primary software components?

- Esri ArcGIS Enterprise License Agreement (ELA)
  - Facilitated the use of 250 ArcGIS Online user accounts.
- Esri ArcGIS Desktop
  - Database design and initial data editing.
- ArcGIS Online
  - Specialized groups configured for departments (Field Services Operations / Management, Fire Ops / Management, Emergency Operations)
  - Users provided access to these groups
• Web maps created with a standard basemap and reference layers
• Collector for ArcGIS mobile application configured for data entry and photo attachments.
  o Field entry configured for dates and numbers to improve accuracy
  o A GPS tracking layer was enabled that functioned whenever Collector was in use.
• Cisco AnyConnect Secure Mobility Client
  o Provided VPN access to the City network allowing for the use of enterprise logins with the ArcGIS Online integration. Users could use the same name/password as their regular Windows accounts.
• Waze – Connected Citizens Program
  o Real-time traffic events and road closures were reported to the Waze application through a data sharing agreement the “Connected Citizens Program.” The City provides authoritative information to Waze which is then displayed to thousands of drivers in the area using the Waze app.

F3. What data does the system work with?

The system displays many GIS data sources including live real-time editing layers, real-time reference layers, and static reference layers.

Live real-time editing datasets consisted of road temperature (points), active incidents (points), active road and lane closures (lines), and GPS tracking of vehicles (points). The road temperatures were entered using Collector for ArcGIS with fields for temperature reading, text location description, timestamp, and the ability to attach photos.

Live Real-time Editing Datasets

• Road temperatures (points)
  o Reported by field workers using Collector for ArcGIS with timestamps.
• Active Incidents (points)
  o Calls for services through 911, field reports from workers, social media, or any other service were added to the map as point events. Events were classified by type, time reported, location, and current status. Pictures were attached when available to incidents.
• Active Road / Lane Closures (lines)
  o Maintained by City of Sandy Springs including planned construction closures and incident closures during the event (such as for downed trees).
• GPS tracking of vehicle locations
  o Template feature service on ArcGIS Online

Static Reference layers:

• Pre-planned salt/plow routes (lines)
• City streets from ArcGIS Online basemap
• Bridges (points)
• Vehicle and operation depots (points)
Historically dangerous intersections (points)

Live Reference Layers:

- Sandy Springs Traffic Cameras
  - Location (points) and latest live pictures available
- Current Wind and Weather Conditions
  - Esri Subscriber Content – ArcGIS Online
  - “The Current Wind Conditions layer is created from hourly METAR/TAF and BUOY data provided from NOAA.”
  - [https://www.arcgis.com/home/item.html?id=29d3ea0ef52a43abab68be309479f2ac](https://www.arcgis.com/home/item.html?id=29d3ea0ef52a43abab68be309479f2ac)
- Recent Weather Radar Imagery
  - “Weather Radar (NEXRAD) Reflectivity Mosaics from NOAA/NWS RIDGE2 for Alaska, CONUS, Puerto Rico, and Hawaii for last 3 hours.”
  - [http://www.arcgis.com/home/item.html?id=da53700b1f324cc685c4d3bcc00c12fc](http://www.arcgis.com/home/item.html?id=da53700b1f324cc685c4d3bcc00c12fc)

F4. What staff resources were required to implement the system?

Two Full Time Equivalent GIS Analyst staff developed, maintained, and trained users on the system over the course of two months while managing other daily activities. During the event, analysts rotated 12-hour shifts. Additional ad-hoc support from IT staff was provided for network troubleshooting, user permissions, hardware support and software installation.

Field workers were required to collect data in trucks during the storm. This was accomplished with two-person teams with one person operating the vehicle and one person using the application and communicating with the command center. The solution is scalable with the number of field staff available for data collection, currently limited to 250 users with the city’s license agreement.

F5. Comment on anything unusual about the resources used to develop your system, such as data, software, personnel and financing

GIS personnel became operational staff in the Emergency Operations Center which, though included in the National Incident Management System framework, is not necessarily a common practice, especially at the municipality level.

The system is unusual in that it is an entirely digital except for hardcopy user documentation. Esri ArcGIS suite of products is used, however, the basic concepts are transferrable to other software platforms. The basic components are a web map, ability to collect GIS data on a mobile device, and the mobile data represented as layer on the web map. The solution is almost an entirely cloud based platform. ArcGIS Online
was the host for all data layers and local servers were only used for user management through Windows Active Directory. This relieves dependency on local conditions, servers, and downtime during maintenance.

An Enterprise License Agreement affords the city plenty of named user accounts for all field workers to have access to ArcGIS Collector. This might be a limiting factor for other organizations and may need to be purchased separately.